Early Removal of Mango Inflorescences Increase Tree Production and Fruit Quality (Mangifera indica L. cv. ‘Tommy Atkins’) [28]

Ashraf E Hamdy*, Sobhy M Khalifa, Hosny F Abdel-Aziz
Horticulture Dept, Fac of Agric, Al-Azhar Univ, P.O. Box 11884 Nasr City, Cairo, Egypt
*Corresponding author: ashrafezat@azhar.edu.eg 01016156965

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Abstract

The present investigation was carried out throughout the two successive seasons 2018 and 2019. Mango trees were grown in a private farm located at Wadi Elmullak El-Sharkia Governorate, Egypt. This study aimed to elucidate the impact of pinching early flowering in the winter severity on tree yield and fruit quality of Mango ‘Tommy Atkins’ cultivar. The old of the mango cultivar under this study was 15 years old and planted as 3x4 m apart grafted on ‘Saber’ seedling rootstocks, grown in sandy soil and irrigated through drip irrigation system. Mango trees were subjected to de-inflorescence in mid-February by manual removing emerged inflorescence as follows complete removing (removing of 100% of emerging inflorescences), sever removing (75% of emerging inflorescences), moderated removing (50% of emerging inflorescences), light removing (25% of emerging inflorescences) and control (without removing inflorescences). Results showed that complete removing treatment was superior to other treatments regarding total acidity percentage and vitamin C. In conclusion complete removing (100% of emerging inflorescences) in mid-Feb. could be a practicable choice for continued production for the ‘Tommy Atkins’ under the environmental conditions of exported mango orchards.

Keywords: Apical panicles; Application; flowering; Sever pruning; Variety

1 Introduction

Mango (Mangifera indica L.) is an important fruit species Admasu et al (2014) cultivated in Egypt it comes in the second rank, after citrus. Egyptian production reached 1091535 tons of fruit in a harvested area 265509 feddan (According to Bulletin the Agriculture Statistics, issued by Ministry of Agric., Egypt 2019). ‘Tommy Atkins’ Mango tree is a variety originated in Florida, USA. Besides, it’s considered as one of the greatest exported cultivars due to its strong shelf life and beautiful greenish red colors (De la Cruz and Garcia 2002). Low productivity is the most important issue faced mango trees industry. Likewise, ‘Tommy Atkins’ cultivar has been suffering from small output that might be due to early flowering. Moreover, low temperature during blooming has been reported as an important factor in reducing perfect flower per in-
Florescence (Whiley 1986). Removal inflorescence at the idea of addon was showed to induce corresponding re-blooming (Yeshitala et al 2005). Yield of mango trees are depending on a serious limitation such as the date of flower beginning. Pruning by eliminating the inflorescences on Mar. and Apr. were treated on cv. Irwin grown at Wakayama which is regarded as a warm climate area in Japan (Sasaki et al 2000), application induced a flower bud initiation as well as differentiation in the axillary buds (a re-flowering), and a maximum number of inflorescences was gained of pani"cules those tipping in Mar. (Sasaki et al 2000). "Furthermore, when mango trees are unprotected to winter temperature to induce flowering, flowers development only occurs by warm temperature during winter season which causes early flowering. While, the low temperature during flowering period decreases the perfect flowers percentage, number of flowers per panicle and length of inflorescences" (Whiley 1986). Warm periods through winter season might be allow early emerged inflorescence to happen in all mango cultivars. This might be injured by following cold temperature. Therefore, this study aimed to elucidate the impact of early removing inflorescence in the winter severity on tree productivity and fruit physical and chemical properties of Mango ‘Tommy Atkins’ cv.

2 Materials and Methods

2.1 Plant materials and experimental application

This investigation was done in 2018 and 2019 seasons on mango trees (Mangifera indica L.) ‘Tommy Atkins’ cv. The study performed in a private farm located at Wadi Elmullak El-Sharkia Governorate, Egypt. The mango trees were 15 years old, planted at 3x5 m apart, grafted on ‘Sabre’ rootstock, grown in sandy soil and irrigated through drip irrigation system. All trees received similar cultural practices. Forty five trees (similar in vigor and healthy) were chosen for investigation. Mango trees were subjected to five deinflorescence level treatments in mid-Feb. by manual removing emerged inflorescences as follows:

Control (without removing inflorescences).
Light removing (removing 25% of emerging inflorescences).
Moderated removing (removing of 50% of emerging inflorescences).
Sever removing (removing of 75% of emerging inflorescences).
Complete removing (removing 100% of emerging inflorescences).

Each manual removing emerged inflorescence treatment had three replicates with three trees per a replicate. The maturity stage was determined at
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fruit age 109 day in Tommy Atkins cv. according to Khalefa (2006). Complete randomized block design was followed according to Snedecor and Cochran (1980).

2.2 Measurements

2.2.1 Tree yield

Fruits of trees were harvested at maturity stage, (fruit at age 109 day in Mango Tommy Atkins cv. according to Khalefa (2006), and separately weighed therefore. The yield (Kg/tree) was calculated in mango cultivar in the both seasons. Moreover, yield increment than untreated treatment percentage was calculated by using El-Naby et al (2019) equation.

Yield increase than control (%) = Yield (treatment) - Yield (control)×100/ Yield (control)

2.2.2 Physical and biochemical characteristics of fruit

2.2.2.1 Fruit physical properties

Five fruits of each mango tree replicated 3 times were devoted and picked during harvest date, then determining some of fruit parameters, such as weight and volume of fruit, fruit dimensions (length and width) as well as weight of fruit peel and pulp.

Firmness of fruit expressed as (lb./inch²) was measured using pressure tester (digital force-Gouge Model IGV-O.SA to FGV-100A.Shimpo instruments).

2.2.3 Fruit chemical properties. The following parameters were recorded

Fruit total soluble solids (TSS %) from the sample’s fruit pulp was determined by using a digital refractometer.

Titratable acidity percentage (TA) was determined by titration and expressed as citric acid according to A.O.A.C. (2005).

Total soluble solids/acid ratio was estimated from the values of total soluble solids divided by values of total acids.

Ascorbic acid (Vitamin C) was estimated by titrating fruit juice sample with 2, 6 dichlorophenol indophenol dye according to A.O.A.C. (2005).

Fruit total sugar content was determined colorimetrically in fruit dry weight (g / 100 g dr. wt.) according to the method of Miller (1972).

Statistical Analysis: The analysis of variance (ANOVA) was performed using one way ANOVA Co-stat software according to Stern (1991) and the means were differentiated using Duncan multiple range test at 5% level (Waller and Duncan 1969).

3 Results and Discussion

3.1 Tree yield

The results in Table 1 clearly showed that all applied removing inflorescences treatments to mango tree cv. ‘Tommy Atkins’ significantly increased fruits number per tree and fruit yield (kg/tree) when compared with control in the two studied seasons 2018 and 2019. The best results regarding removing of emerging inflorescence in mango trees were gained when complete removing (100 % of inflorescence were removed), followed descending order by severe removing, moderate removing and slight removing. On the other hand, the lowest fruit number and fruit yield (kg per tree) were recorded when mango trees they received treatment (control). Similar trend was observed regarding yield increment (%) where was superior to untreated treatment in the both seasons. From the early removing trials of the two studied seasons it may be concluded that the yield of large mango cv. ‘Tommy Atkins’ is about doubled. These results are in harmony with those obtained by Shaban (2005) who found that the number of emerged axillary panicles in ‘Hindi Besinara’ cultivar significantly increased by early removing apical panicle treatment. Similarly, Yeshitela et al (2005) found that removing mango blossom early in the growth season had increased number of reproductive inflorescences per trees in Tommy Atkins cultivar. Also, Samra et al (2010) found
that pinching of early flowering Zebda Mango tree at first emergence on trees from mid-Dec. to mid-Feb. may be significantly enhanced tree yield comparing to the control. Ali (2014) found that pruning of malformed inflorescences increased yield of the fruits than control treatment of ‘Hindy Be-sinnara’, ‘Ewis’ and ‘Sedik’ mango trees. Likewise, Elkhishen (2015) mentioned that removing the apical blossom of mango cultivar ‘Hindi Besinnara’ at the first and third week of Feb. improved significantly the fruit yield per tree.

The higher fruit numbers that recorded in complete removing treatment (Table 1), “might be attributed to the increase in fruit retention after re-flowering. Favourable higher temperature during the growth of the different parts of the flowers caused the higher fruit setting in turn” (Yeshitela 2005). The increments in fruit (number and the yield per tree) by removing inflorescence was in agreement with Shaban (2005) who reported that heading back or pinching ‘Hindi Besinnara’ mango trees in December recorded the maximum No. of fruits per tree. The enhancing effects of early inflorescence removal by winter might be attributed to enhancing number of panicles developing per terminal panicle (Oosthuyse and Jacobs 1997). Samra et al (2010) found that pinching of early flowering Zebda Mango tree in December or January was the most effective treatment for increasing number of fruits / tree comparing to the control. Sarkhosh et al (2018) found that tip-pruning applied in Feb. increased canopy flowering percentage, No. of fruits/tree and fruit weight of mango tree cv. Honey Gold compared with control.

It could be concluded that applied early removing panicles treatments to mango trees in mid-February caused an increase in yield per tree in compared with those of untreated and opposite treatments.

3.2 Effect of removing severity of the emerging inflorescences on some fruit physical characteristics

3.2.1 Fruit weight, volume and dimensions (length and width)

The results in Table 2 showed that moderated removing, light removing and control treatments significantly increased fruit (weight and volume) as well as dimensions of fruit (length and width), of mango ‘Tommy Atkins’ cultivar when compared with complete or sever removing treatments in the first season. The increasing of fruit weight in removing treatments might be due to an improved microclimate and higher photosynthetic rates (Sharma and Singh 2006). On the other hand this trend had not observed in the second season. Maximum fruit weight was recorded in control treatment. The rise in weight of fruit in control treatment might be attributed to the lowest number of mango fruits per tree (Table 1). These findings are in harmony with those gained by Yeshitela (2005) who found that removing 50% of the panicles increased fruit weight and size of ‘Sensation’ mango cultivar. Moreover, fruit thinning, by reducing competition for carbohydrates between fruits (Horscroft ; Sharples 1987; Yeshitela 2004). The same trend was observed regarding peel weight, pulp weight and seed weight when compared with complete or sever removing treatments. Ali (2014) found that pruning of malformed inflorescences improved physical parameters of the fruits than control treatment of ‘Hindy Besinnara’, ‘Ewis’ and ‘Sedik’ mango trees.

3.2.2 Fruit firmness

Results in Table 2 also cleared that all tested removing treatments significantly increased fruit firmness of mango ‘Tommy Atkins’ cultivar in comparison to control in the two seasons. Insignificant difference in fruit firmness was noticed between treatments in the first season except
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Table 1. Effect of removing severity of the emerging inflorescences on yield characteristics (kg/tree) of Mango ‘Tommy Atkins’ cv. trees during seasons 2018 and 2019

| Treatments          | Fruits number /tree | Yield (kg/tree) | Yield increase than control (%) | Yield (ton)/ feddan |
|---------------------|---------------------|-----------------|---------------------------------|--------------------|
| Season 2018         |                     |                 |                                 |                    |
| Control             | 16.00 e             | 10.23 d         | 0.0 d                           | 2.86 c             |
| Light removing      | 24.00 d             | 15.93 c         | 55.9 c                          | 4.46 b             |
| Moderated removing  | 27.33 c             | 18.51 b         | 79.7 b                          | 5.09 b             |
| Sever removing      | 39.67 b             | 18.38 b         | 81.5 b                          | 5.15 b             |
| Complete removing   | 60.00 a             | 25.89 a         | 153.5 a                         | 7.25 a             |
| Season 2019         |                     |                 |                                 |                    |
| Control             | 25.00 e             | 18.02 c         | 0.0c                            | 5.05 c             |
| Light removing      | 51.67 d             | 29.56 b         | 64.0 b                          | 8.28 b             |
| Moderated removing  | 61.00 c             | 30.65 b         | 70.2 b                          | 8.58 b             |
| Sever removing      | 73.33 b             | 32.16 b         | 78.6 b                          | 9.01 b             |
| Complete removing   | 96.87 a             | 42.90 a         | 137.6 a                         | 11.08 a            |

Means followed by the same letter (s) in each column are not significantly different at 5 % level.

Table 2. Effect of removing severity of the emerging inflorescences on some physical characteristics of ‘Tommy Atkins’ mango cv. during 2018 and 2019 seasons

| Character. Treatments | Fruits weight (gm) | Fruits volume cm³ | Fruit length (cm) | Fruit width (cm) | Peel weight (g) | Pulp Weight (g) | Seed weight (g) | Firmness lb/inch² |
|-----------------------|--------------------|-------------------|-------------------|------------------|-----------------|-----------------|-----------------|------------------|
| Season 2018           |                    |                   |                   |                  |                 |                 |                 |                  |
| Control               | 669.2 a            | 680.0 a           | 13.9 ab           | 9.4 ab           | 95.1 ab         | 512.4 a         | 57.3 b          | 24.6 b           |
| Light removing        | 664.8 a            | 665.0 a           | 14.4 a            | 10.0 a           | 93.8 b          | 503.0 a         | 72.4 a          | 33.7 a           |
| Moderated removing    | 645.7 a            | 583.3ab           | 14.2 ab           | 9.7 ab           | 97.6 a          | 481.8 a         | 66.3 a          | 36.5 a           |
| Sever removing        | 464.2 b            | 516.7ab           | 12.9 b            | 8.7 b            | 59.0 c          | 352.2 b         | 53.0 b          | 38.2 a           |
| Complete removing     | 431.6 b            | 426.7 b           | 11.4 c            | 7.8 c            | 47.6 d          | 343.4 b         | 40.6 c          | 39.3 a           |
| Season 2019           |                    |                   |                   |                  |                 |                 |                 |                  |
| Control               | 721.8a             | 666.7a            | 14.0 a            | 9.4 a            | 93.4 a          | 561.1 a         | 67.2 a          | 21.2 c           |
| Light removing        | 572.4b             | 516.7b            | 13.7 a            | 9.0 a            | 80.8 b          | 428.6 b         | 63.1 a          | 30.2 b           |
| Moderated removing    | 502.6bc            | 416.7c            | 12.1 ab           | 8.4 a            | 83.1 b          | 372.0 b         | 47.4 b          | 33.2 ab          |
| Sever removing        | 438.6cd            | 403.3c            | 12.4 ab           | 8.2 a            | 48.5 c          | 348.0 b         | 42.1 b          | 35.5 a           |
| Complete removing     | 371.0d             | 306.7d            | 10.8 b            | 6.5 b            | 35.5 d          | 305.0 b         | 30.4 c          | 36.0 a           |

Means followed by the same letter (s) in each column are not significantly different at 5 % level.
in control. Maximum value of fruit firmness percentage was obtained with complete removing treatments. The increase in fruit firmness with trees that received the inflorescences removing treatments might be due to inducing for synchronisation of re-flowering. “It is predictable that complete removing treatment could had raised nutrient uptake of soil, as well as changed activities of enzyme, anatomy of fruit and fruit shape index. Complete early removing raise calcium translocation is also stated in apple fruits. The presence of calcium in fruit known to support the middle lamella and lower the activities of cell wall-degrading enzyme such as pectin methylesterase and polygalactouronase” (Asrey et al 2013). These trees also attained late fruit set and more fruit per panicle than the opposite panicle pruning treatment Yeshitela (2004). “Firmness of fruit is a multifactorially-influenced phenomenon viz. size of fruit, number and size of cells, volume of intercellular space, fruit shape index, harvest maturity, mineral content and enzyme activity” (Link 2000).

We can conclude that applying early removing emerging inflorescence treatments to ‘Tommy Atkins’ mango trees in mid-February caused improvement in the tasted physical properties in comparison to those of control.

3.3 Effect of removing severity of the emerging inflorescences on some fruit chemical characteristics

3.3.1 The percentage of TSS, Total acidity, vitamin C and total sugars

The results in Table 3 cleared that complete removing of emerging inflorescences treatment significantly decreased total soluble solids % (TSS%), TSS.acid ratio and total sugars (%) of mango fruits ‘Tommy Atkins’ cv., when compared with other treatments or control. Wheadarase total acidity% and ascorbic acid (vitamin C) showed an opposite trend since they possessed higher than values than control in the two seasons. The higher recovery of fruits total soluble solids percentage from unremoved mango trees could be due to quicker carbohydrates degradation in comparison to fruits from tipped mango trees. These results are in agreement with those gained by Asrey et al (2013) who reported that a moderately more significant level of total soluble solids and lower level of of total acidity was recorded both in developed green and matured fruits gathered from un-tipping mango trees. “Fruit organic acids the synthesis and accumulation are influenced by numerous factors, the most important ones are phytohormon and the canopy microclimate. The organic acids level becomes more pronounced throughout the initial fruit development period” (Chen et al 2009).

The maximum values of (TSS%) and T.S.S / acid ratio were obtained with untreated mango trees. These findings are in agreement with results of Lakshminarayana (1980) who clarified that the total organic acids of fruit decreased during physiological fruit ripening stage. T.S.S/acid ratio has been used to assess the flavor of fruit (Oliveira 2017), as it increased by fruit ripening. Chitarra and Chitarra (2005) reported that the decrease in fruit acidity by ripening physiological stage, induces an important role in the fruit acid: sugar stability therefore, in influencing the fruit chemical properties (taste and flavor). The increasing in vitamin C in fruit as well as fruit total acidity percentage at the end of grown season (harvest time) might be due to the rise in growth caused by panicles pruning treatments (Yeshitela 2005).

The results also showed that a definite trend could be drawn between apical removing treatments and their severity. Hence, mango tree that received complete removing treatment gained the maximum values of both total acidity % and ascorbic acid (vitamin C) parameters, followed by severe removing and moderated removing treatments. Ali (2014) found that pruning of malformed inflorescences improving chemical parameters of the fruits than control treatment of ‘Hindy Be- sinnara’, ‘Ewis’ and ‘Sedik’ mango trees. Meanwhile the fruit maturity physiological stage under removed treatment situations arrived late in our investigation, the reason for higher titratable acidity in removed situations is fairly
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Table 3. Effect of removing severity of the emerging inflorescences on some chemical characteristics of mango ‘Tommy Atkins’ cv., during 2018 and 2019 seasons

| Treatments          | Character          | T.S.S (%) | Total acidity (%) | T.S.S / acid ratio | V.C mg/100 ml of pulp juice | Total sugars (%) |
|---------------------|--------------------|-----------|-------------------|--------------------|------------------------------|------------------|
|                     | Season 2018        |           |                   |                    |                              |                  |
| Control             | T.S.S (%)          | 11.0 a    | 2.2 c             | 4.7 a              | 38.7 c                       | 7.48 a           |
| Light removing      | 10.7 a             | 2.6 bc    | 3.9 b             | 39.7 c             | 7.25 a                       |
| Moderated removing  | 9.3 a              | 2.7 bc    | 3.3 bc            | 43.4 b             | 6.35 ab                      |
| Sever removing      | 9.0 a              | 2.8 b     | 3.0 c             | 42.8 b             | 6.12 b                       |
| Complete removing   | 7.0 b              | 3.0 a     | 2.0 d             | 47.2 a             | 4.47 c                       |
|                     | Season 2019        |           |                   |                    |                              |                  |
| Control             | T.S.S (%)          | 12.0 a    | 2.6 b             | 4.6 a              | 38.7 e                       | 8.17 a           |
| Light removing      | 11.7 a             | 2.9 ab    | 4.0 b             | 40.6 d             | 7.79 a                       |
| Moderated removing  | 10.7 ab            | 3.2 a     | 3.3 c             | 41.6 c             | 7.27 ab                      |
| Sever removing      | 9.6 b              | 3.3 a     | 2.9 c             | 44.4 b             | 6.53 b                       |
| Tipping removing    | 6.7 c              | 3.4 a     | 2.0 d             | 46.3 a             | 4.57 c                       |

Means followed by the same letter (s) in each column are not significantly different at 5 % level.

obvious. It could be concluded that applying early removing emerging inflorescences treatments to ‘Tommy Atkins’ mango trees in mid-February caused a decrease in both total soluble solids %, total soluble solids /acid ratio as well as total sugars % of mango fruits and an increase in (vitamin C) and titratable acidity % in comparison to those of control.

4 Conclusion

In conclusion our observations suggested that the issue of mango removal inflorescence is need further studies to evaluate the continuous effect of this treatment on mango tree yield and fruit quality. Removing treatments applied to ‘Tommy Atkins’ mango trees in mid-February caused an increase in tree yield and improved physical and chemical properties in comparison to those of control. Hence, complete removing (removing of 100% emerging inflorescences) in mid-February could be a practical opportunity for continued yield of the ‘Tommy Atkins’ mango farms.

References

Abd El-Naby, A; Abdelkhalek, AM; El-Naggar, YI (2019) Effect of melatonin, GA3 and NAA on vegetative growth, yield and quality of ‘Canino’apricot fruits. Acta Scientiarum Polonorum. Hortorum Cultus 18, 167-174.

Admasu, W; Sahile, S; Kibret, M (2014) Assessment of potential antagonists for anthracnose (Colletotrichum gloeosporioides) disease of mango (Mangifera indica L.) in North Western Ethiopia (Pawe). Archives of Phytopathology and Plant Protection 47, 2176-2186.

AOAC (2005) Official Methods of Analysis of the Association of Official Analytical Chemists. 16 ed., Published by the Association of Official Analytical chemists, Arlington, Virginia, USA.

Ali, SF (2014) The effect of some foliar spray and pruning application on yield and fruit quality of some mango cultivars under the reclaimed soil conditions. Middle East J. Agric. Res. 3,1-12.
Pruning affects fruit yield and postharvest quality in mango (*Mangifera indica* L.) cv. Amrapali. *Fruits* 68, 367-380.

Chen, FX; Liu, XH; Chen, LS (2009) Developmental changes in pulp organic acid concentration and activities of acid-metabolising enzymes during the fruit development of two loquat (*Eriobotrya japonica* Lindl.) cultivars differing in fruit acidity. *Food Chemistry* 114, 577-564.

Chitarra, MI; Chitarra, AB (2005) Pós-Colheita de Frutas e Hortaliças: Fisiologia e Manuseio. 2nd edn (Lavras: UFLA).

De la Cruz MJ; Garcia, HS (2002) Mango: postharvest operations. Compendium on post-harvest operations 2-8.

Elkhishen, MA (2015) Time of deblossoming in relation to cropping in hinidi besinnara mango trees (*Mangifera indica* L.). *Journal of Plant Production* 6, 1451-1458.

Horscroft, JC; Sharples, RO (1987) The effect of modern production systems on apple quality. *Report of the East Mailing Research Station*, Kent, UK, 111-113.

Issarakraisila, M; Considine, JA (1994) Effects of temperature on pollen viability in mango cv. ‘Kensington’. *Annals of Botany* 73, 231-240.

Jannoyer, M; Lauri, PE (2009) Removal of mango inflorescences increase fruit set and dose not affect yield (*Mangifera indica* cv. Cogshall). *Acta Hort.* 820, 433-436.

Khaleda, SM (2006) Evaluation studies on some mango varieties. M.Sc. in Agricultural Horticulture, Horticulture Dept, Fac of Agric, Al-Azhar, University pp.166.

Lakshminarayana, S (1980) Mango. In: Nagy, S. and Shaw, P.E., Eds., Tropical and Subtropical Fruits; Composition, properties and Uses, AVI, Westport, pp. 15-22.

Link, H (2000) Significance of flower and fruit thinning on fruit quality. *Plant Growth Regulation* 31, 17-26.

Litz, RE (2009) The mango botany, production and uses. 2nd edition., pp.238-244 CAB international New York, USA.

Miller, GL (1972) Use of dinitrosalicyclic acid reagent for determination of reducing sugar, *Anal. Chem.* 31, 426-428.

Mullins, PD (1986) Effect of varying climatic regimes on flower behaviour and pollination in 'Sensation' and 'Haden' mango trees. S. Afr. Mango Grow. Ass. Yr. book 6, 3-42.

Oliveira, GP; Siqueira, DLD; Salomão, LCC; Cecon, PR; Machado, DLM (2017) Paclobutrazol and branch tip pruning on the flowering induction and quality of mango tree fruits. *Pesquisa Agropecuária Tropical* 47, 7-14.

Oosthuysen, SA; Jacobs, G (1997). Flowering synchronization of Sensation mango trees by chemical inflorescence removal. Yearb. S. Afr. Mango Growers’ Assoc 17, 53-56.

Perring MA and Jackson CH (1975) The mineral composition of apples. Calcium concentration and bitter pit in relation to means mass per apple. *J Sci Agric* 26, 1493–1502.

Robbertse, PJ; von Teichman, I, van Rensburg, HJ (1986) A re-evaluation of the structure of the mango ovule in comparison with those of a few other Anacardiaceae species. *South African Journal of Botany* 52,17-24.

Samra, NR; Hegazi, A; Abdel-Fattah, MI (2010) Effect of GA3, urea and pinching treatments on "zebda" mango trees *J Plant Prod Mansoura Univ* 1, 1399 - 1407.

Sarkhosh, A; McConchie, C; Khadiivi, A (2018) The effects of different tip-pruning times on flowering, yield, and maturity of two mango cultivars in subtropical climate of Northern Territory (Katherine region) from Australia. *Scientia Horticulturae* 234, 140-145.

Sasaki, K; Lnoue, H; Utsunomiya, N (2000) Floral induction in axillary buds affected by pruning at panicle emergence in mango trees cv. Irwin growing in plastic house in Japan. *Acta. Hort.* 509, 301-306.
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Shaban, AE (2005) Effect of pruning on growth, flowering and fruiting of ‘Hindi Bisinnara’ mango trees. *Journal of agriculture science, Mansoura Univ.*, 30, 1541-1551.

Sharma, RR; Singh, R (2006) Effect of pruning intensity on light penetration and leaf physiology in Amrapali mango trees under high-density planting. *Tropical Science* 46, 16-19.

Shu, ZH; Sheen, TF; Lee, KC (1989) Current researches on the unfruitfulness of mango in Taiwan. *Acta Hort.* 231, 68-72.

Singh, RN; Majumdar, PK; Sharma, DK; Sinha, GC; Bose, PC (1974) Effect of deblossoming on the productivity of mango. *Scientia Hort.* 2, 399-401.

Snedecor, GW; Cochran, WG (1980) Statistical Methods Oxford and JBH Publishing. 7th edition, 224-308.

Stern, RD (1991) Review of ‘CoStat- Statutical Software’ *Experimental Agriculture* 27, 87-87.

Waller, RA; Duncan, DB (1969) A Bayes rule for the symmetric multiple comparisons problem. *Journal of the American Statistical Association* 64, 1484-1503.

Whiley, AW (1986) Crop management-a review. In Proc of the first Australian mango research workshop, Australia, Melbourne pp. 186-195.

Yeshitela, T; Robbertse, PJ; Fivas, J (2004) Effects of fruit thinning on ‘Sensation’ mango (Mangifera indica) trees with respect to fruit quantity, quality and tree phenology. *Experimental Agriculture*, 40, 433.

Yeshitela, T; Robbertse, PJ; Stassen, PJ (2005) Effects of pruning on flowering, yield and fruit quality in mango (Mangifera indica L.). *Australian Journal of Experimental Agriculture* 45, 1325-1330.
الخف المبكر لنورات المانجو الزهرية يزيد من إنتاج الشجرة وجودة الثمار لصنف "تومي أتكينز" 

[28] 

أشرف عزت حمدى - صبحى محمد خليفة - حسنى فتحى عبدالعزيز
قسم البساتين - كلية الزراعة ب القاهرة - جامعة الأزهر - ص ب 11884 - مدينة نصر - القاهرة - مصر

*Corresponding author: ashrafzet@azhar.edu.eg

الموجز

أجريت هذه الدراسة خلال موسمين متتاليين 2018/2019 على أشجار مانجو مزرعة في بستان خاص يقع في منطقة وادي الملوك بمحافظة الشرقية. وهدفت هذه الدراسة إلى دراسة تأثير شدة التطويش للازهار المبكرة في الشتاء على المحصول وجودة ثمار المانجو صنف "تومي أتكينز". بلغت أعمار الأشجار محل الدراسة عمر 15 سنة وعلى مساحات زراعية 4*4 م مطعومة على الأصل البذرى (Saber) وناجمة في أرض رملية وتورى باستخدام نظام الري (Subirrigation). عرضت أشجار المانجو محل الدراسة إزالة النورات الزهرية في منتصف شهر فبراير في كل من الموسمين بإزالة النورات الزهرية بيدوا كالتالي: القصف الكامل (خصوص 100% من النورات الزهرية المبتهقة) والقسم الشديد (خصوص 75% النورات الزهرية المبتهقة).

الخف المبكر لنورات المانجو الزهرية يزيد من إنتاج الشجرة وجودة الثمار لصنف "تومي أتكينز".