

Improvement of Yield and Quality of Banana (*Musa* sp) Grand “Nain” cv. Through Bunch Coverage Color and Trimming

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ABSTRACT: This investigation was conducted during two successive seasons 2015 and 2016 on (*Musa* sp.) cv. Grand Nain plants grown in in private orchard in Badr center, Behira governorate, Egypt, to study the effect of bunch covers and bunch trimming on growth, yield and fruit quality of banana. A split plot designed experiment was carried out where the four bunch covers (untreated, white, blue and double bags) were arranged in main plots, four bunch trimming (untreated, removing one, two and three hands) were arranged in sub plots. Results revealed that the treatment of double bags and removing three hands gave the highest mean values of yield and fruit quality as (finger length, diameter and weight, earliness of harvesting time (days), yield, pulp weight, pulp (%), number of finger/ hand, bunch and hand weights compared with control and other treatments during both seasons. Also, results indicated that, the treatment of bunch trimming (removing three hands) gave the maximum mean values of (finger length, diameter and weight, earlier time of harvesting (days), yield, pulp weight, pulp (%), number of fingers/ hand, bunch and hand weights) compared with control and other treatments during both seasons.

Keywords: banana, bunch covers, bunch trimming, yield, fruit quality, chemical composition

INTRODUCTION

Banana (*Musa* sp.) is the most consumed fruit in the world. Bananas are also an important part of the smallholder farming communities and families living in rural areas. Edible bananas (*Musa* sp.) are believed to have originated from Asia and were distributed throughout the world during early migration of Polynesians (Lorenzen, 2010). It is grown in gardens and smallholdings in some 120 countries, mainly in the tropics and subtropics (Amani, 2005 & 2007 and Jones, 2000). Major banana growing areas of the world are geographically situated in the tropics between the equator and latitudes 20° North and 20° South (Robinson, 1993).

There are several different species of bananas that are cultivated today, all of which belong to the family Musaceae, and the genus *Musa*. The most commonly cultivated one (the one that is found in grocery stores) is the Cavendish cultivar. This banana (*Musa acuminata*) makes up 95% of all banana sales in North America (Koeppel, 2010). Although none of them are nearly as popular as Cavendish, there are of course many other cultivars produced. The ‘Lady Finger’ and ‘Orito’ varieties are much shorter and stubbier. There are also the ‘Apple’ Bananas, ‘Pisang Raja’, ‘Red’ and ‘Plantains’, the last of which actually belong to the species *M. paradisiaca* and are much starchier and less sweet than the other bananas (Nsabimana, 2014).

The effect of banana bunch covering especially in the tropics has demonstrated inconsistent results on the size of fruit. Double covering increased finger weight of the top six hands by 4% (Johns, 2005). Trimming to

10, 8 and 6 hands increased the yield per bunch of extra grade fruit by 18%, 23% and 39% (Jones, 2005) maturity. Double covering did not affect the yield of extra-large fruit significantly (Jones, 2005).

Bunch covers of various colors and conditions (perforated and non-perforated) have been extensively used in both tropical and subtropical banana growing countries with the aim of improving yield and quality (Robinson, 1996). Improved quality includes appealing skin color, reduced sunburn, and reduced fruit splitting, increased finger length and bunch weight among others (Amarante *et al.*, 2002). Bunch covers have also been used to protect bunches from low temperatures, especially in temperate countries (Gowen, 1995; Robinson, 1996; Harhash and Al-Obeed, 2010). Indeed bagging has been shown to reduce winter stress under supra-optimal condition which resulted in early fruit maturation (Jia *et al.*, 2005).

The removal of the 3 lower hands from the immature racemes significantly reduced bunch mean weight and total yield. However, both removal of lower hands and bunch bagging increased size of individual fruits in the distal hand, thus up-grading fruit quality. In addition, these practices also reduced the number of days required from bunch-shooting to harvest (Irizarry *et al.*, 1992). Accordingly, the aims of this study are as follows:

1. Finding an ideal protocol that determines the color of the appropriate cover and the number of hands required to reduce the impact on the banana crop.
2. Improving productivity and quality recipes of bananas to increase export rates.
3. Protecting banana plants from low temperatures and from bad effects on the bunches by choosing the appropriate cover for the bunch.
4. Increasing the productivity of the banana crop by relaxing the hands and providing food
5. Improving the quality and quantity of bananas grown on sandy soil in the Arab Republic of Egypt.

MATERIALS AND METHODS

This study was carried out during two successive seasons 2015 and 2016 on (*Musa spp.*) cv. Grand Nain cultivar plants grown in private orchard in Badr center, Behira governorate, Egypt. The treatment of covering the bunch with transparent polypropylene skirt bag was compared against the normal farmers' practice without covering the bunch. The bunches under the first treatment were covered at the time of opening of first hand. One ends of the bag was tied with a thread and the lowers end was open. The bunch trimming with removing one, two and three hands of bunches. The experiment followed the spilt plot design. The treatments can be illustrated as follows:

A) Main plots (bunch covers)

- Untreated.
- White bags.
- Blue bags.
- Double bags (white and blue).

B) Sub-plots (bunch trimming)

- Untreated
- Removing one hand.
- Removing two hands.
- Removing three hands.

So, the experiment included four cover and four bunch trimming treatments (4x4= 16) with 4 blocks for each treatment.

Data recorded:

Samples of five plants of each experimental plot were taken to determine growth parameters at the end of the season as follows:

A) Yield and fruit quality

The produced fruit yield on each replicate tree resulting from the applied treatments was expressed as:

- Finger length (cm)

Finger length was measured by using foot scale from the top of a finger to the pedicel; the mean length of finger was recorded and expressed in centimeters.

- Finger diameter (cm)

Finger diameter was measured at the middle of finger by using vernier calipers and mean diameter of finger was recorded and expressed in centimeters.

- Finger weight (g)

Fingers were weighed by using electronic balance and the mean weight of fingers was recorded and expressed in grams.

- Time of harvesting (days)
- Yield (ton/fed.)
- Pulp weight (g)
- Number of fingers/ hands.
- Bunch weight (kg)

Were determined at harvest stage.

B) Chemical fruit characteristics:

Regarding chemical fruit characteristics, samples of 10 fruits from each replicate plant, i.e., fruits for each of the applied treatment were selected randomly at harvest to determine the following parameters:

- **Total soluble solids of fruit juice (TSS %):** The juice extracted by squeezing the homogenized fruit pulp through muslin cloth was used to measure the TSS by hand refractometer according to Chen and Mellenthin (1981).

- **The percentage of total acidity:** was determined in fruit juice according to (Chen and Mellenthin, 1981). A known weight of fruit pulp (5g) was homogenized with distilled water and filtered using muslin cloth followed by Whatman No. 1 filter paper. An aliquot of 10 ml was taken and titrated against standard 0.1N NaOH using phenolphthalein indicator. The appearance of light pink colour was marked as the end point. The value was expressed in terms of malic acid as per cent titratable acidity of juice. Five milliliters from the obtained juice were used to determine the titratable acidity. The titratable acidity was expressed as grams malic acid / 100 milliliters fruit juice.

• **TSS/ acidity ratio:** were calculated for each replicate of the applied treatments.

• **Total sugars:** were determined in fresh fruit samples according to Malik and Singh (1980). Sugars were extracted from 5 g fresh weight and determined by phenol sulfuric and Nelson arsenate –molybdate colorimetric methods for total and reducing sugars, respectively. The non-reducing sugars were calculated by difference between total sugars and reducing sugars.

• **Vitamin C (Ascorbic acid):**

The ascorbic acid content of the juice was determined by titration with 2, 6 dichloro phenol-indo-phenol (AOAC,1985) and calculated as milli-grams per 100 ml of juice.

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using MSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 probability level according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

A) Yield and fruit quality

Results recorded in Tables (1, 2 and 3) revealed that double covering bunches significantly increased fruit quality characters such as finger length (21.55 and 23.75 cm), finger diameter (3.23 and 3.55 cm), finger weight (168.30 and 185.15 g), earliness of harvesting (114.50 and 109.33 days), yield (34.87 and 38.36 t/fed), pulp weight (124.63 and 136.81 g), number of finger/ hand (20.44 and 22.47) and bunch weight (30.68 and 47.33 kg), respectively, during both seasons, compared to the control treatment which gave the lowest mean values of finger length (16.58 and 18.24 cm), finger diameter (2.41 and 2.64 cm), finger weight (149.24 and 164.26 g), untreated plants recorded the highest number of days to maturity (128.50 and 141.00 days), also, gave the lowest mean values of yield (25.82 and 30.23 kg), pulp weight (101.45 and 111.59 g), number of fingers/ hand (17.71 and 19.48) and bunch weight (24.18 and 25.42 kg), during 2015 and 2016 seasons, respectively.

On the other hand, data presented in Table (1) indicated that bunch trimming (remove three hands) caused a significant increase of finger length (22.26 and 24.14 cm), finger diameter (3.16 and 3.39 cm), finger weight (169.38 and 186.35 g), earliness of harvesting time (113.00 and 124.25 days), yield (35.56 and 39.17 t/fed), pulp weight (131.36 and 144.49 g), number of fingers/ hand (24.39 and 26.83) and bunch weight (30.98 and 32.38 kg), respectively, in 2015 and 2016 seasons, compared the control treatment which gave the lowest mean values of finger length (17.78 and 19.53 cm), finger diameter (3.69 and 2.96 cm), finger weight (145.75 and 160.41g), yield (24.75 and 29.05 kg), pulp weight (89.76 and 105.07g), pulp % (67.32 and 67.52 %) and decreased the time of harvesting (127.00 and 139.50 days), number of fingers/ hand (15.04 and 16.54) and bunch weight (23.96 and 42.38 kg), respectively, in 2015 and

2016 seasons. These results are in agreement with those obtained by Aba *et al.* (2009), Baiyeri *et al.* (2009), Kassem *et al.* (2010), Vargas-Calvo and Valle-Ruiz (2011), Amani and Avagyan (2014) and Sharma (2014) on banana.

Table (1). Effect of bunch covers and bunch trimming on finger length, diameter and weight of Grand Nain banana plants in sandy soil (2015 and 2016 seasons)

| Treatments | Finger length (cm) | | Finger diameter (cm) | | Finger weight (g) | | |
|---------------------------------|----------------------|---------------|----------------------|----------------|-------------------|----------------|-----------|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | |
| A) Bunch covers | | | | | | | |
| Untreated | 16.58 | 18.24 | 2.41 | 2.64 | 149.24 | 164.26 | |
| White bags | 20.28 | 21.96 | 2.62 | 2.88 | 156.21 | 173.61 | |
| Blue bags | 21.39 | 23.53 | 3.14 | 3.36 | 159.73 | 180.50 | |
| Double bags | 21.55 | 23.75 | 3.23 | 3.55 | 168.30 | 185.15 | |
| LSD(0.05) | 2.01** | 0.06** | 0.06** | 0.151** | 0.375** | 0.186** | |
| B) Bunch trimming | | | | | | | |
| Untreated | 17.78 | 19.53 | 3.69 | 2.96 | 145.75 | 160.41 | |
| Removing one hand | 19.49 | 21.04 | 2.64 | 2.90 | 153.35 | 175.26 | |
| Removing two hands | 20.27 | 22.77 | 2.90 | 3.19 | 165.00 | 181.50 | |
| Removing three hands | 22.26 | 24.14 | 3.16 | 3.39 | 169.38 | 186.35 | |
| LSD (0.05) | ns | 0.06** | 0.06** | 0.15** | 0.37** | 0.19** | |
| Interaction effect (AXB) | | | | | | | |
| Untreated | Untreated | 14.82 | 16.30 | 2.03 | 2.21 | 141.35 | 155.86 |
| | Removing one hand | 15.92 | 17.50 | 2.33 | 2.56 | 145.71 | 160.28 |
| | Removing two hands | 17.12 | 18.83 | 2.56 | 2.81 | 151.32 | 166.45 |
| | Removing three hands | 18.47 | 20.32 | 2.71 | 2.98 | 158.60 | 174.46 |
| White bags | Untreated | 18.08 | 19.62 | 2.34 | 2.57 | 144.15 | 158.56 |
| | Removing one hand | 20.62 | 21.07 | 2.46 | 2.70 | 152.43 | 174.79 |
| | Removing two hands | 18.91 | 22.68 | 2.75 | 3.02 | 162.33 | 178.56 |
| | Removing three hands | 23.52 | 24.47 | 2.94 | 3.23 | 165.94 | 182.53 |
| Blue bags | Untreated | 18.90 | 20.79 | 3.59 | 3.95 | 147.11 | 161.82 |
| | Removing one hand | 20.44 | 22.48 | 2.75 | 3.02 | 148.90 | 182.99 |
| | Removing two hands | 22.16 | 24.37 | 2.95 | 3.24 | 170.35 | 187.38 |
| | Removing three hands | 24.07 | 26.48 | 3.28 | 3.24 | 172.55 | 189.80 |
| Double bags | Untreated | 19.31 | 21.42 | 2.82 | 3.10 | 150.38 | 165.42 |
| | Removing one hand | 21.01 | 23.10 | 3.02 | 3.32 | 166.36 | 182.99 |
| | Removing two hands | 22.90 | 25.19 | 3.36 | 3.69 | 176.00 | 193.60 |
| | Removing three hands | 23.00 | 25.30 | 3.73 | 4.10 | 180.45 | 198.61 |
| Interaction AXB | | ** | ** | ** | ** | ** | ** |

* Significant at 0.05 level of probability. ns: not significant

Table (2). Effect of bunch covers and bunch trimming on time of harvesting, yield, pulp weight and pulp (%) of Grand Nain banana plants in sandy soil (2015 and 2016 seasons)

| Treatments | Time of harvesting (days) | | Yield (Ton/fed) | | Pulp weight (g) | | Pulp (%) | | |
|---------------------------------|---------------------------|-----------|-----------------|---------------|-----------------|---------------|-----------|---------------|-----------|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | |
| A)Bunch covers | | | | | | | | | |
| Untreated | 128.50 | 141.00 | 25.82 | 30.23 | 101.45 | 111.59 | 67.70 | 67.72 | |
| White bags | 118.25 | 130.25 | 30.70 | 33.82 | 102.08 | 118.88 | 71.59 | 71.74 | |
| Blue bags | 116.00 | 127.50 | 32.38 | 35.62 | 117.35 | 129.09 | 72.94 | 76.01 | |
| Double bags | 114.50 | 129.33 | 34.87 | 38.36 | 124.63 | 136.81 | 75.99 | 79.08 | |
| LSD (0.05) | 2.04** | ns | 2.80* | 0.01** | ns | 0.01** | ns | 0.10** | |
| B)Bunch trimming | | | | | | | | | |
| Untreated | 127.00 | 139.50 | 24.75 | 29.05 | 89.76 | 105.07 | 67.32 | 67.52 | |
| Removing one hand | 121.25 | 133.50 | 29.11 | 32.02 | 106.40 | 117.04 | 69.70 | 71.78 | |
| Removing two hands | 116.00 | 120.83 | 34.35 | 37.78 | 117.98 | 129.77 | 71.76 | 75.82 | |
| Removing three hands | 113.00 | 124.25 | 35.56 | 39.17 | 131.36 | 144.49 | 79.43 | 79.43 | |
| LSD (0.05) | 2.33** | ns | 2.80** | 0.01** | 8.67** | 0.01** | ns | 0.10** | |
| Interaction effect (AXB) | | | | | | | | | |
| Untreated | Untreated | 139 | 152 | 15.79 | 24.70 | 86.02 | 94.62 | 60.70 | 60.69 |
| | Removing one hand | 132 | 145 | 25.41 | 27.95 | 95.58 | 105.13 | 65.59 | 65.60 |
| | Removing two hands | 124 | 136 | 30.00 | 33.00 | 106.20 | 116.82 | 70.11 | 70.18 |
| | Removing three hands | 119 | 131 | 32.06 | 35.26 | 118.00 | 129.79 | 74.40 | 74.40 |
| White bags | Untreated | 126 | 139 | 25.34 | 27.87 | 67.85 | 101.03 | 65.07 | 65.69 |
| | Removing one hand | 118 | 130 | 28.40 | 31.24 | 102.06 | 112.27 | 69.69 | 69.69 |
| | Removing two hands | 116 | 128 | 33.77 | 37.15 | 112.41 | 123.63 | 73.79 | 73.79 |
| | Removing three hands | 113 | 124 | 35.29 | 39.03 | 126.00 | 138.59 | 77.80 | 77.80 |
| Blue bags | Untreated | 123 | 135 | 27.25 | 29.97 | 99.51 | 109.47 | 70.02 | 70.02 |
| | Removing one hand | 119 | 131 | 30.73 | 33.80 | 110.56 | 121.62 | 74.25 | 74.25 |
| | Removing two hands | 112 | 123 | 35.25 | 38.77 | 122.85 | 135.12 | 78.20 | 78.30 |
| | Removing three hands | 110 | 121 | 36.30 | 39.93 | 136.50 | 150.14 | 81.47 | 81.47 |
| Double bags | Untreated | 120 | 132 | 30.59 | 33.65 | 105.67 | 115.13 | 73.51 | 73.67 |
| | Removing one hand | 116 | 128 | 31.91 | 35.09 | 117.42 | 129.14 | 77.51 | 77.58 |
| | Removing two hands | 112 | 156 | 38.38 | 42.22 | 130.46 | 143.51 | 56.69 | 81.03 |
| | Removing three hands | 110 | 121 | 38.61 | 42.47 | 144.96 | 159.44 | 84.06 | 84.06 |
| Interaction AXB | | ** | ** | ** | ** | ** | ** | ** | ** |

* Significant at 0.05 level of probability. ns: not significant

Table (3). Effect of bunch covers and bunch trimming on number of finger, bunch weight and hand weight of Grand Nain banana plants in sandy soil (2015 and 2016 seasons)

| Treatment | Number of finger /hand | | Bunch weight (kg) | | Hand weight (kg) | | |
|---------------------------------|------------------------|---------------|-------------------|-----------|------------------|---------------|-----------|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | |
| A)Bunch covers | | | | | | | |
| Untreated | 17.71 | 19.48 | 24.18 | 25.42 | 2.70 | 2.66 | |
| White bags | 19.05 | 20.96 | 26.75 | 28.25 | 3.00 | 3.21 | |
| Blue bags | 19.83 | 21.78 | 28.73 | 32.15 | 3.25 | 3.53 | |
| Double bags | 20.44 | 22.47 | 30.68 | 47.33 | 3.47 | 3.82 | |
| LSD(0.05) | 0.06** | 0.02** | 0.22** | ns | 0.07** | 0.45** | |
| B)Bunch trimming | | | | | | | |
| Untreated | 15.04 | 16.54 | 23.96 | 24.38 | 2.20 | 2.38 | |
| Removing one hand | 17.22 | 18.92 | 26.46 | 27.16 | 2.72 | 2.98 | |
| Removing two hands | 20.37 | 22.39 | 28.93 | 31.23 | 3.36 | 3.70 | |
| Removing three hands | 24.39 | 26.83 | 30.98 | 32.38 | 4.14 | 4.17 | |
| LSD(0.05) | 0.06** | 0.02** | 0.22** | ns | 0.07** | 0.45** | |
| Interaction effect (AXB) | | | | | | | |
| Untreated | Untreated | 12.98 | 14.28 | 20.42 | 20.76 | 1.84 | 2.02 |
| | Removing one hand | 15.35 | 16.88 | 23.10 | 24.51 | 2.35 | 2.57 |
| | Removing two hands | 19.56 | 21.51 | 25.70 | 27.27 | 2.96 | 3.25 |
| | Removing three hands | 22.95 | 25.24 | 27.50 | 29.12 | 3.64 | 2.80 |
| White bags | Untreated | 14.57 | 16.03 | 22.84 | 23.54 | 2.10 | 2.31 |
| | Removing one hand | 17.32 | 19.05 | 25.82 | 26.50 | 2.64 | 2.90 |
| | Removing two hands | 20.70 | 22.77 | 28.91 | 30.70 | 3.36 | 3.69 |
| | Removing three hands | 23.60 | 25.98 | 29.42 | 32.26 | 3.92 | 3.97 |
| Blue bags | Untreated | 15.48 | 17.03 | 24.77 | 26.54 | 2.28 | 2.35 |
| | Removing one hand | 1.20 | 19.93 | 27.94 | 27.73 | 2.88 | 3.17 |
| | Removing two hands | 19.96 | 21.92 | 29.23 | 32.05 | 3.40 | 3.74 |
| | Removing three hands | 25.70 | 28.24 | 33.00 | 33.00 | 4.43 | 4.87 |
| Double bags | Untreated | 17.15 | 18.85 | 27.81 | 28.69 | 2.58 | 2.84 |
| | Removing one hand | 18.03 | 19.83 | 29.01 | 29.91 | 3.00 | 3.30 |
| | Removing two hands | 21.25 | 23.37 | 31.90 | 34.89 | 3.74 | 4.11 |
| | Removing three hands | 25.32 | 27.85 | 34.00 | 35.09 | 4.57 | 5.03 |
| Interaction AXB | | ** | ** | ** | ** | ** | ** |

* Significant at 0.05 level of probability. ns: not significant

B) Chemical fruit characteristics

The results of the chemical composition of Grand Nain banana are shown in (Tables 4 and 5) as affected by bunch cover and bunch trimming. Regarding the chemical composition, the double bags covering significantly increased all the studied chemical compositions parameters i.e. TSS (21.94 and 23.68 %), acidity (0.330 and 362 %), TSS/Acidity (64.87 and 66.66), VC (6.62 and 7.04 mg/100 g FW), total sugars (22.47 and 24.97%), reducing sugars (15.52 and 18.93 %) and non-reducing sugars (6.93 and 5.39%), while, control treatment gave the lowest mean values of TSS (15.80 and 20.84 %), acidity (0.255 and 0.259 %), TSS/Acidity (61.81 and 59.91), VC (4.40 and 4.71 mg/100 g FW), total sugars (15.97 and 17.46 %), reducing sugars (9.98 and 12.02 %) and non-reducing sugars (6.00 and 5.42), during 2015 and 2016 seasons. Regarding to bunch trimming, data presented in (Tables 4 and 5) indicated that bunch trimming caused significant increase of fruit chemical composition parameters, where, the removal of three hands gave the maximum values of TSS (21.41 and 22.98 %), acidity (0.322 and 0.369 %), TSS/Acidity (63.17 and 61.20 %), VC (6.18 and 6.99 mg/100 g FW), total sugars (22.21 and 24.27 %), reducing sugars (15.46 and 18.61 %) and non-reducing sugars (6.70 and 5.66), compared with untreated treatment which gave the minimum values

of TSS (15.63 and 20.20 %), acidity (0.235 and 0.269 %), TSS/Acidity (61.15 and 63.17), VC (4.61 and 5.10 mg/100 g FW), total sugars (15.67 and 17.69 %), reducing sugars (11.23 and 13.56 %) and non-reducing sugars (4.87 and 4.10), respectively, during both seasons. These results are in agreement with those reported by Irizarry *et al.* (1992), Daniells *et al.* (1994), Goenaga and Irizarry (2006), Hassan *et al.* (2007), Wanichkul and Boonma (2009), Bugaud *et al.* (2012), Kutinyu *et al.* (2015) and Sarkar (2015) on banana.

Table (4). Effect of bunch covers and bunch trimming on TSS (%), acidity (%), TSS/Acidity (%) and VC (mg/100 g FW) of Grand Nain banana plants in sandy soil (2015 and 2016 season)

| Treatments | TSS (%) | | Acidity (%) | | TSS/Acidity | | VC (mg/100 g FW) | | |
|---------------------------------|---------------------|---------------|---------------|---------------|-------------|---------------|------------------|---------------|-----------|
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | |
| A)Bunch covers | | | | | | | | | |
| Untreated | 15.80 | 20.84 | 0.255 | 0.259 | 61.81 | 59.91 | 4.40 | 4.71 | |
| White bags | 17.42 | 20.92 | 0.280 | 0.297 | 61.79 | 62.62 | 4.91 | 5.67 | |
| Blue bags | 18.55 | 22.70 | 0.303 | 0.330 | 61.64 | 61.27 | 5.68 | 6.62 | |
| Double bags | 21.94 | 23.68 | 0.330 | 0.362 | 64.87 | 66.66 | 6.62 | 7.04 | |
| LSD(0.05) | 0.38** | 0.02** | 0.01** | 0.03** | ns | 0.02** | 0.17** | 0.03** | |
| B)Bunch trimming | | | | | | | | | |
| Untreated | 15.63 | 20.20 | 0.235 | 0.269 | 61.51 | 63.17 | 4.61 | 5.10 | |
| Removing one hand | 17.37 | 22.91 | 0.281 | 0.300 | 62.51 | 63.14 | 5.12 | 5.66 | |
| Removing two hands | 19.30 | 22.05 | 0.312 | 0.310 | 62.91 | 62.96 | 5.69 | 6.29 | |
| Removing three hands | 21.41 | 22.98 | 0.322 | 0.369 | 63.17 | 61.20 | 6.18 | 6.99 | |
| LSD(0.05) | 0.38** | 0.02** | 0.01** | 0.03** | ns | 0.02** | 0.17** | 0.03** | |
| Interaction effect (AXB) | | | | | | | | | |
| Untreated | Untreated | 13.39 | 19.14 | 0.216 | 0.238 | 61.81 | 59.96 | 3.73 | 3.99 |
| | Removing one hand | 14.88 | 21.44 | 0.240 | 0.265 | 61.84 | 60.11 | 4.14 | 4.46 |
| | Removing two hands | 16.53 | 21.00 | 0.267 | 0.207 | 61.78 | 59.80 | 4.61 | 4.93 |
| | Removing three ands | 18.37 | 21.78 | 0.297 | 0.328 | 61.80 | 59.79 | 5.12 | 5.48 |
| White bags | Untreated | 14.79 | 20.20 | 0.253 | 0.251 | 63.15 | 62.83 | 4.29 | 4.81 |
| | Removing one hand | 16.44 | 20.05 | 0.290 | 0.284 | 59.57 | 61.79 | 4.76 | 5.33 |
| | Removing two ands | 18.27 | 21.34 | 0.322 | 0.310 | 62.74 | 62.90 | 5.30 | 5.94 |
| | Removing three ands | 20.18 | 22.11 | 0.255 | 0.344 | 61.68 | 62.95 | 5.30 | 6.60 |
| Blue bags | Untreated | 15.73 | 20.46 | 0.264 | 0.280 | 61.63 | 61.46 | 4.81 | 5.61 |
| | Removing one hand | 17.47 | 24.63 | 0.283 | 0.311 | 61.63 | 61.51 | 5.35 | 6.24 |
| | Removing two ands | 19.42 | 22.11 | 0.315 | 0.346 | 61.64 | 61.41 | 5.94 | 6.93 |
| | Removing three ands | 21.58 | 23.62 | 0.350 | 0.385 | 61.64 | 60.72 | 6.61 | 7.70 |
| Double bags | Untreated | 18.60 | 21.01 | 0.279 | 0.307 | 59.44 | 68.43 | 5.61 | 5.97 |
| | Removing one hand | 20.67 | 25.54 | 0.310 | 0.341 | 66.98 | 68.44 | 6.23 | 6.63 |
| | Removing two ands | 22.97 | 23.74 | 0.345 | 0.379 | 66.52 | 68.44 | 6.93 | 7.37 |
| | Removing three ands | 25.52 | 24.42 | 0.385 | 0.421 | 66.53 | 61.33 | 7.70 | 8.19 |
| Interaction AXB | | 0.10 | ** | ** | 0.41 | 0.34 | ** | 0.01 | ** |

* Significant at 0.05 level of probability. ns: not significant

Table (5). Effect of bunch covers and bunch trimming on total sugars (%), reducing sugars (%), TSS/Acidity (%) and non-reducing sugars of Grand Nain banana plants in sandy soil (2015 and 2016 seasons)

| Treatments | | Total sugars (%) | | Reducing sugars (%) | | Non-reducing sugars (%) | |
|---------------------------------|----------------------|------------------|-----------|---------------------|---------------|-------------------------|---------------|
| | | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| A) Bunch covers | | | | | | | |
| Untreated | | 15.97 | 17.46 | 9.98 | 12.02 | 6.00 | 5.42 |
| White bags | | 18.04 | 19.44 | 12.90 | 15.45 | 5.07 | 3.99 |
| Blue bags | | 19.35 | 21.75 | 14.83 | 17.68 | 5.01 | 4.06 |
| Double bags | | 22.47 | 24.97 | 15.52 | 18.93 | 6.93 | 5.39 |
| LSD(0.05) | | 0.33** | ns | 0.26** | 0.04** | 0.23** | 0.03** |
| B) Bunch trimming | | | | | | | |
| Untreated | | 15.67 | 17.69 | 11.23 | 13.56 | 4.87 | 4.10 |
| Removing one hand | | 17.99 | 19.65 | 12.56 | 15.09 | 5.42 | 4.57 |
| Removing two hands | | 19.95 | 21.99 | 13.97 | 16.81 | 6.02 | 4.54 |
| Removing three hands | | 22.21 | 24.27 | 15.46 | 18.61 | 6.70 | 5.66 |
| LSD(0.05) | | 0.33** | ns | 0.26** | 0.04** | 0.23** | 0.03** |
| Interaction effect (AXB) | | | | | | | |
| Untreated | Untreated | 13.54 | 14.80 | 8.45 | 10.13 | 5.09 | 4.59 |
| | Removing one hand | 15.05 | 16.45 | 9.39 | 11.31 | 5.65 | 5.14 |
| | Removing two hands | 16.72 | 18.28 | 10.50 | 12.75 | 6.28 | 5.53 |
| | Removing three hands | 18.58 | 20.32 | 11.59 | 13.90 | 6.98 | 6.42 |
| White bags | Untreated | 15.30 | 16.50 | 10.71 | 13.10 | 4.30 | 3.40 |
| | Removing one hand | 16.99 | 18.29 | 12.21 | 14.55 | 4.78 | 3.77 |
| | Removing two hands | 18.89 | 20.35 | 13.57 | 16.18 | 5.13 | 4.17 |
| | Removing three hands | 20.99 | 22.61 | 15.08 | 17.97 | 5.90 | 4.64 |
| Blue bags | Untreated | 14.78 | 18.43 | 12.57 | 14.99 | 4.25 | 3.44 |
| | Removing one hand | 18.75 | 20.49 | 13.97 | 16.66 | 4.72 | 3.83 |
| | Removing two hands | 20.77 | 22.77 | 15.53 | 18.51 | 5.24 | 4.26 |
| | Removing three hands | 23.08 | 25.30 | 17.25 | 20.57 | 5.83 | 4.73 |
| Double bags | Untreated | 19.07 | 21.04 | 13.19 | 16.04 | 5.85 | 5.00 |
| | Removing one hand | 21.19 | 23.38 | 14.65 | 17.83 | 6.53 | 5.54 |
| | Removing two hands | 23.43 | 26.58 | 16.29 | 19.82 | 7.26 | 4.19 |
| | Removing three hands | 26.17 | 28.87 | 17.93 | 22.02 | 8.07 | 6.85 |
| Interaction AXB | | ** | ** | ** | ** | ** | ** |

* Significant at 0.05 level of probability. ns: not significant

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الملخص العربي

تحسين محصول وجودة الموز صنف "جراند نان" من خلال لون غطاء السباطة وخف الكفوف

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أجريت هذه الدراسة خلال موسمين متتاليين ٢٠١٥ و ٢٠١٦ على نباتات الموز صنف (جراند نان) في مزرعة بمركز بدر بمحافظة البحيرة بمصر لدراسة تأثير تغطيه وخف الكفوف على المحصول وجود ثمار الموز، وأستخدم في التجربة تصميم القطع المنشقة مرة واحدة حيث تم ترتيب معاملات: التغطية في القطع الرئيسية ورتبت اربعة مستويات الخف (بدون خف، خف كف واحد و خف كفين، خف ثلاثة كفوف) في القطع تحت الرئيسية. اظهرت النتائج ان معاملة التغطية المزدوجة (الأبيض + الأزرق) مع ازالة ثلاثة كفوف/سباطة اعطت اعلى القيم لكل من المحصول ومكوناته (وزن وطول وقطر الأصبع، عدد الايام حتي التزهير، وزن الكف، وزن السباطة، عدد الاصابع/كف، وزن اللب، % لللب، المحصول (بالطن/فدان)، كذلك أعطت أفضل محتوى من التركيب الكيميائي (% للسكريات الكلية والمختزلة وغيور المختزلة والحموضة والمواد الصلبة الذاتية الكلية، محتوى فيتامين ج) وذلك مقارنة بالمعاملات الأخرى والكنترول.

