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EFFECT OF STIMULANT COMPOUND ON "HAYDI AND NAOMI" MANGO CULTIVARS' GROWTH AND FRUITING

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ABSTRACT

This study examined the effects of foliar spraying a stimulant on 'Haydi and Naomi' mango trees in a private orchard in Egypt during the 2021/22 growing season. Applying the stimulant at 0, 0.4, 0.6, and 0.8 ml/L at full bloom and 30 days later had a substantial impact on fruiting, growth, and leaf mineral contents. Particularly at the 0.8 ml/L concentration, the results showed enhanced leaf area, mineral content, early and final fruit set, fruit retention, and total yield.

The research provides information for better mango farming techniques by indicating the stimulant's ability to increase vegetative and reproductive features.

Key words: Mango - Bio Stimulant - Growth - yield - Fruit Set - Fruit retention

INTRODUCTION

Mango (*Mangifera indica* L.) is a highly favoured fruit crop in Egypt, with a total cultivation area of 265,509 feds and a production yield of 1,091,535 tonnes of fruits in 2020 (M.A.L.R, 2020). A significant number of commercially grown mango cultivars experience a substantial amount of fruit drop, resulting in a loss of over 99% of the fruit. To address this issue, it is necessary to enhance the vegetative development and fruiting of such trees by employing growth regulators. Thus, it is expected that the stimulant ingredient might enhance the quality of the fruit.

Applying several growth regulators to mango trees at full bloom enhanced vegetative growth, fruit quality, and fruit yield. The following studies have been conducted: Ghulam *et al.* (1999), Wahdan and Melouk (2004), Wahdan *et al.* (2011), Nkansah *et al.* (2012), Osama *et al.* (2015), Dheeraj *et al.* (2016), Vijay Krishna *et al*. (2016), Parauha and Pandey (2019), and Attia and Shehata (2023).

Auxins, cytokines, and gibberellins are important players in the development of fruit. Fruit yield might decline in the absence of any growth

regulator. It is hypothesised that by topically applying these plant growth regulators to the mango panicles or immature fruits, metabolites would be stimulated to travel to the affected locations.

Further investigation is needed on this matter.Examining the effects of a commercially available growth biostimulant on the vegetative growth, fruit set, and yield of the mango cultivars "Haydi and Naomi" was the main goal of this research.

MATERIALS AND METHODS

This research examined 'Haydi and Naomi' mango trees (*Mangifera indica* L.) at a private orchard in El Salhia, Sharkia Governorate, Egypt, during two seasons (2021/22). The orchard has drip irrigation and sandy soil. Planting five-year-old trees at a 2x5-meter spacing followed typical agricultural techniques. To test foliar spraying with a stimulant, 24 healthy, similar-sized trees were selected. The stimulant contains amino acid (4.9%), boron (1%), magnesium (2%), zinc (1.5%), cytokinine, auxin, and vitamins (2%). The study examined how this treatment affected vegetative development, fruit set, and yield.

The experiment included four 3-liter spray applications of stimulants per tree, once at full bloom and once one month later. The control group was unsprayed. Stimulant concentrations were 0.4, 0.6, and 0.8 ml/L.

The experiment used a randomized full block design with three duplicates per treatment. Each replication has one tree and two cultivars, "Haydi and Naomi." The study used 24 trees (2 cultivars * 4 treatments * 3 repetitions).

Mature leaves from unfruitful branches were randomly chosen at harvest date and measured for leaf area (cm2) to evaluate the Stimulant using Electronic Digital Planimeter (HAFF com., Germany). The samples of twenty leaves per tree were picked from the 3rd and 4th nod below panicle.

Following Chapman and Pratt's (1961) methodology, the samples underwent the following processes: sulphoric acid and hydrogen peroxide digestion, grinding, and dehydration at 70 degrees Celsius until their weight remained constant. The analysis revealed the presence of N, P, K, and Ca in the digested solution.

The initial fruit set was calculated as the number of setting fruits per panicle 15 days after petals falls. The quantity of panicle-retained fruits at harvest determined the final fruit set. The percentage of retained fruits at harvest time was calculated at final fruit set / Initial fruit set x 100; To determine the yield in kilograms, multiply the average fruit weight by the number of fruits on each tree.

Statistics were applied to the acquired data in accordance with Snedecor and Cochran's (1989) methodology. MSTAT-C version 7 (1990) was utilized to conduct analysis of variance and mean comparison (LSD, at 5%).

RESULTS AND DISCUSSION

Growth characteristics (Leaf area):

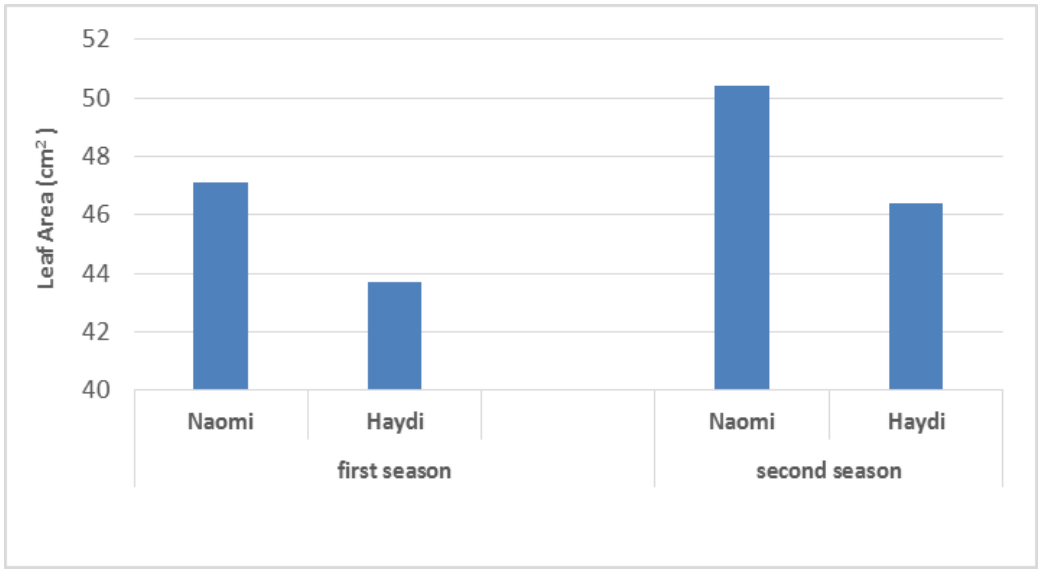
Data in Figure (1) revealed that the average leaf area cm^2 of Naomi cv. Significantly affected and was largest compared to Haydi cv. in both seasons.

The tested treatments showed significant effects on average leaf area. Trees sprayed with Stimulant 0.8 ml/L showed the highest average leaf area (49.25 & 51.87cm^2) in the first and second seasons, respectively. While, the lowest average leaf area (41.76 & 43.35 cm^2) in the first and second seasons recorded for trees sprayed with control treatment.

The interaction between Naomi cv. × treatment of Stimulant 0.8 ml/L had superior values of average leaf area, compared with Haydi cv. × control treatment in both seasons.

It should be pointed out that synthetic auxins have a role to stimulate the multiplication and lengthening the meristem cells, resulting increasing vegetative growth. The results was in agreement with of mango Notodimedjo (2000), Khamis *et al.* (2001), Wahdan (2011), Moawad *et al.* (2015), El-Sharony *et al.* (2015) and Ahmed Salem *et al.* (2017).

A



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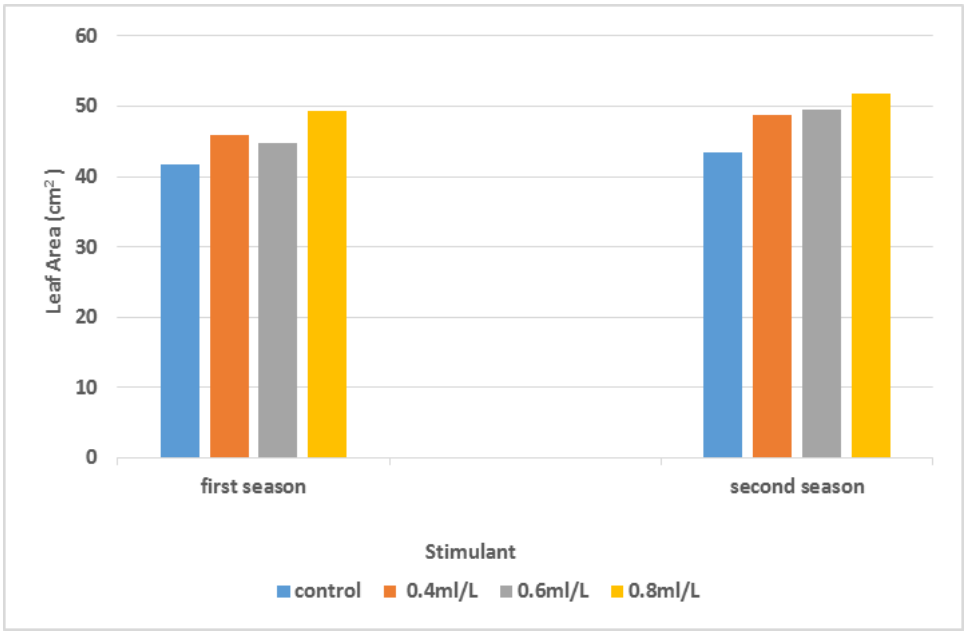

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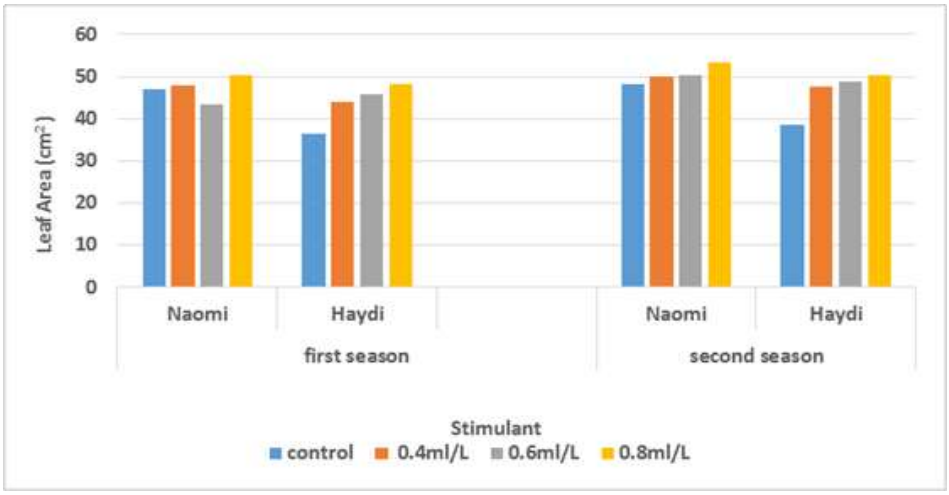


Figure (1): Effect of cultivars (A), Bio Stimulant treatments (B) and interaction between them (C) on average leaf area of Naomi and Haydi mango cvs in 2021 and 2022 seasons.

Leaf mineral contents:

Data presented in Tables 2 & 3 indicated that, Naomi cv. trees showed significant highest values of nitrogen, phosphorus and calcium content of

leaves compared with Haydi cv. Nevertheless, content of potassium in leaf Haydi cv. was affected and highest compared Naomi cv. trees in both seasons.

The highest values of leaf nitrogen percentage (1.6 & 1.43 %) recorded for trees with control treatment in the first and second seasons, respectively. However, treatment of Stimulant decreased of values of leaf nitrogen percentage of leave.

The interaction between cultivars × treatments recorded significantly the highest values of leaf nitrogen percentage from Naomi cv. × control treatment. However, the lowest values came from Haydi cv. × treatment of Stimulant 0.6 ml/L during both seasons. Treatment of Stimulant at 0.6 ml/L showed the highest average values of phosphorus content (0.379 & 0.387 %). While the lowest values of phosphorus content were record with control treatment.

The highest values of leaf phosphorus percentage were obtained from in Naomi cv. × stimulant 0.6 ml/L treatment. and the lowest values came from Haydi cv. × control treatment in the two seasons.

The highest values of potassium content were record with of Stimulant at 0.8 ml/L (0.61 & 0.59 %) in the two seasons, respectively. While, the lowest values of potassium content were record with control treatment.

The values of leaf potassium percentage were significantly and the highest in Haydi cv. × treatment of stimulant 0.8 ml/L, the lowest values came from Haydi cv. × control treatment in the two seasons.

The highest values of calcium content were record with of Stimulant at 0.8 ml/L (1.46 &1.44 %) in the two seasons, respectively. While, the lowest values of calcium content were record with control treatment.

The values of leaf calcium percentage were significantly and the highest in Naomi cv. × stimulant 0.6 ml/L. While, the lowest values came from Haydi cv. × control treatment in the two seasons.

Treatment of stimulant decreased values of leaf nitrogen percentage of leave perhaps due to increase of leaf area, fruit weight and yield.

The results were contradicted on mangoes cultivars with Rath and Rajput (1990), Merwad *et al.* (2016) and El- Gioushy (2016).

Table (2): Effect of Bio Stimulant treatments on nitrogen and phosphorus percentages of Naomi and Haydi mango cvs in 2021 and 2022 seasons

Treatments	Nitrogen %			Phosphorus %		
	Cultivars		Treat. av.	Cultivars		Treat. av.
	Naomi	Haydi		Naomi	Haydi	
First season (2016)						
Control	1.64	1.56	**1.6a**	0.37	0.365	**0.367ab**
Stimulant 0.4ml/L	1.63	1.42	**1.52b**	0.38	0.32	**0.350b**
Stimulant 0.6ml/L	1.48	1.37	**1.42d**	0.38	0.36	**0.379a**
Stimulant 0.8ml/L	1.43	1.56	**1.49c**	0.375	0.36	**0.367ab**
Cultivar av.	**1.54A**	**1.47B**		**0.376A**	**0. 351B**	
LSD at 0.05 (interaction)	**0.027**			**0.033**		
Second season (2017)						
Control	1.47	1.4	**1.43a**	0.37	0.355	**0.362c**
Stimulant 0.4ml/L	1.45	1.31	**1.38b**	0.379	0.371	**0.378b**
Stimulant 0.6ml/L	1.38	1.26	**1.32c**	0.41	0.365	**0.387a**
Stimulant 0.8ml/L	1.4	1.34	**1.37b**	0.396	0.375	**0.385ab**
Cultivar av.	**1.42A**	**1.32B**		**0.388A**	**.366B**	
LSD at 0.05 (interaction)	**0.056**			**0.019**		

Means having the same letter (s) within the same column and row are not significantly different according to Duncan, s multiple range test at 5% level of probability.

Table (3): Effect of Bio Stimulant treatments on potassium and calcium percentages of Naomi and Haydi mango cvs in 2021 and 2022 seasons

Treatments	Potassium %			Calcium %		
	Cultivars		Treat. av.	Cultivars		Treat. av.
	Naomi	Haydi		Naomi	Haydi	
First season (2016)						
Control	0.53	0.52	**0.52d**	1.27	1.23	**1.25d**
Stimulant 0.4ml/L	0.55	0.58	**0.56c**	1.39	1.28	**1.33c**
Stimulant 0.6ml/L	0.56	0.62	**0.59b**	1.56	1.31	**1.43b**
Stimulant 0.8ml/L	0.56	0.67	**0.61a**	1.54	1.39	**1.46a**
Cultivar av.	**0.55B**	**0.59A**		**1.44A**	**1.30B**	
LSD at 0.05 (interaction)	**0.006**			**0.021**		
Second season (2017)						
Control	0.54	0.52	**0.53d**	1.29	1.23	**1.26d**
Stimulant 0.4ml/L	0.55	0.56	**0.55c**	1.3	1.27	**1.28c**
Stimulant 0.6ml/L	0.57	0.60	**0.585b**	1.55	1.29	**1.42b**
Stimulant 0.8ml/L	0.56	0.62	**0.59a**	1.5	1.39	**1.44a**
Cultivar av.	**0.56A**	**0.57A**		**1.41A**	**1.29B**	
LSD at 0.05 (interaction)	**0.013**			**. 0.022**		

Means having the same letter (s) within the same column and row are not significantly different according to Duncan, s multiple range test at 5% level of probability.

Fruit set, retention and yield:

Initial, final fruit set and fruit retention:

Results in Figures (2 and 3) showed the effect of spraying of Bio-Stimulant treatments on initial (fruits per panicle 15 days after petals falls), final fruit set (fruits per panicle at harvest) and fruit retention (final fruit set / Initial fruit set x 100) of Naomi and Haydi mango trees in the two growing seasons (2021 and 2022 seasons).

Naomi cv was superior to Haydi cv. of initial fruit set in the first season (5.64 and 2.76 fruits / panicle) while, Naomi cv was increased to Haydi cv. In the second season (5.23 and 6.17 fruits / panicle).

Final fruit set recorded highest values with Haydi cv. (1.21 and 1.45 fruits / panicle) compared to with Naomi cv. (1.04 and 1.10 fruits / panicle) under different spraying treatments effect in the two growing seasons.

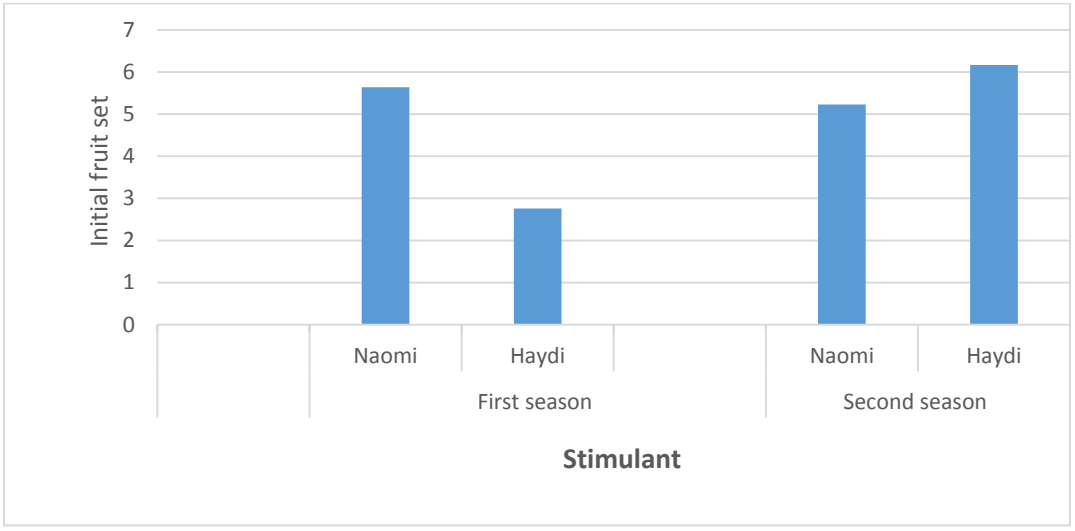
In general, each of spraying treatments superior to control treatment in the initial and final fruit set. Treatment of 0.8 ml/L of Bio-Stimulant recorded highest values (5.96 & 7.69 and 1.66 & 1.75 fruits / panicle Naomi and Haydi, respectively) in the two growing seasons.

The highest values in initial fruit set obtained of Bio-Stimulant at 0.8 ml/L treatment with Naomi cv (8.43 and 8.03 fruits / panicle) under the two growing seasons. However, final fruit set obtained bio Stimulant at 0.8 ml/L treatment (1.90 fruits / panicle) in the first season and 0.6 & 0.8 ml/L treatments (2.03 and 2.00 fruits / panicle) in the second season with Haydi cv.

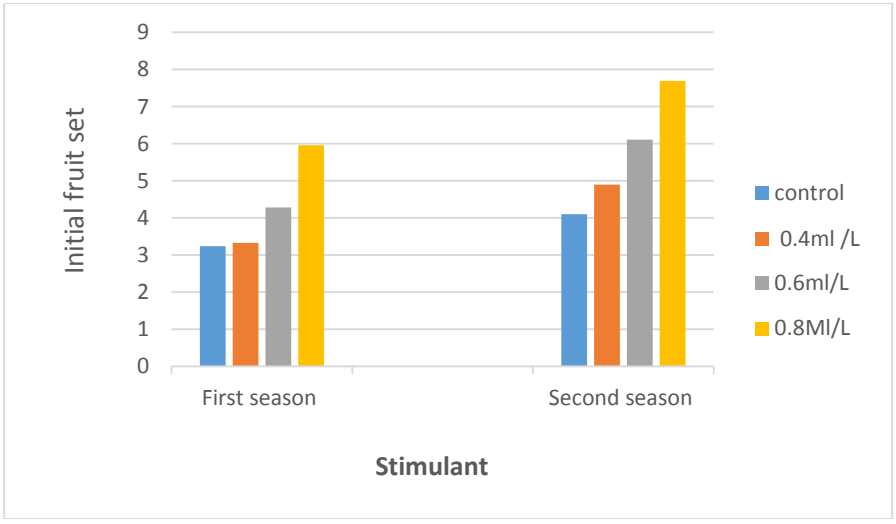
Fruit retention percentage recorded the highest values with Haydi cv (42.77 and 25.53 %) compared to (18.84 and 21.89 %) with Naomi cv in the two growing seasons.

The highest values of fruit retention percentage was record with of Stimulant at 0.8 ml/L treatment (35.62 %) in the first season. While, the lowest values was record with control treatment. Nevertheless, in the second season the highest values of fruit retention percentage was obtain with of Stimulant at 0.6 ml/L and control treatments without insignificant between them (25.66 and 25.73 %).

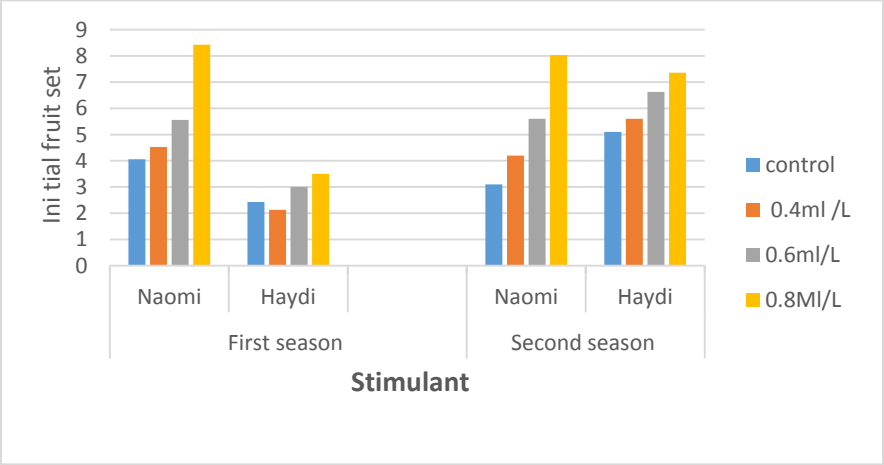
The highest values in retention fruit obtained of Haydi cv with bio Stimulant at 0.8 ml/L treatment (54.028 %) in the first season and with bio Stimulant at 0.6 ml/L treatment (30.61 %) in the second season. While, the lowest values came from Naomi cv. × bio Stimulant at 0.8 ml/L treatment (16.96 and 18.67 %) in the two seasons.


Initial fruit set
7
6
5
4
3
2
1
0
Naomi
Haydi
Naomi
Haydi
First season
Second season
Stimulant

A


Initial fruit set
9
8
7
6
5
4
3
2
1
0
First season
Second season
Stimulant
control
0.4ml /L
0.6ml/L
0.8Ml/L

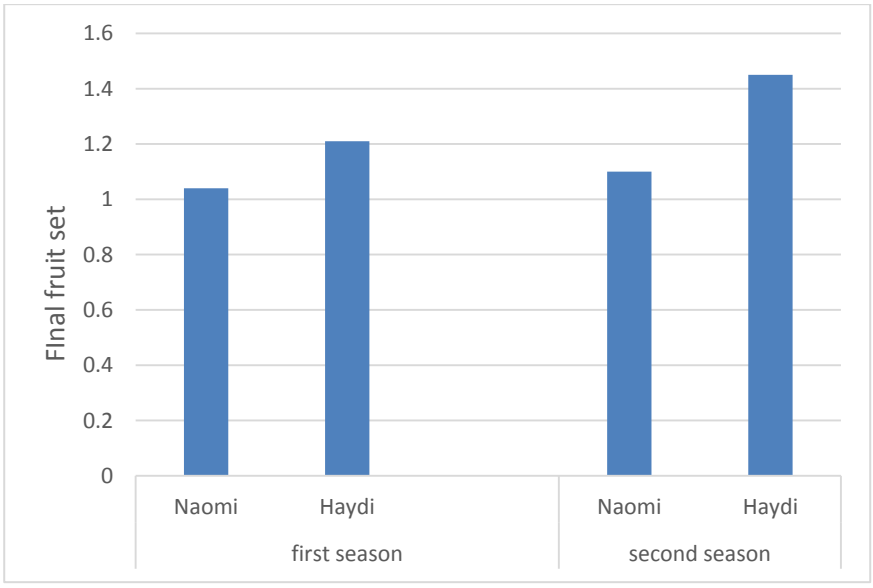
B

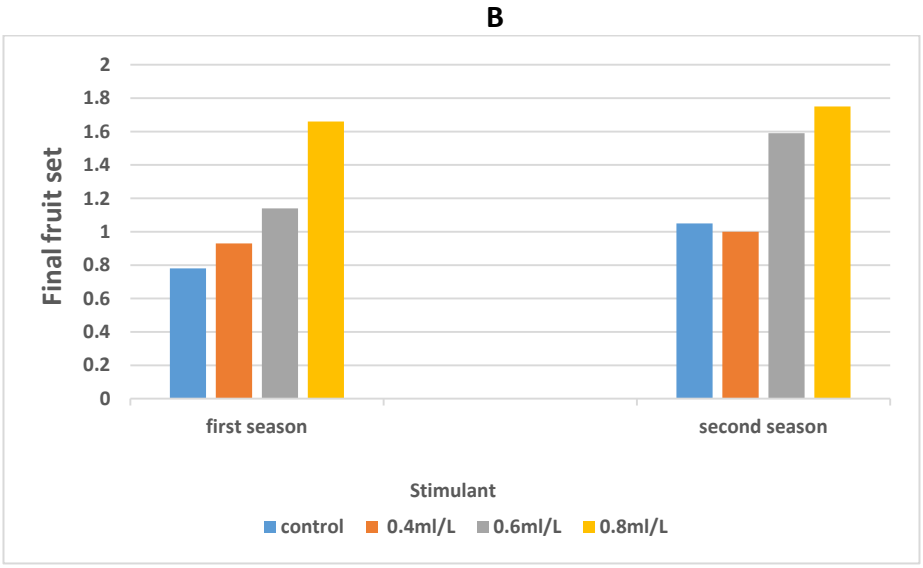


C

Figure. (2): Effect of cultivars (A), Bio Stimulant treatments (B) and their interaction between them (C) on Initial fruit set per panicle 15 days after petals falls of Naomi and Haydi mango cvs in 2021 and 2022 seasons

A





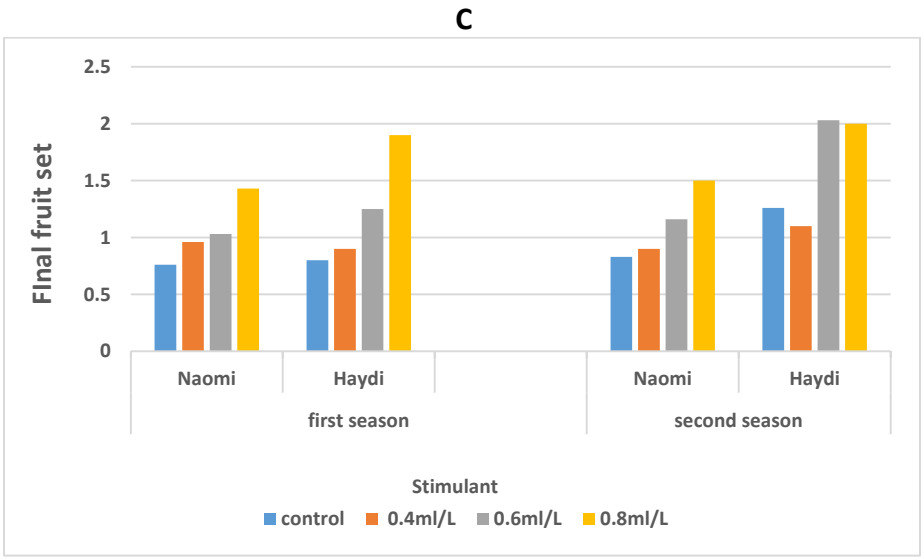
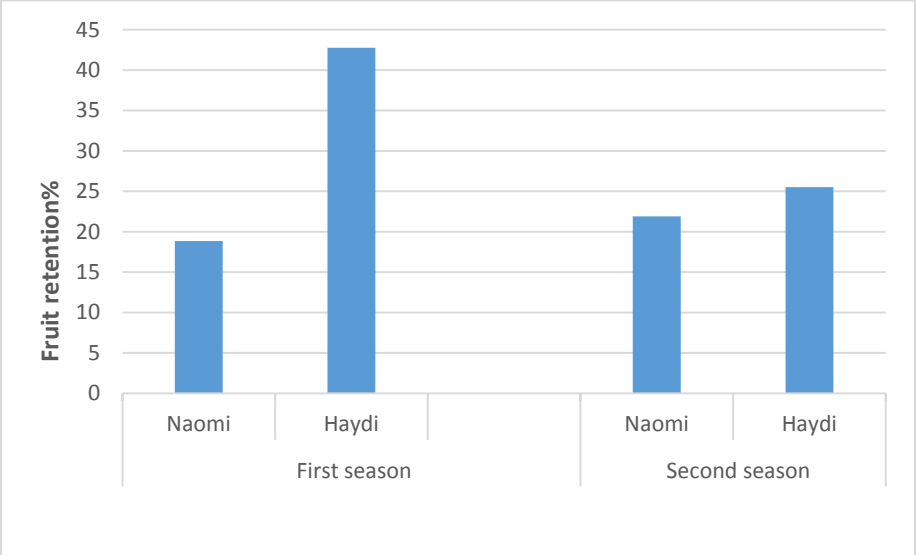
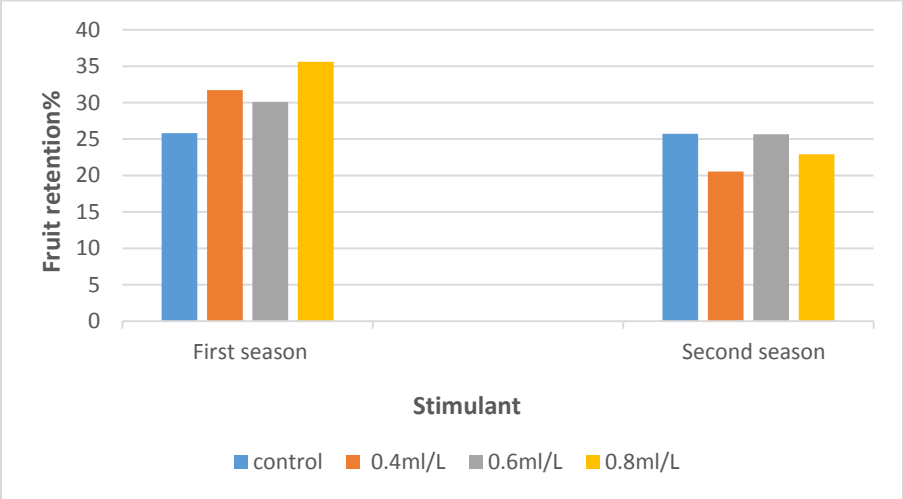


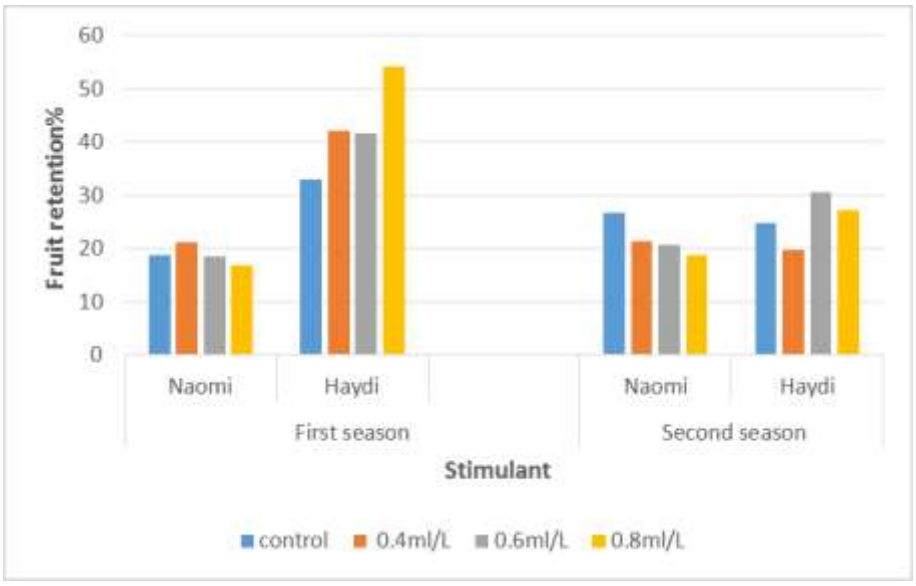
Figure (3): Effect of cultivars (A), Bio Stimulant treatments (B) and their interaction between them (C) on Final fruit set per panicle at harvest of Naomi and Haydi mango cvs in 2021 and 2022 seasons


45
40
35
30
25
20
15
10
5
0
Fruit retention%
Naomi
Haydi
Naomi
Haydi
First season
Second season

A


40
35
30
25
20
15
10
5
0
Fruit retention%
First season
Second season
Stimulant
control
0.4ml/L
0.6ml/L
0.8ml/L

B



C

Figure (4): Effect of cultivars (A), Bio Stimulant treatments (B) and their interaction between them (C) on fruit-retention (final fruit set / Initial fruit set x 100) of Naomi and Haydi mango cvs in 2021 and 2022 seasons

Yield / feddan (tons):

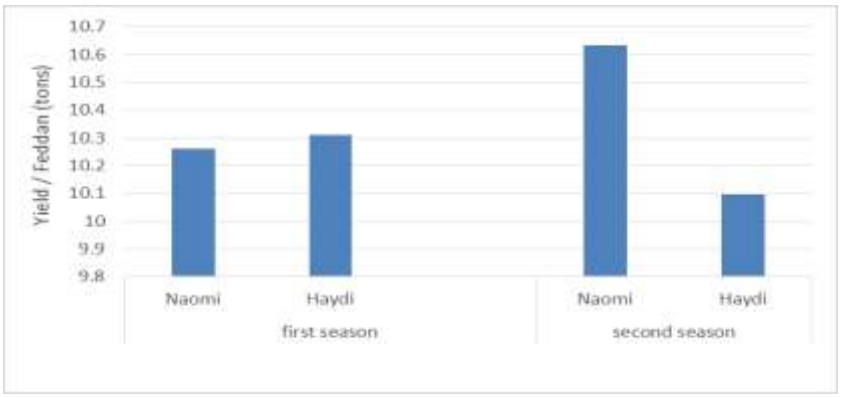
Data in Figure (5) revealed that the average yield / feddan (tons) of Naomi cv. significantly affected and was largest compared to Haydi cv. in second season.

Concerning the effect of stimulant treatments on yield, data in figure (5) illustrated that in both seasons it gave a significantly increased in yield / feddan (tons) especially with 0.6 or 0.8 ml/L of stimulant treatments.

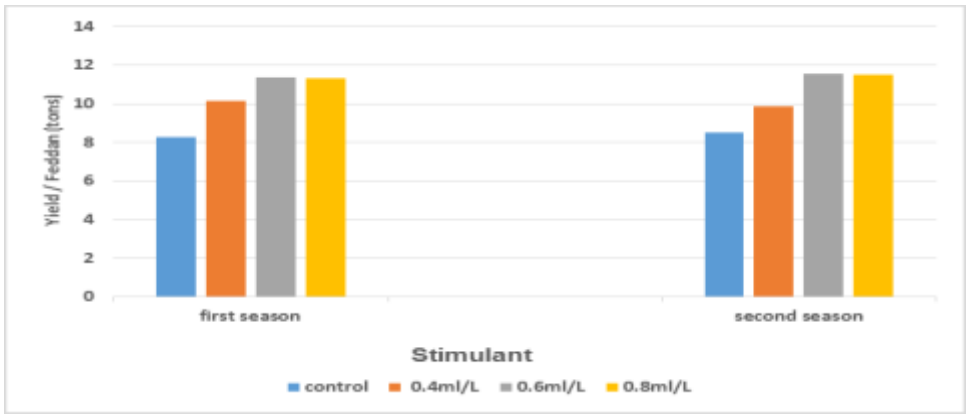
Combining Haydi with either 0.6 or 0.8 ml/L of stimulant treatments led to the best yields and feddan in both seasons.

The results correspond with the findings on mango trees by El Gammal et al. (2015), Wahdan and Melouk (2004), Vijay Krishna et al. (2016), Dheeraj et al. (2016), Parauha and Pandey (2019), and Attia and Shehata (2023).

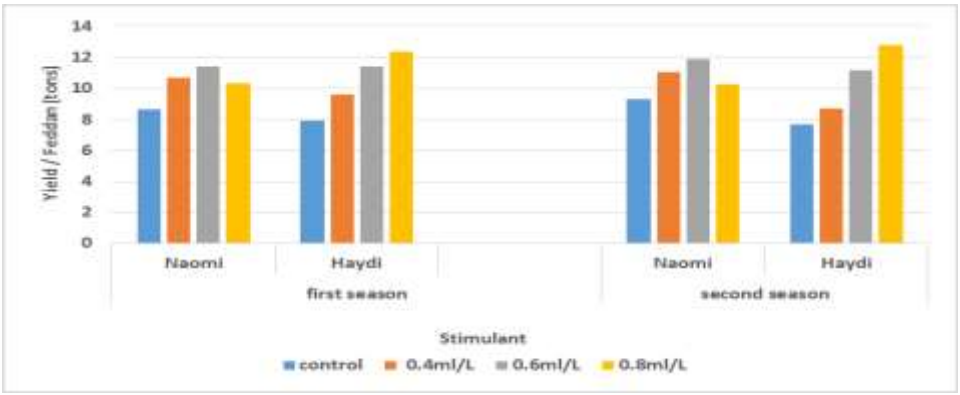
Application of auxins countered the negative effects of growth inhibitors such as ethylene or abscisic acid, reducing fruit loss and increasing fruit retention in mango. In order to balance the metabolic activities of sources and sinks in the plant, Ram (1992) proposed that a tiny amount of exogenous hormones sprayed on the plant would activate and boost the effectiveness of endogenous hormones, resulting in decreasing fruit drop. According to Wahdan and Melouk (2004), there is a possibility that the higher auxin concentration of mango fruit contributed to the decrease in fruit drop % when applying synthetic auxin (amcotone). shown



A



B



C

Figure (5): Effect of cultivars (A), Bio Stimulant treatments (B) and their interaction between them (C) on yield / feddan of Naomi and Haydi mango cvs in 2021 and 2022 seasons

that gibberellins, auxins, and cytokinins are all involved in the formation of the mango fruit. A decrease in fruit set might result from the absence of any growth regulator.

The hypothesis was that the external application of these plant growth regulators to the mango panicles or early fruits would result in the mobilisation of metabolites at the application locations.

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تأثير مركب منشط للنمو على نمو وأثمار المانجو صنفى الهايدى والنعومى

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أجريت هذة التجربة موسمى ٢٠٢١/ ٢٠٢٢ ميلادى على أشجار مانجو صنفى هايدى ونعومى . تنمو فى مزرعة خاصة -منطقة الصالحية - الشرقية لتقيم الرش الورقى بمركب المنشط الحيوى الأستميولانت بتركيز صفر ، ٠.٤ – ٠.٦ – ٠.٨ مللى /لتر فى مرحلة التفتح الكامل للأزهار ثم بعد شهر من الرشة الأولى، على نمو وأثمار الأشجار.

عموماً أدت كل تركيزات الأستميولانت إلى زيادة كل من عقد الثمار الأولى والنهائى ونسبة بقاء الثمار على الأشجار خصوصاً تركيز ٠.٨ مللى /لتر. كذلك صفات النمو التى تم تقديرها.

التوصية: بناء عليه ، أستخدام الأستميولانت رشاً على أشجار المانجو بتركيز ٠.٨ مللى /لتر يحسن من العقد المبدئى والنهائى للثمار ونسبة بقاء الثمار على الأشجار وبالتالى زيادة المحصول.