# Response of "Grandnain"Banana to Humic Acid, Potassium and Magnesium Fertilization

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## ABSTRACT

**This study was carried out in a private orchard, at Kafr El-Dwar, El-Behera Governorate, on "GrandNain" banana plants (*Musa cavendishii* Lamb.) during the 2006/2007 and 2007/2008 growing seasons. Twelve treatments of different Humic acid (HA), potassium (K) and Magneisum (Mg) HA:K:Mg ratios were applied. The results indicated that there were great effects on growth aspects, yield, physical and chemical properties and leaf mineral content with varying HA:K:Mg ratios. Since increasing HA:K:Mg rates from 0 to 10 gm/plant, K from 0 to 300 gm/plant and Mg from 0 to 150 gm/plant/year caused a remarkable promotion on all studied parameters. Leaf potassium and magnesium contents were increased with increasing the applied potassium and magnesium fertilizer rates. On the other hand, results did not show a constant trend due to different treatments in respect with phosphorus, but did not affect nitrogen content. The best treatment was obtained with using (HA:K:Mg) at rate of 10 gm/plant Humic acid, 300 gm potassium sulfate and 150 gm magnesium sulfate for all studied parameters.**

## INTRODUCTION

Banana (*Musa cavendishi* Lamb.) is considered as one of the most important fruit in tropical zones of the world. Banana fruits are highly appreciated by Egyptian consumers and are considered good source of energy and vitamins A, B6 and C. Gross return of banana is very high and environmental conditions in Egypt are suitable for growing and production (El-Shenawi, 2000).

It is well known that banana needs large amounts of fertilizers especially nitrogen and potassium. Moreover, it draws nutrients from a very limited soil depth because of its shallow root system (Saleh, 1996). On the other hand, the major problem facing banana growers is the high costs of excessive manufactured fertilizers needed for banana plants. Besides, these chemical fertilizers cause air, soil and water pollution during their production and utilization. The pollution of the soil and water resulted from leached chemical fertilizers into the soil, which transfer through the plants to the human and causes serious diseases (El-Shenawi and El-Sayed, 2005). For banana plants, using banana compost and chicken manure induced similar results with the recommended dose of mineral nitrogen fertilizer and gave the best fruit characteristics, (Abd El-Naby and Gomaa, 2000 and Gomaa and Abd El-Naby, 2000). On the other hand, many commercial products containing humic acid (HA) have been promoted for use on various crops, Liu *et al.* (1998). Benefits ascribed to the use of humic acid, particularly in low organic matter, alkaline soil, include increasing nutrient uptake, tolerance to drought and temperature extremes, stimulating activity of beneficial soil micro organisms and availability of soil nutrients (Seen and Kingman, 1973; and Russo and Berlyn, 1990). Humic materials may also increase root growth in a manner similar to auxins, (Donnell, 1973 and Tatini *et al.*, 1991). Liquid fertilizer containing humic acid increased apple fruit weight, yield and soluble solids content (Li *et al.*, 1999). Saad and Atawia (1999) studied the effect of potassium fertilizers treatments on the growth, yield and fruit quality of GrandNain banana, they found that the treatment of 800 gm $K_2O$/plant/year seems not only to be the promising treatment to produce the highest vegetative growth and yield but also to improve the fruit quality. Moreover, potassium in required in great amounts as reported by different researchers. Lahave (1976) found that increasing the amount of manure caused early flowering and reduced maturation period. Application of both $KNO_3$ and organic manure were necessary to obtain optimal yield and early flowering of Williams banana grown from suckers (Lahave *et al.*, 1981). All plantations given potassium produced better yields than the control.

Humic substances are ubiquitous in the environment. Their importance in agriculture and soil sciences has been acknowledged for over 150 years. Purchase 1997, Humic acid contains Sulfur, Nitrogen and Phosphorus in varying amounts. It also contains metals such as Ca, Mg, Cu, Zn etc. A substantial fraction of the mass of the humic acids is in carboxylic acid functional groups, which endow these molecules with the ability to chelate positively charged multivalent ions (Mg++, Ca++, Fe++ and most other "trace elements" of value to plants, as well as other ions that have no positive biological role, such as Cd++ and Pb++.) This chelation of ions is probably the most important role of humic acids with respect to living systems.

The aim of this study is to study the effect of humic acid, potassium and magnesium fertilization on vegetative growth, yield, fruit quality and some leaf mineral contents of GrandNain banana in order to reduce

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Received December21, 2008, Accepted December 28, 2008

the costs of fertilizers increase the yield and improve the fruit quality.

## MATERIALS AND METHODS

The present study was carried out during two successive seasons of 2006/2007 and 2007/2008 in a private orchard at Kafr El-Dwar, El-Behera Governorate on GrandNain banana plants (*Musa Cavendishii* Lamb.). Plants were grown at 3 x 3 m., apart in clay soil. The suckers were planted in March 2005 (Two offshoots/mother plant) 900 plants/fed. The experiment started on the first ratoon and its suckers were chosen on the 1st week of July 2005 as well as on the second ratoon and its suckers were chosen at the same time in 2006. The stools were thinned and two suckers were left for fruiting in the following season. In addition, two plants were left to give the crop in the current season. In both seasons, organic manure was added in December at the form of chicken manure with rate of 15 $m^3$/fed. Nitrogen fertilizers was added to the plants on twelve equal split doses every 15 days intervals starting on April 1st until October in form of ammonium sulfate (20.5% N). Calcium super mono phosphate (16% $P_2O_5$) was also added every season per feddan once in December with rate of ton/fed. Banana plants were irrigated by surface irrigation system every 8-10 days through the growing season. Each treatment was represented by 9 holes distributed in Complete Randmized Block Design; three of each block received one of the following treatments:

| Treatment No. | Humic (gm) | Potassium sulfate(gm) | Magnesium sulfate (gm) |
|---|---|---|---|
| 1 (Control) | 0 | 0 | 0 |
| 2 | 0 | 100 | 50 |
| 3 | 0 | 200 | 100 |
| 4 | 0 | 300 | 150 |
| 5 | 5 | 0 | 0 |
| 6 | 5 | 100 | 50 |
| 7 | 5 | 200 | 100 |
| 8 | 5 | 300 | 150 |
| 9 | 10 | 0 | 0 |
| 10 | 10 | 100 | 50 |
| 11 | 10 | 200 | 100 |
| 12 | 10 | 300 | 150 |

Soil fertilizer (humer 86% potassium hummate), the humer was added at one dose at the first week of May. Potassium sulfate (48% $K_2O$) was added at three equal doses (April, June and August). Magnesium sulfate (48% $Mg_2O$) was added in one dose at first week May, in both seasons.

Standard annual measurements carried of banana plants vigor; yield and leaf nutrients contents were made. The following parameters were used to evaluate tested treatments:

**1. Vegetative growth:**

At the bunch shooting stage, pseudostem length cm (PSL), pseudostem girth, cm (PG), number of green leaves (NGL), number of days from shooting to harvest (NDSH) were counted and total leaf area (TLA) was calculated according to Ahmed and Morsy (1999), using the formula

$$TLA = 0.67 (l \times w) + 107.15$$

Where: T = Total L = leaf A = area

l = length w = width

**2. Yield, bunch parameters:**

At harvesting time, bunch weight in Kg (BW) and harvested yield (BHY), tone/fed., were estimated. On the other hand, number of hands per bunch (NHB), number of fingers per bunch (NFB) were computed as bunch characteristics.

**3. Physical and chemical fruit quality:**

Average finger diameter (cm) was measured as physical fruit quality. Total acidity % (expressed % as gm malic acid/100 gm pulp), total soluble solids %, starch % and total sugars % were determined according to A.O.A.C. 1995 as indicators of chemical fruit quality.

**4. Leaves nutrient contents:**

Leaf samples were collected at bunch shooting stage from the third upper leaf in the succession of leaves from the top of the plant as recommended by (Hewit, 1955 and Lahave and Turner, 1989). Macro elements (N, P, K and Mg) were determined in banana leaves. Leaf samples were washed, then dried at 70°C ground and wet digested using $H_2SO_4$ and $H_2O_2$ (FAO, 1980). N, P, K and Mg concentrations were determined using semi-automatic nitrogen distillation unit, spectrophotometer 21D and Jenway flame photometer, respectively, (Westerman, 1990). Magnesium was determined against a standard using Perkin Elmer 305 B Atomic Absorption Spectrophotometer.

Soil samples were taken at 0-30 cm, 30-60 cm and 60-90 cm from soil surface orchard for routine analysis and the data is listed in Table (1).

The obtained data during both studied growing seasons were statistically analyzed according to Sendecor and Cochran (1990) and LSD test at 0.05 levels was used.

## RESULTS AND DISCUSSION

**1. Effect of Humic acid, K and Mg fertilization on growth:**

The data in Table (2) indicated that all treatments markedly increased pseudestem length, pseudestem girth, number of green leaves/plant and leaf area as compared with control. Moreover, treatment HA:K:Mg

**Table 1. Mechanical and chemical soil analysis**

| Characteristics | 0-30 | 30-60 | 60-90 |
|---|---|---|---|
| **Mechanical analysis** | | | |
| Sand % | 20.25 | 16.42 | 21 |
| Silt % | 34.80 | 31.38 | 34 |
| Clay % | 44.95 | 52.20 | 45 |
| Soil texture | Clay | Clay | Clay |
| **Chemical analysis** | | | |
| O.M. % | 2.2 | 2.04 | 1.80 |
| pH | 7.7 | 7.90 | 8.23 |
| E.C. mmhos/cm (1:5) | 0.55 | 0.57 | 0.58 |
| **Cations and anions meq/L** | | | |
| $Ca^{++}$ | 2.60 | 2.80 | 2.70 |
| $Mg^{++}$ | 2.20 | 2.10 | 2.00 |
| $Na^{+}$ | 0.70 | 0.78 | 0.77 |
| $K^{+}$ | 0.05 | 0.04 | 0.03 |
| $HCo^{-}_{3}$ | 5.00 | 5.0 | 4.9 |
| $Cl^{-}$ | 0.35 | 0.54 | 0.53 |
| $So^{--}_{4}$ | 0.22 | 0.18 | 0.17 |

**Table 2. Effect of Humic acid, K and Mg on some growth aspects of GrandNain banana 2006/2007 and 2007/2008 seasons**

| Treatments (HA:K:Mg) gm/plant/year | Pseudstem Length (cm) | Pseudstem girth (cm) | Number of green leaves/plant | Leaf area ($m^2$) | Number of days from shooting to harvest |
|---|---|---|---|---|---|
| **2006/2007** | | | | | |
| 0:0:0 | 243.0g | 65.3f | 10.0f | 22.0g | 195.3a |
| 0:100:50 | 257.0e | 71.0e | 11.7e | 24ef | 181.0cd |
| 0:200:100 | 262.7d | 76.7d | 13.0d | 26.0d | 175.0e |
| 0:300:150 | 268.3c | 80.7c | 13.7cd | 28.0c | 167.3f |
| 5:0:0 | 253.3f | 68.3ef | 10.7ef | 23.0fg | 187.0b |
| 5:100:50 | 262.7d | 74.7d | 13.3cd | 25.3de | 177.3de |
| 5:200:100 | 269.3c | 81.3c | 14.3c | 28.0c | 173.3e |
| 5:300:150 | 281.3b | 86.3b | 16.0b | 30.0b | 162.3g |
| 10:0:0 | 258.0e | 70.3e | 13.7c | 24.0ef | 182.3bc |
| 10:100:50 | 269.7c | 76.3d | 15.7b | 29.0bc | 173.0e |
| 10:200:100 | 283.0b | 88.0b | 17.3a | 33.3a | 163.0fg |
| 10:300:150 | 294.3a | 92.7a | 17.7a | 34.3a | 120.3h |
| **2007/2008** | | | | | |
| 0:0:0 | 244.3h | 66.0i | 10.7g | 22.7f | 187.3a |
| 0:100:50 | 253.0g | 72.3gh | 11.7g | 24.7ef | 173.3c |
| 0:200:100 | 265.0e | 77.7ef | 13.0f | 25.7de | 163.0d |
| 0:300:150 | 269.7d | 81.3cd | 14.3e | 28.3bc | 155.7e |
| 5:0:0 | 253.3fg | 69.0hi | 11.3g | 24.0ef | 182.0b |
| 5:100:50 | 263.7e | 75.0fg | 14.7e | 27.3cd | 167.0d |
| 5:200:100 | 269.7d | 82.7c | 15.3de | 28.7bc | 154.3e |
| 5:300:150 | 280.0c | 87.7b | 16.3cd | 29.7b | 149.3f |
| 10:0:0 | 257.3f | 71.0h | 11.7g | 24.7ef | 171.3c |
| 10:100:50 | 271.0d | 79.0de | 16.7bc | 29.7b | 157.3e |
| 10:200:100 | 284.3b | 87.7b | 17.7ab | 35.0a | 142.0g |
| 10:300:150 | 298.0a | 93.7a | 18.7a | 36.3a | 118.0h |

Values with the same letter(s) in each column are not significantly differed at 0.05 levels.

in 10:300:150 gm/plant, respectively gave the highest values for those parameters. Moreover, all treatments significantly reduces the No. of days from shooting to harvest in comparison with control in both experimental seasons. Humic materials may also increase root growth in a manner similar to auxins. The previous results agreed with those obtained by Abou-Aziz *et al.* (1993), Russo *et al.* (1995), Mayaz (1997), Saad and Attawia (1999), Awaad and El-Shenawi (2005) and Du-Hui Ying *et al.* (2007).

**2. Effect of Humic acid, K and Mg fertilization on physical properties of fingers and yield:**

As for the effect of Humic acid, K and Mg fertilization on yield properties, the data in Table (3) revealed that the rate of 10:300:150 gm/plant for HA:K:Mg treatment significantly increase finger diameter, number of fingers per bunch, number of hands per bunch, bunch weight and yield per feddan when compared with all remaining treatments. The data also, showed tendency to increase these parameters gradually with increasing the levels of Humic acid, K and Mg applied through fertilization. Application of three nutrients at 0 gm/plant (control) produced the minimum values. These results were true in both seasons. The present influence of Humic acid, K and Mg was attributed to their positive action on the biosynthesis of proteins and carbohydrates (Nijjar, 1985). These findings may be also due to the increase of leaf chlorophyll which leads to increase carbohydrates contents vegetative growth and better nutritional balance attained by adding $MgSO_4$ level (Zhang *et al.*, 2001). These finding are in conformity with those of Li *et al.* (1999) and Awad and El-Shenawi (2005). Moreover, El-Shenawi and Fayed (2005) reported that adding humic acid with organic fertilizer significantly increased yield of Crimson seedless grapevine than organic fertilizer alone.

**3. Effect of Humic acid, K and Mg fertilization on finger chemical properties:**

Concerning the effect of different combinations for HA:K:Mg on chemical characteristics the data in Table (4) clearly showed that GrandNain banana fruits

**Table 3. Effect of Humic acid, K and Mg on yield characteristics of GrandNain banana 2006/2007 and 2007/2008 seasons**

| Treatments (HA:K:Mg) gm/plant/year | Avg. finger diameter (cm) | No. of finger/bunch | No. of hands/ bunch | Bunch weight (Kg) | Yield/fed. (900 bunches) (ton) |
|---|---|---|---|---|---|
| | | | 2006/2007 | | |
| 0:0:0 | 2.60i | 194.33i | 9.33g | 19.00i | 17.10i |
| 0:100:50 | 2.80hi | 210.00gh | 10.33ef | 23.00h | 20.70h |
| 0:200:100 | 3.03fg | 216.33fg | 11.33cd | 27.00ef | 24.30ef |
| 0:300:150 | 3.30e | 226.00de | 11.67cd | 30.00cd | 27.00cd |
| 5:0:0 | 2.87gh | 20367h | 10.00fg | 22.67h | 20.40h |
| 5:100:50 | 3.17ef | 222.67ef | 11.33cd | 24.67fgh | 22.20fgh |
| 5:200:100 | 3.67d | 230.00d | 12.00c | 28.00de | 25.20de |
| 5:300:150 | 3.93c | 237.67c | 13.67b | 31.67c | 28.50c |
| 10:0:0 | 3.00fgh | 210.33g | 11.00de | 24.00gh | 21.60gh |
| 10:100:50 | 3.60d | 225.33de | 13.33b | 26.00efg | 23.40e |
| 10:200:100 | 4.20b | 246.00b | 13.67b | 35.00b | 31.50b |
| 10:300:150 | 4.60a | 266.00a | 15.00a | 38.67a | 34.80a |
| | | | 2007/2008 | | |
| 0:0:0 | 2.67f | 196.33g | 8.33ef | 20.33g | 18.30g |
| 0:100:50 | 2.83f | 211.67f | 6.67f | 24.00ef | 21.60ef |
| 0:200:100 | 3.17e | 219.67e | 11.00be | 27.33cd | 24.60cd |
| 0:300:150 | 3.53d | 226.00d | 11.67a-d | 31.33b | 28.2b |
| 5:0:0 | 2.80f | 200.67g | 9.33def | 23.00f | 20.70f |
| 5:100:50 | 3.23e | 220.33e | 11.00be | 25.67de | 23.10de |
| 5:200:100 | 3.63d | 232.33c | 11.67ad | 29.00c | 26.10c |
| 5:300:150 | 3.87c | 240.00b | 13.00abc | 32.33b | 29.10b |
| 10:0:0 | 3.13e | 212.00f | 10.33cde | 24.00ef | 21.60ef |
| 10:100:50 | 3.63d | 228.67cd | 13.33ab | 27.00cd | 24.30cd |
| 10:200:100 | 4.37b | 240.00b | 14.00a | 33.33b | 30.00b |
| 10:300:150 | 4.70a | 268.00a | 14.33a | 38.33a | 34.50a |

Values with the same letter(s) in each column are not significantly differed at 0.05 levels.

**Table 4. Effect of Humic acid, K and Mg on total soluble solids, total acidity, starch and total sugars percentages of GrandNain banana 2006/2007 and 2007/2008 seasons**

| Treatments (HA:K:Mg) gm/plant/year | T.S.S. % | Total acidity % | Starch % | Total sugars % |
|---|---|---|---|---|
| | | 2006/2007 | | |
| 0:0:0 | 14.80g | 0.343a | 1.35f | 14.49i |
| 0:100:50 | 15.23fg | 0.297b | 1.41de | 15.18h |
| 0:200:100 | 16.03e | 0.277d | 1.55c | 16.18ef |
| 0:300:150 | 16.47de | 0.237h | 1.58c | 16.88d |
| 5:0:0 | 15.33f | 0.283c | 1.36ef | 14.98hi |
| 5:100:50 | 16.13e | 0.270e | 1.46d | 15.68fg |
| 5:200:100 | 16.83cd | 0.243g | 1.60c | 16.38de |
| 5:300:150 | 17.73b | 0.223j | 1.68b | 17.54c |
| 10:0:0 | 16.13e | 0.257f | 1.40ef | 16.63de |
| 10:100:50 | 17.20c | 0.230i | 1.56c | 17.54c |
| 10:200:100 | 18.03b | 0.207k | 1.72b | 19.27b |
| 10:300:150 | 20.50a | 0.183l | 1.81a | 21.67a |
| | | 2007/2008 | | |
| 0:0:0 | 15.40h | 0.393a | 1.34h | 15.27h |
| 0:100:50 | 15.67gh | 0.370b | 1.42fg | 15.53gh |
| 0:200:100 | 16.37f | 0.350d | 1.52e | 16.43def |
| 0:300:150 | 16.80e | 0.290g | 1.64cd | 16.87d |
| 5:0:0 | 15.80g | 0.370b | 1.39gh | 15.97fg |
| 5:100:50 | 16.47ef | 0.350c | 1.46f | 16.21ef |
| 5:200:100 | 17.63d | 0.310e | 1.62cd | 16.74de |
| 5:300:150 | 18.70c | 0.260h | 1.67c | 17.87c |
| 10:0:0 | 16.77e | 0.310f | 1.41fg | 16.97d |
| 10:100:50 | 19.70d | 0.240i | 1.62d | 18.33c |
| 10:200:100 | 20.00b | 0.220j | 1.75b | 20.53b |
| 10:300:150 | 22.53a | 0.160k | 1.83a | 22.33a |

Values with the same letter(s) in each column are not significantly differed at 0.05 levels.

were positively affected by the combined application of humic acid, potassium sulphate and magnesium sulphate compared with control treatment. Fruit quality was greatly improved in terms of increasing total soluble solids, starch, as well as total sugars and decreasing acidity due to the application of the three materials. The promotion on fruit quality was associated with the increase in concentrations of each compound. Fruit quality was improved by increasing humic acid, potassium sulphate and magnesium sulphate concentrations, the best treatment was (10, 300 and 150 gm/plant), respectively. Untreated plants (control) showed the lowest fruit quality in both experimental seasons and the differences were statistically significant with this treatment and the other remaining treatments. These results, completely, agreed with those obtained by Li (1999), Saad and Atawia (1999), Itoo and Manivannan (2004) and Abd El-Mawgoud *et al.* (2007).

**4. Effect of Humic acid, K and Mg fertilization on N, P, K and Mg percentage:**

Table (5) showed that increasing HA, K and Mg levels was followed by gradual significant increase in the percentages of K and Mg in the leaves. The highest values were recorded for treatment HA:K:Mg at 10:300:150 gm/plant. The minimum values were detected on the untreated plants. The concentration of nitrogen in banana leaves was not affected by humic acid, potassium sulphate and magnesium sulphate during both experimental seasons. This may be due to better growth and yield attained by Mg rates and number of application. The different fertilization treatments caused significant changes in the leaf phosphorus content and the highest values were found in humic acid 5 gm with potassium sulphate 0, 100 and 200 and magnesium sulphate 0, 50 and 100 gm/plant in the first season, whereas in the second season the highest values were recorded for treatments HA:K:Mg in rates 0:100:50 and 0:200:100 gm/plant. Similar observation was obtained by Abd El-Kader *et al.* (1994), Mayaz (1997), Abd El-Naby (2000), Fallahi *et al.* (2006), Farag (2006) and Du-Hui Ying *et al.* (2007).

**Table 5. Effect of Humic acid, K and Mg on N, P, K and Mg percentages in the leaves of GrandNain banana 2006/2007 and 2007/2008 seasons**

| Treatments(HA:K:Mg) gm/plant/year | N % | P % | K % | Mg % |
|---|---|---|---|---|
| | | 2006/2007 | | |
| 0:0:0 | 3.23a | 0.217d | 3.40g | 0.293l |
| 0:100:50 | 3.20a | 0.217d | 3.80ef | 0.363i |
| 0:200:100 | 3.17a | 0.233b | 4.00de | 0.377g |
| 0:300:150 | 3.17a | 0.220c | 4.37c | 0.397e |
| 5:0:0 | 3.17a | 0.227a | 3.63fg | 0.307k |
| 5:100:50 | 3.20a | 0.227a | 4.13cd | 0.373h |
| 5:200:100 | 3.13a | 0.227a | 4.23cd | 0.393f |
| 5:300:150 | 3.20a | 0.223b | 4.80b | 0.420c |
| 10:0:0 | 3.17a | 0.213e | 3.80ef | 0.337j |
| 10:100:50 | 3.17a | 0.210f | 4.10d | 0.403d |
| 10:200:100 | 3.13a | 0.217d | 4.70b | 0.437b |
| 10:300:150 | 3.17a | 0.220c | 5.10a | 0.460a |
| | | 2007/2008 | | |
| 0:0:0 | 3.40a | 0.220c | 3.30h | 0.317l |
| 0:100:50 | 3.37a | 0.227a | 3.67fg | 0.357j |
| 0:200:100 | 3.37a | 0.227a | 3.90de | 0.390h |
| 0:300:150 | 3.33a | 0.223b | 4.13c | 0.413f |
| 5:0:0 | 3.37a | 0.223b | 3.57g | 0.343k |
| 5:100:50 | 3.33a | 0.223b | 3.83ef | 0.397g |
| 5:200:100 | 3.40a | 0.220c | 4.07cd | 0.440d |
| 5:300:150 | 3.30a | 0.220c | 4.60b | 0.453c |
| 10:0:0 | 3.40a | 0.223b | 4.77ef | 0.370i |
| 10:100:50 | 3.33a | 0.220c | 4.13c | 0.433e |
| 10:200:100 | 3.67a | 0.220c | 4.63b | 0.457b |
| 10:300:150 | 3.67a | 0.220c | 4.83a | 0.500a |

Values with the same letter(s) in each column are not significantly differed at 0.05 levels.

## CONCLUSION

Generally, it could be concluded that the treatment of (10 gm HA:K:Mg at 10:300:150 gm/plant, respectively, seems to be the promising treatment to produce the highest growth, physical properties of fingers and yield, finger chemical properties and leaf mineral content of GrandNain banana under the above experimental conditions. It will keep out environment pollution and fertilizers lost from applying high fertilizer rates.

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## الملخص العربي

# أستجابة نباتات الموز صنف "جراندنان" بالتسميد بحمض الهيوميك والبوتاسيوم والمغنسيوم

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أجريت هذه الدراسه فى مزرعه خاصه بمنطقة كفرالـدوار- محافظة البحيره على نباتات الموز صنف جراندنان خـلال مـوسمى النمو ٢٠٠٦/٢٠٠٧ و٢٠٠٧/٢٠٠٨ وقد تم أستخدام أثنى عشر معامله من حمض الهيوميك البوتاسيوم:المغنسيوم.

أوضحت نتائج الدراسه أن هناك أختلافات كبيره فى صفات النمووالمحصول والخصائص الطبيعيه والكيماويه للثمـار والمحتـوى المعدنى للأوراق بإختلاف نسبة الهيوميك والبوتاسيوم والمغنسـيوم وكانت هناك زيادة تدريجيه واضحه فى كل الصفات تحت الدراسة عند زيادة المعدلات المضافه من حمض الهيوميك من صفر إلى عشرة جرام والبوتاسيوم من صفر إلى ٣٠٠ جرام والمغنسيوم من صفر إلى ١٥٠ جرام لكل نبات. ومع زيادة معدل التسـميد البوتاسـى زاد محتوى الأوراق من البوتاسيوم. ومن ناحيه أخرى لم توضح النتائج أتجاه ثابت للمعاملات المختلفه فى محتوى الأوراق مـن الفسـفور ولكن لايوجد تأثير على محتوى الأوراق من النيتروجين. كـذلك أوضحت النتائج أن أفضل معامله كانت عند معدل١٠جرام/نبـات من حمض الهيوميك، ٣٠٠جرام من كبريتـات البوتاسـيوم، ١٥٠ جرام من كبريتات المغنسيوم على التوالى فى جميع الصفات الـتى تم دراستها.