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Enhancing Flowering and Fruiting Attributes of Mango (*Mangifera indica*) CV. Zebda in the Off-Year by Binary Application of KNO_3, Ethrel and Paclobutrazol

M.A. Elkhishen

Department of Pomology, Faculty of Agriculture, Cairo University, Giza, Egypt

Abstract: This study was conducted during two seasons 2012-2013 and 2013-2014 to elucidate the effect of combined applications of KNO_3, Paclobutrazol and Ethrel on flowering and fruiting attributes as follows: KNO_3 4%+Ethrel 400ppm, KNO_3 4%+Ethrel 800ppm, KNO_3 6%+Ethrel 400ppm, KNO_3 6%+Ethrel 800ppm, KNO_3 4%+PBZ 2.5 gm, KNO_3 4%+PBZ 5 gm, KNO_3 6%+PBZ 2.5 gm, KNO_3 6%+PBZ 5 gm, Ethrel 400ppm + PBZ 2.5 gm, Ethrel 400ppm + PBZ 5 gm, Ethrel 800ppm + PBZ 2.5 gm, Ethrel 800ppm + PBZ 5 gm and control (untreated trees) of mango Zebda in Off-year season.KNO_3 and Ethrel sprayed at the first half of November, while PBZ applied as soil application in the second week of October. All treatments were done before Off- year. Results indicated that application of KNO_3 6%+Ethrel 800ppm, KNO_3 4%+ PBZ 5gm and PBZ 5gm + Ethrel 400 ppm recorded the highest values of average number of flowering shoots per tree and total number of panicles per tree compared with the control trees. Control trees recorded the highest panicle length compared with the other treatments. Application of KNO_3 6% +Ethrel 800 ppm and PBZ 2.5 gm + Ethrel 400 ppm recorded the highest percentage of fruit retention and significant perfect flowers percentage. Treatments of KNO_3 6%+ Ethrel 800 ppm achieved the highest significant value of average number of secondary branches per panicle, total number of fruits per tree, yield per tree, C/N ratio and total sugars percentage compared with the other treatments. Control trees recorded the highest value of fruit firmness and T.S.S/acid ratio.

Key words: Mango · *Mangifera indica* · Ethrel · KNO_3 · PBZ · Flowering · Fruit yield

INTRODUCTION

Mango is one of the most commercially important fruit crops growing in tropical and sub tropical zones [1]. Also mango is one of the most valuable fruits in the world [2]. Egypt is considered one of the most important producers of mango in the Middle East. However mango unit area under Egyptian conditions is very low in comparison to the other producers. Irregular flowering, low fruit set as well as fruit retention leads to low yield [2]. Most of mango cultivars grown in Egypt especially Zebda cultivar suffers from low productivity due to many reasons such as alternate bearing [3]. Ethrel is considered an effective floral promoter of some mango cultivars such as Ewais and Sedik which suffer from alternate bearing as Zebda cultivar [4]. Potassium nitrate (KNO_3) may help to solve the alternate bearing problem through increasing the number of flowering shoots, promoting flowering in the Off-year, increasing sex ratio, number of panicles, fruit retention and yield [5, 2, 1, 6-9]. Generally KNO_3 gives better results in flowering and fruiting and alternate bearing [10, 11]. On the other hand it seems that application of Ethrel increased total number of panicles per tree, more over application of Ethrel increased flowering and fruit yield, sex ratio [12 -16]. Paclobutrazol is considered as one of the most important growth retardants which enhance flowering attributes such as number of panicles, also increase number of flowering shoots, sex ratio and fruit yield [17, 7, 10]. Ethrel, Paclobutrazol and KNO_3 were previously tested as a single application to overcome alternate bearing of mango cultivars [1, 2, 4-10, 17]. In the current investigation the proposed component were used as a binary combination for enhance flowering and fruiting of Zebda mango cultivar in the Off-year. This experiment aimed to investigate the impact of Ethrel, Paclobutrazol and KNO_3 as combinations on flowering and fruiting attributes of Zebda mango on On-year to decrease severity of alternate bearing in the Off-year.

Corresponding Author: M.A. Elkhishen, Department of Pomology, Faculty of Agriculture, Cairo University, Giza, Egypt.

MATERIAL AND METHODS

The present investigation was conducted during two successive seasons 2012-2013 and 2013-2014 on 18 years old of Zebda mango cultivar located in private orchard at Cairo-Alex desert road. Trees were planted in sandy soil at 6 x 6 meters apart. All investigated trees received the same cultural practices. 78 trees were chosen for each season Zebda trees were uniform as much as possible in On-year at time of application. Ethrel and KNO_3 were sprayed at the first half of November, while soil application of PBZ was applied during the second week of October. Each treatment included 6 trees each 2 trees as a replicate, one of them was used for morphological assessment on each 40 shoots were tagged and the other for chemical analysis. This experiment comprised the following treatments:

- Control (sprayed with water only in the same time of the other treatments)
- pbz 2.5 gm / tree + KNO_3 4%
- pbz 5 gm / tree + KNO_3 4%
- pbz 2.5 gm / tree + KNO_3 6%
- pbz 5 gm / tree + KNO_3 6%
- PBZ 2.5 gm / tree + Ethrel 400 ppm
- PBZ 2.5 gm / tree + Ethrel 800 ppm
- PBZ 5 gm / tree + Ethrel 400 ppm
- PBZ 5 gm / tree + Ethrel 800 ppm
- KNO_3 4% + Ethrel 400 ppm
- KNO_3 4% + Ethrel 800 ppm
- KNO_3 6% + Ethrel 400 ppm
- KNO_3 6% + Ethrel 800 ppm

The following attributes were measured on the Off-year.
Average number of flowering shoots per tree counted on April of the Off-year.
Total number of panicles per tree was counted at the end of flowering (in the second week of April).
Average panicle length measured at the end of flowering using 15 panicles from each replicate.
Average number of secondary branches per panicles.
Perfect flowers percentage calculated as follows

Perfect flowers % = No. of perfect flowers / total No. of flowers x 100

Fruit retention percentage calculated as follows

Fruit retention % = number of ultimate fruit set / number of initial fruit set x 100.

Yield (Kg /tree) was estimated by multiplying the number of fruits per tree x average fruit weight at harvest.
Mature fruit firmness (Kg / cm^2) was measured at the top, middle and at the base of the fruits (fruit maturity was assessed according to Khattab *et al.* [4].

Total soluble solids / acid ratio, was calculated by dividing TSS by acid contents of fruit.

C/N ratio: samples from the third, fourth and the fifth leaves from the tip of the previously tagged shoots were taken after treatments in the second week of March (before flowering of the Off-year), then leaf total carbohydrates contents was determined according to Duboise *et al.* [18], also nitrogen was determined by using the modified micro Keldahal methods as described by Pregl [19], then C/ N ratio was calculated according to the following equation:

C / N ratio = carbohydrate % / nitrogen % x 100.

The total sugars in the leaves was determined according to Sadasivam and Manickam [20].

Statistical Analysis: Data were subjected to a normal analysis of variance of the randomized complete block design (RCBD) according to Sendecor and Cochran [21] for each season and over season if the homogeneity test was not significantly different; (LSD) at 0.05 was used to detect significance between treatments.

RESULTS AND DISCUSSION

Average Number of Flowering Shoots per Tree: Results in Table (1) cleared that application of KNO_3 4%+ PBZ 5 gm, KNO_3 6% + Ethrel 800 ppm and PBZ 5 gm + Ethrel 400 ppm increased significantly average number of flowering shoots per tree in the Off-year compared with the other treatments and control trees which recorded the lowest number. On the other hand it is cleared that the other treatments insignificant difference between them. The same results were recorded in the second season.

Total Number of Panicles per Tree: Data in Table (1) clear that KNO_3 6 % + Ethrel 800 ppm and KNO_3 4 % + PBZ 5gm recorded significantly the highest number of panicles/tree compared to the other treatments. The other treatments recorded a higher number of panicles in Off-year than the control. Control trees recorded significantly the lowest number of panicles/tree.

Table 1: Effect binary treatments of KNO_3, PBZ and Ethrel on average number of flowering shoots/tree, total number of panicles/tree and average length of panicle during seasons 2012-2013 and 2013-2014.

	Average number of flowering shoots/tree		Total number of panicles/tree		Average length of panicle	
Treatments	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014
Control	0.2 d	0.18 d	66.6 c	89.3 d	15.3 a	15.2 a
KNO3 4%+pbz 2.5 gm	0.6 c	0.59 c	175.3 b	194.6 bc	12.8 d	12.4 h
KNO3 4%+pbz 5 gm	0.9 a	0.94 a	301.6 a	307.3 a	12.7 d	12.2 h
KNO3 4%+Ethrel 400 ppm	0.7 b	0.66 bc	192.3 b	210.6 bc	12.7 d	13.0 fg
KNO3 4%+Ethrel 800 ppm	0.7 b	0.75 b	193.3 b	222.3 bc	13.6 c	13.1 ef
KNO3 6%+pbz 2.5 gm	0.7 b	0.61 c	178.6 b	186.3 c	13.4 c	13.6 c
KNO3 6%+pbz 5 gm	0.7 b	0.68 bc	181.6 b	196.3 bc	13.7 c	13.4 de
KNO3 6%+Ethrel 400 ppm	0.7 b	0.77 b	177.6 b	199.0 bc	13.5 c	14.0 c
KNO3 6%+Ethrel 800 ppm	0.9 a	0.96 a	302.0 a	314.3 a	14.3 b	14.9 b
Pbz 2.5 gm+Ethrel 400 ppm	0.7 b	0,68 bc	192.6 b	214.3 bc	13.4 c	12.7 g
Pbz 2.5 gm+Ethrel 800 ppm	0.7 b	0.75 b	192.6 b	213.0 bc	13.7 c	13.3 de
Pbz 5 gm+Ethrel 400 ppm	0.9 a	0.94 a	218.1 b	226.4 b	13.4 c	12.8 fg
Pbz 5 gm+Ethrel 800 ppm	0.7 b	0.77 b	216.3 b	236.6 b	12.03 e	10.9 i

* Values shown are average and standard deviation, within each column, Different letters indicate significant differences according to means of multiple Duncan range tests ($P < 0.05$).

Table 2: Effect of KNO3, PBZ and Ethrel on average number of secondary branches per panicle, perfect flowers% and fruit retention% during seasons 2012-2013 and 2013-2014

	Average number of secondary branches/panicle		Perfect flowers %		Fruit retention %	
Treatments	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014
Control	25.4 g	24.7 e	24.8 f	25.3 f	0.8 g	0.7 d
KNO3 4%+pbz 2.5 gm	29.4 cd	28.9 d	28.9 e	29.5 e	2.7 f	3.3 c
KNO3 4%+pbz 5 gm	31.9 b	30.5 b	34.1 a	34.9 a	6.2 a	5.9 a
KNO3 4%+Ethrel 400 ppm	29.4 cd	30.3 bc	29.0 e	29.7 e	2.9 ef	3.6 b
KNO3 4%+Ethrel 800 ppm	28.2 f	28.9 d	30.7 cd	31.4 d	3.7 cd	4.2 b
KNO3 6%+pbz 2.5 gm	28.4 ef	29.0 d	30.3 d	31.1 d	3.6 de	3.6 c
KNO3 6%+pbz 5 gm	29.1 de	29.5 cd	31.4 c	32.1 c	3.8 cd	3.9 c
KNO3 6%+Ethrel 400 ppm	29.9 c	30.4 bc	30.3 d	31.06 d	4.6 b	5.03
KNO3 6%+Ethrel 800 ppm	33.4 a	33.7 a	34.1 a	35.1 a	5.7 a	6.2 a
Pbz 2.5 gm+Ethrel 400 ppm	28.7 def	29.1 d	33.06 b	33.9 b	5.7 a	6.2 a
Pbz 2.5 gm+Ethrel 800 ppm	29.03 de	29.4 d	30.06 d	30.7 d	4.5 bc	4.8 b
Pbz 5 gm+Ethrel 400 ppm	29.2 cd	30.2 bc	30.4 d	31.1 d	4.3 bcd	4.5 b
Pbz 5 gm+Ethrel 800 ppm	29.06 de	29.5 cd	30.2 d	31.03 d	4.7 b	4.6 b

* Values shown are average and standard deviation, within each column, Different letters indicate significant differences according to means of multiple Duncan range tests ($P < 0.05$).

This highest number of panicles recorded by KNO_3 4% + Ethrel 800ppm and KNO_3 4%+PBZ 5gm might be related to the effect of these treatments on the average number of flowering shoots, these treatments increased the average number of flowering shoots in Off-year which increased total number of panicles per tree. The same results were recorded in the second season.

Panicle Length: Table (1) show that control trees recorded the longest panicle in the "Off-year" compared with the other treatments followed by application of KNO_3 6% + Ethrel 800 ppm with significant difference, while the shortest panicle were recorded by the application of PBZ 5gm + Ethrel 800 ppm. These results were noted in the second season. The longest panicle which was recorded by control trees in Off-year might be related to few numbers of panicle which decrease the competition between them.

The shortest panicle length were recorded by PBZ 5 gm + Ethrel 800 ppm treatment followed by PBZ 5 gm + KNO_3 4% might related to the negative effect of PBZ in both treatments.

Average Number of Secondary Branches per Panicle: Results in Table (2) revel that application of KNO_3 6% + Ethrel 800 ppm resulted in the highest significant number of secondary branches per panicle compared to the other treatments followed by KNO_3 4% + PBZ 5 gm. On the other hand control trees recorded significantly the lowest number of secondary branches per panicle. The same

Table 3: Effect of KNO3, PBZ and Ethrel on total number of fruits/tree, tree yield, fruit firmness and fruit T.S.S/Acid ratio during seasons 2012-2013 and 2013-2014

	Total number of fruits /tree		Yield (Kg/tree)		Fruit firmness (Kg/cm²)		T.S.S /Acid ratio	
Treatments	2012-2013	2013 -2014	2012-2013	2013-2014	2012-2013	2013-2014	2012-2013	2013-2014
Control	13.6 d	24.3 e	5.6 d	9.8 d	8.5 a	10.8 a	8.5 a	8.5 a
KNO3 4%+pbz 2.5 gm	62.6 c	67.3 d	23.3 c	25.5 c	7.4 d	7.7 bc	7.4 d	7.5 b
KNO3 4%+pbz 5 gm	84.0 b	86.8 b	30.2 b	30.8 b	8.4 b	8.7 b	7.5 b	7.5 b
KNO3 4%+Ethrel 400 ppm	72.3 bc	86.3 b	26.4 bc	31.6 b	5.7 f	5.9 dc	5.7 f	5.7 d
KNO3 4%+Ethrel 800 ppm	78.6 bc	81.6 bc	28.4 bc	29.4 b	5.7 f	5.7 d	5.7 f	5.7 d
KNO3 6%+pbz 2.5 gm	74.3 bc	70.6 d	26.2 bc	24.9 c	6.6 e	6.9 cd	6.6 e	6.5 c
KNO3 6%+pbz 5 gm	75.0 bc	74.6 cd	25.8 bc	25.8 c	6.6 e	6.8 cd	6.6 e	6.5 c
KNO3 6%+Ethrel 400 ppm	71.6 bc	72.0 d	25.7 bc	26.1 c	6.5 e	6.5 cd	6.5 e	6.5 c
KNO3 6%+Ethrel 800 ppm	108.6 a	119.6 a	42.5 a	47.2 a	8.5 a	10.8 a	8.5 a	8.5 a
Pbz 2.5 gm+Ethrel 400 ppm	83.0 b	84.6 bc	31.2 b	29.6 b	7.4 d	7.7 bc	7.4 d	7.5 b
Pbz 2.5 gm+Ethrel 800 ppm	79.3 bc	85.3 b	28.06 bc	29.8 b	8.4 b	8.7 b	7.5 b	7.5 b
Pbz 5 gm+Ethrel 400 ppm	80.6 b	88.3 b	40.1 a	31.03 b	5.7 f	5.9 dc	5.7 f	5.7 d
Pbz 5 gm+Ethrel 800 ppm	84.0 b	88.3 b	30.2 b	31.0 b	5.7 f	5.7 d	5.7 f	5.7 d

* Values shown are average and standard deviation, within each column, Different letters indicate significant differences according to means of multiple Duncan range tests ($P < 0.05$).

trends of results were recorded in the second season. No relation between panicle length and number of secondary branches of panicle where control trees recorded the longest panicles length and the lowest number of secondary branches per panicle, while application of KNO_3 6% + Ethrel 800 ppm synchronized both criteria. The greatest number of secondary branches per panicle might be reflected on the fruiting characteristics of trees due to increase in the density of flowers per panicle.

Perfect Flowers Percentage: Results in Table (2) show that all applications increased significantly the percentage of perfect flowers of Zebda cultivar in the Off-year compared to control trees. The highest percentage of perfect flowers was achieved by both application of KNO_3 4% + PBZ 2.5 gm and KNO_3 6% + Ethrel 800 ppm without significant difference between them. The results of the second season were in the same line with those recorded in the first season.

Fruit Retention Percentage: Results in Table (2) clear that both KNO_3 4% + PBZ 5gm and KNO_3 6% +Ethrel 800ppm resulted in significantly the highest fruit retention percentage without significant differences, while control trees recorded the lowest fruit retention percentage.

These results were detected in the both seasons of investigation. However it was cleared that the other application were not effective in this respect.

Total Number of Fruits per Tree: As detected from Table (3) control trees recorded the lowest significant number of fruits per tree in the "Off-year" compared with the other treatments. On the other hand the application of KNO_3 6% + Ethrel 800 ppm recorded the highest total number with significant difference, while the other treatments did not recorded a significant difference. The highest total number of fruits per tree in the "Off-year" was recorded with the same previously mentioned treatment in the first season.

Tree Yield (Kg/tree): Application of KNO_3 6% + Ethrel 800 ppm induced the highest tree yield in Off-year with significant difference compared to the other treatments (Table 3). Contrarily the control trees recorded the lowest tree yield. The other treatments achieved tree yield more than control trees this was recorded in both seasons.

Fruit Firmness (Kg/cm²): Control trees recorded the highest fruit firmness with significant difference compared to the other treatments Table (3), while both of KNO_3 4% + Ethrel 400 ppm and KNO_3 4% + Ethrel 400 ppm recorded the lowest fruit firmness with significant difference. Second season results show that control trees recorded the highest fruit firmness with significant difference compared to the other treatments, while the other treatments were of an insignificant difference between them. The high fruit firmness with control trees may be due to the low number of fruits per tree.

Fruit T.S.S./Acid ratio: Data presented in Table (3) prove that control trees recorded the highest significant fruit T.S.S/Acid ratio. On the other hand both of applications by KNO_3 4% + Ethrel 400% and KNO_3 4% + Ethrel 800% recorded the lowest fruit T.S.S/Acid ratio. The same trends of results were noted in the second season. It is

Table 4: Effect of KNO3, PBZ and Ethrel on total sugars percentage and C/N ratio during seasons 2012-2013 and 2013-2014

	Total sugars %		C/N ratio	
Treatments	2012-2013	2013-2014	2012-2013	2013-2014
Control	13.1 h	12.5 h	8.5 f	9.2 g
KNO3 4%+pbz 2.5 gm	15.1 g	14.6 g	13.4 bc	12.5 f
KNO3 4%+pbz 5 gm	18.3 c	17.6 b	13.5 b	14.8 b
KNO3 4%+Ethrel 400 ppm	15.2 g	15.0 f	13.2 cd	12.6 fe
KNO3 4%+Ethrel 800 ppm	17.0 e	16.6 d	12.7 e	12.3 f
KNO3 6%+pbz 2.5 gm	17.5 d	17.2 c	12.9 de	13.2 d
KNO3 6%+pbz 5 gm	18.1 c	17.7 b	12.9 de	13.4 d
KNO3 6%+Ethrel 400 ppm	17.5 d	17.1 c	13.7 b	14.0 c
KNO3 6%+Ethrel 800 ppm	19.4 a	19.03a	15.6 a	15.8 a
Pbz 2.5 gm+Ethrel 400 ppm	19.1 a b	18.9 a	13.3 b	14.7 b
Pbz 2.5 gm+Ethrel 800 ppm	15.8 f	15.4 e	12.6 e	13.06 de
Pbz 5 gm+Ethrel 400 ppm	15.8 f	15.3 e	12.7e	13.1 d
Pbz 5 gm+Ethrel 800 ppm	17.7 d	17.1 c	13.0 de	13.1 d

* Values shown are average and standard deviation, within each column, Different letters indicate significant differences according to means of multiple Duncan range tests ($P < 0.05$).

cleared from both of fruit firmness and fruit T.S.S/Acid ratio (fruit quality) that, it increased with non treated trees and it might be related to the low number of control fruit trees.

C/N Ratio: Data presented in Table (4) clear that application of KNO_3 6% + Ethrel 800 ppm recorded the highest significant C/N ratio compared to other treatments, while control trees recorded the lowest ratio. The same results were noted in the second season. Thus the highest C/N ratio content reserve in the beginning of "Off-year" might have led to increasing the ability of buds to produce panicles more than produce vegetative shoots, moreover application of Ethrel increased C/N ratio reserve in the plant as well as KNO_3 affect. Component of KNO_3 and Ethrel increased C/N ratio. The increasing in C/N ratio in mango trees before flowering of Off-year increased total number of panicles and improved fruit retention which resulted in increased fruit yield in Off-year.

Total Sugars Percentage: As shown in Table (4) control trees achieved the lowest total sugars content with significant difference. On the other hand application of KNO_3 6% + Ethrel 800 ppm and PBZ 2.5 gm + Ethrel 400 ppm recorded the highest total sugars content Off-year without significant difference between them. On the other hand the other treatments achieved total sugar content in Off-year that was more than control trees but less than both applications of KNO_3 6% + Ethrel 800 ppm and PBZ 2.5 gm + Ethrel 400 ppm with significant difference. It is clear that the high content of total sugars in Off-year before flowering period reflected on the increase in flowering and fruiting attributes in Off-year such as number of flowering shoots, perfect flowers percentage and fruit retention percentage which led to an increase in tree fruit yield.

From the previous results it confirmed that finding of Burondkar *et al.* [22] who reported that PBZ application with pruning increased average number of flowering shoots per tree. Also Khattab *et al.* [4] found that Ethrel at 500 and 1000 ppm increased significantly total number of flowering shoots in the Off-year of Ewais and Sedik mango cultivars. Moreover Deepedra and Sarvesh [5] recorded that application of KNO_3 increased this criteria. All the former applications were using KNO_3, PBZ and Ethrel alone and all these applications increased this criteria, but application s of the combinations of those were considered promising applications which increased total number of flowering shoots significantly by application of KNO_3 4%+PBZ 5gm and KNO_3 6% + Ethrel 800 ppm in the Off-year. According to increasing in total number of flowering shoots by using the former applications it led to enhance the total number of panicles per tree in the Off-year because of it increased the flowering units in the tree. These results were confirmed by those recorded by Babul and Rahim [2] and Navprem *et al.* [1] who found that single application of KNO_3 increased the total number of panicles per tree in Dusehri mango cultivar. Also Galila and El-Masry [12] reported that single application of Ethrel on Ewais mango cultivar increased total number of panicles per tree. While the combination between KNO_3, PBZ and Ethrel decreased significantly the panicles length comparing to control trees. This decreasing in length might related to the high density of panicles per tree which means high competition

between panicles, while control trees did not suffering from the competition which led to increase panicles length. These results were not in agreement with those recorded by Yeshitela *et al.* [17] who reported that KNO_3 application increased significantly panicles length, moreover this decreasing in panicles length might relate to the combination between KNO_3 and Ethrel. Application of KNO_3 6% + Ethrel 800 ppm increased significantly average number of secondary branches per panicle comparing to the other combinations and control trees. The increasing in this criterion might relate to the effect of this combination on increasing number of panicles which gave a chunky form for these panicles. However Babul and Rahim [2] found that application of KNO_3 increased significantly the total number of secondary branches per panicle but does not decrease the panicle length. The combinations between KNO_3, PBZ and Ethrel increased significantly perfect flowers percentage. A single application of PBZ and KNO_3 increased sex ratio as recorded by Abou-Rawash *et al.* [14] and Khattab *et al.* [10] who reported that PBZ at 7.5 gm/tree increased this regard, also Khattab *et al.* [4] found that single application of Ethrel at 1000 ppm increased this criteria, so using the combination between KNO_3, PBZ and Ethrel might be very promising in this regard. According to increasing in perfect flowers percentage by using KNO3 4% + PBZ 5gm and KNO_3 6% + Ethrel 800ppm it led to increase fruit retention percentage. The previous results confirmed by Tandel and Patel [7] who reported that PBZ increased fruit retention, also Khattab *et al.* [4] reported that Ethrel at 1000 ppm in Ewais and Sedik mango cultivars increased this criteria, so Combination between PBZ and Ethrel as application and KNO_3 and Ethrel might be more effective in this regard. According to high percentage of perfect flowers and flowering shoots which attained by the applications KNO_3 4% + PBZ 5gm and KNO_3 6% + Ethrel 800 ppm, it is cleared that this criteria increased fruit retention percentage positively so applications might increase fruit retention percentage which affects the other fruiting attributes. The combinations of KNO_3, PBZ and Ethrel increased number of fruits per tree these results are not agreed with those found by Tandel and Patel [7] who reported that application of PBZ alone recorded the highest total number of fruits per tree at harvest compared to KNO_3 and Ethrel alone. However it seemed that the high number of flowering shoots, total number of panicles per tree and perfect flowers percentage resulted by KNO_3 6% + Ethrel 800 ppm effect in this criteria thus it increased the total number of fruits per tree. According to the previous results the combination between KNO_3 at 6% and Ethrel at 800 ppm increased number of fruits per tree which led to increase tree fruit yield. These results are in harmony with those recorded by Abou-Rawash *et al.* [14] and Khattab *et al.* [4]. However tree fruit yield was affected by total number of fruits per tree, perfect flowers percentage and total number of flowering shoots per tree thus application of KNO_3 6% + Ethrel 800 ppm recorded the highest value which reflected on tree fruit yield. Thus the highest C/N ratio content reserve in the beginning of "Off-year" might be increasing the ability of duds to produce panicles more than produce vegetative shoots, moreover application of Ethrel increased C/N ratio reserve in the plant as well as KNO_3 affect. Component of KNO_3 and Ethrel increased C/N ratio. The increasing in C/N ratio reserve in mango trees before flowering of Off-year increased total number of panicles and improved fruit retention which resulted in increased fruit yield in Off-year. It is cleared that the high content of leaves total sugars in the Off-year before flowering period reflected to the increase in flowering and fruiting attributes in Off-year such as number of flowering shoots, perfect flowers percentage and fruit retention percentage which lead to increase tree fruit yield. The high fruit firmness with control trees may be due to the low number of fruits per tree. These results are in agreed with Martinez *et al.* [23].

CONCLUSION

It could be concluded from the obtained results that application of KNO_3 6% + Ethrel 800 ppm at the first half of November is considered a promising application for increase flowering and fruiting attributes of Zebda cultivar in the "Off-year", thus this application increased C/N ratio and total sugars resaved in leaves in Off-year season before flowering time which led to better flowering and fruiting attributes of Zebda in Off-year season.

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