

## Influence of Strands Thinning and Brassinolide Spray on Yield and Economic Return of Sewi Date Palm Cultivar

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### Abstract

The influence of strands thinning and spraying brassinolide on yield index, fruit physical and chemical properties as well as the economic return of "Sewi" date palm fruits were investigated during three successive seasons. Spray brassinolide (5 and 10 % concentrations) and strand thinning rate (15 and 30 % strands number/bunch) each alone or combined with them as compared with control (untreated). Treatments were done at 30 days after hand pollination. Results showed that the superior treatment was strand thinning 15% combined with spraying 10 % brassinolide as significantly increased yield index (bunch weight and yield/palm) and maintained fruit quality (fruit weight, length and diameter, flesh weight and soluble solids content%, total sugars, reducing and non-reducing sugars compared with control. Also, Palms were strand thinning 15% combined with spraying 10 % brassinolide recorded high-priced economic return (133082 L.E./fed./year) compared with palms untreated (control) as enrolled the lowest income (77968.8 L.E./fed./year). The study suggests that strand thinning of 15% combined with spraying 10 % brassinolide treatment could be a promising candidate as long as fruit quality is maintained and a high yield of Sewi date palm.

**Keywords:** Sewi date palm, strands thinning, brassinolide, fruit quality, yield, economic return

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### Introduction

Sewi is the most economically important semi-dry date palm cultivar across Egypt which is consumed at tamer ripening stage. This cultivar is anticipated to contribute significantly to the nation's economic growth by generating a sizable amount of foreign currency (Dawoud and Fatima, 2021). The date industry is currently having a lot of trouble producing high-quality date palm fruits for the lucrative global market. Date fruit thinning due to reduced competition for water and food absorption, palm is a crucial cultural strategy to improve fruit quality, limit biannual bearing, and keep a physiological balance between vegetative and reproductive sections (Slatnar *et al.*, 2020) (Omar *et al.*, 2014 and El-Sharabasy and Ghazzawy, 2019). Several methods were used to thin date palm trees, i.e. bunch thinning,

bunch strands thinning and individual fruit removal. Thinning by removing 10-30% of bunches number significantly increased the bunch weight, accelerated ripening and gave the best fruit quality compared to non-thinned (Mostafa and El-Akkad, 2011, Samouni *et al.*, 2016). In addition, (Radwan, 2017 and EL- Badawy *et al.* , 2018) found that thinning of Sewi and Bent Aisha date palm by removing 20 and 30% strands /bunch significantly increase of bunch weight and fruit weight, size, flesh weight, soluble solids content and sugar contents. Strands thinning of Sewi date palm by 8 bunches /palm + removing 30% strands /bunch significantly improved fruit quality. Brassinolides are major aspects of plant vegetative and reproductive growth are governed by key plant hormones. The application of BRs has a significant impact on the physiological processes of plants and biomass production, which modulates some horticultural features like flowering, fruit set, fruit growth, and yield, etc. (Sharma, 2021). Several studies refer to spraying some fruits with growth regulators at different concentrations to encourage cell division, increase cell size and consequently increase fruit quality and yield. Brassinolide are group of plant hormones that have various effects on plant growth and development. The impact of exogenous brassinolide applications has been studied in many fruits and vegetables like papaya (Manju and Kumar 2015) and avocado (Eid *et al.*, 2016). Therefore, our study was planned to assess the response of date palm fruiting characteristics (yield and fruit quality) to strand thinning rate and different concentrations of brassinolide application.

## Materials and methods

### Experiment Site

This work was done at the private farm located at performed in El-Baharia Oasis, Giza Governorate, Egypt, at (28°19'10``N: 28°57'35``E) during the consecutive three seasons of 2017, 2018 and 2019.

### Plant material

The experiments were carried out on 27 female 'Sewi' date palms Eight years old and were selected to be healthy and uniform in growth. 30 days after hand pollination, thinning and brassinolide spray treatments were applied in 3 studied seasons as follows:

#### The treatments were:

##### Main plot: strands thinning application:

1. Control (without thinning)
2. Thinning strands/bunch 15%
3. Thinning strands/bunch 30%

##### Splat plot: brassinolide application:

1. Control (without brassinolide)
2. Brassinolide at 5%
3. Brassinolide at 10%

## Experimental design

Experimental 9 treatments, control (sprayed with water and non- thinned) & 15% and 30% strands thinning/bunch treatments and brassinolide spray at 5% and 10% concentration and interaction between them) in a wholly randomized design with three replications for each treatment and one palm for each replication.

## Quality assessments of “Sewi” date palm fruits at harvest

### 1. Physical properties

The following measurements were determined during the three examined seasons:

#### 1.1. Palm yield index and bunch weight

The bunches of each palm were harvested in the first half of October when the fruits reached the tamer stage and then each bunch was weighed independently using a weighing balance to calculate the total yield at harvest, which was expressed in kilograms (kg). At the harvesting time a sample of 30 fruits was randomly taken from each replicate to determine:

#### 1.2. Fruit weight (g)

A digital balance was used to determine the weight of the fruits

#### 1.3. Flesh weight (g)

$$\text{Flesh weight} = \text{Fruit weight} - \text{Seed weight}$$

#### 1.4. Flesh weight (%)

$$\text{Flesh weight}\% = \{ \text{Flesh weight (g)} / \text{Fruit weight (g)} \} \times 100$$

#### 1.5. Fruit dimensions (length & diameter)

Fruit length was measured from the end of the fruit to the top of the shoulder which was expressed in (cm). While, fruit diameter was measured at the broadest point of the fruit shoulder and stated in (cm).

### 2. Chemical properties

#### 2.1. Soluble solids content (S.S.C %)

At room temperature, soluble solids content were measured with a digital refractometer (Atago, Japan) and expressed in percentage.

#### 2.2. Chemical analyses of sugars:

Total sugars (mg/ 100 g FW), reducing sugars (mg/ 100 g FW) and non-reducing sugars (mg/ 100 g FW) determine according to A.O.A.C. (2010).

### 3. Economic returns

The total cost of mechanical thinning and spray brassinolide estimated at the third season only.

Economic returns were calculated by using the following formula:

$$ER = TI - TC.$$

ER= Economic returns, TI= Total income, TC= Total costs according to (Irfana *et al.*, 2015).

#### 4. Statistical analysis

The results were analysis of variances (ANOVA) according to Snedecor and Cochran (1980). This experiment was analyzed as a factorial experiment with 2 factors, thinning treatments and brassinolide spray treatments with 3 replicates. MSTAT-C statistical package was used to calculate the least significant differences L.S.D letters were used for comparing between means of different treatments according to Wallar and Duncan (1969) at a probability of 0.05 level.

### Results and discussions

#### 5. Effect of thinning and brassinolide treatments on fruit quality of Sewi date palms

##### 5.1. Yield index and bunch weight

Data in Figures (1& 2) exhibit the effect of palm thinning rate and different concentrations of brassinolide of Sewi date palm cultivar through three seasons. There is a significant variation between treatments on bunch weight (kg) and yield per palm (kg). Thinning of 15 % of strands applied after 30 days of pollination had a maximum bunch weight and yield per palm. Minimum bunch weight and yield were recorded with untreated palms (control) without thinning. Spray brassinolide at 10% had the heaviest bunch weight and yield. The interaction data showed that significantly highest bunch weight and yield at 15% strands thinning combined with 10% brassinolide. Mahmoud *et al.* (2003) revealed that bunch thinning for "Zaghloul" dates by removing 20% from the tips of strands after pollination significantly increased bunch weight and yield/palm compared with control. The ability of light and dark reactions and the photosynthetic rate depends on the balance of nutrient ion influx. Brassinolide as the plant growth is largely a result of the photosynthetic apparatus and the building blocks synthesized through the uptake of essential nutrients, the efficiency of light energy transformation, and CO<sub>2</sub> productivity. (Talaat, 2013 and Song *et al.*, 2016). Additionally, Eid *et al.* (2016) reported that spraying avocado trees cv. with brassinolide at different doses of 5 g/100 L or 7.5g/100 L were the most effective for increasing the yield (kg/tree).

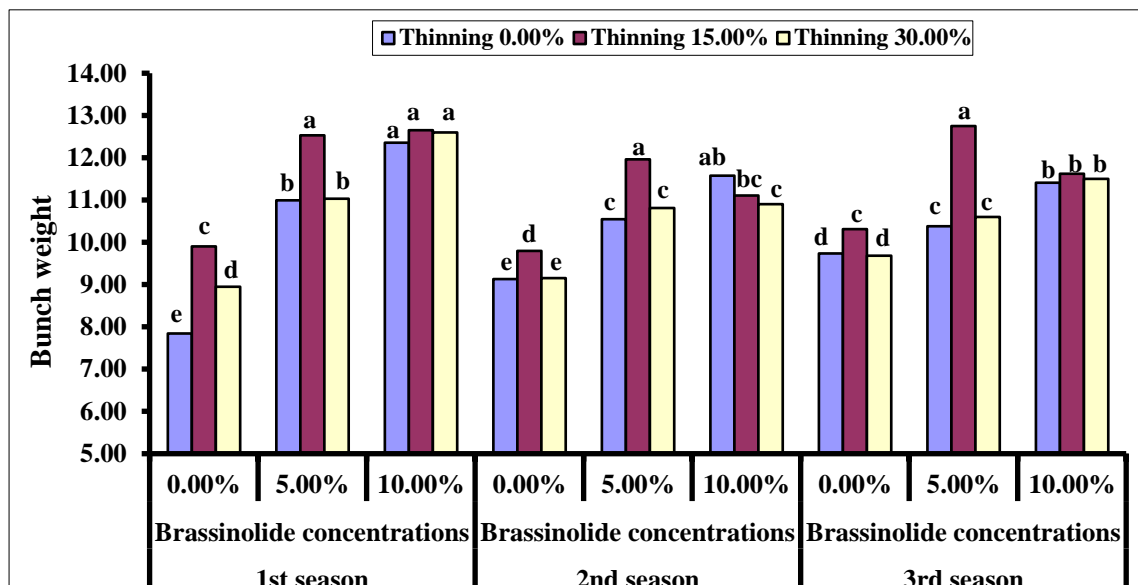


Fig. (1): Effect of thinning treatments and brassinolide concentrations on bunch weight (kg) of Sewi date palm cv. at three seasons

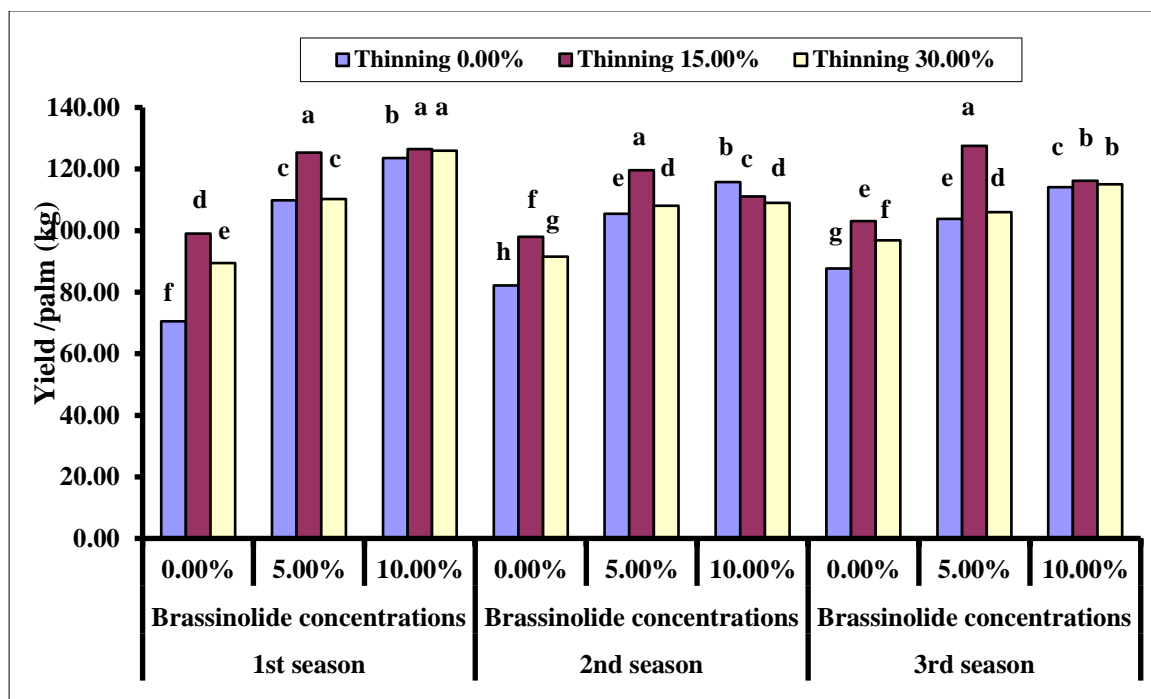


Fig. (2): Effect of thinning treatments and brassinolide concentrations on yield/palm (kg) of Sewi date palm cv. at three seasons

## 6. Physical properties

### 6.1. Fruit weight (g)

Data in Figure (3) refer to significant increase in fruit weight at thinning treatments as compared to control of Sewi date palm cultivar. Spraying palms with brassinolide at 10% increased the average fruit weight. Concerning the interaction effect, display that the specific effect of each investigated factor (15 or 30% strand thinning and brassinolide spray at 5% or 10% ) was reflected on their combination effect (interaction) whereas the highest values of fruit weight (g) were significantly induced by 15 % strand thinning and 10% brassinolide in three seasons of study. The increase in date palm yield and the positive impact on several parameters may be attributed to thinner and brassinolide uptake from the leaf from the applied brassinolide sprays. Significant variation was found in the weight of date palm fruit between thinner and brassinolide treatment contrast with control (Fig 3). By the application of thinning and Br sprays, maximum and minimum date palm fruit weight was obtained at the highest (15 % and 10 %) and the lowest control level of thinner and brassinolide. In this regard, fruit thinning of several date palm cultivars in the opinion of many investigators was found to greatly improve and increase the fresh weight of date palm fruit. Mahmoud *et al.*, (2003) on "Zaghloul" date palms. Al-Obeed *et al.* (2005) on "Succary" date, Kaur *et al.* (2006) on khadrawi date palms, Soliman *et al.* (2011) on "Khalas" date palms. Also, Bashir *et al.* (2014) showed that 50% or 25% strand thinning treatments significantly increased fruit weight as compared to control. El-Badawy *et al.*, 2018 found that the fruit weight was significantly induced by 8 bunches/palm + 30 thinning % of Sewi date palm.

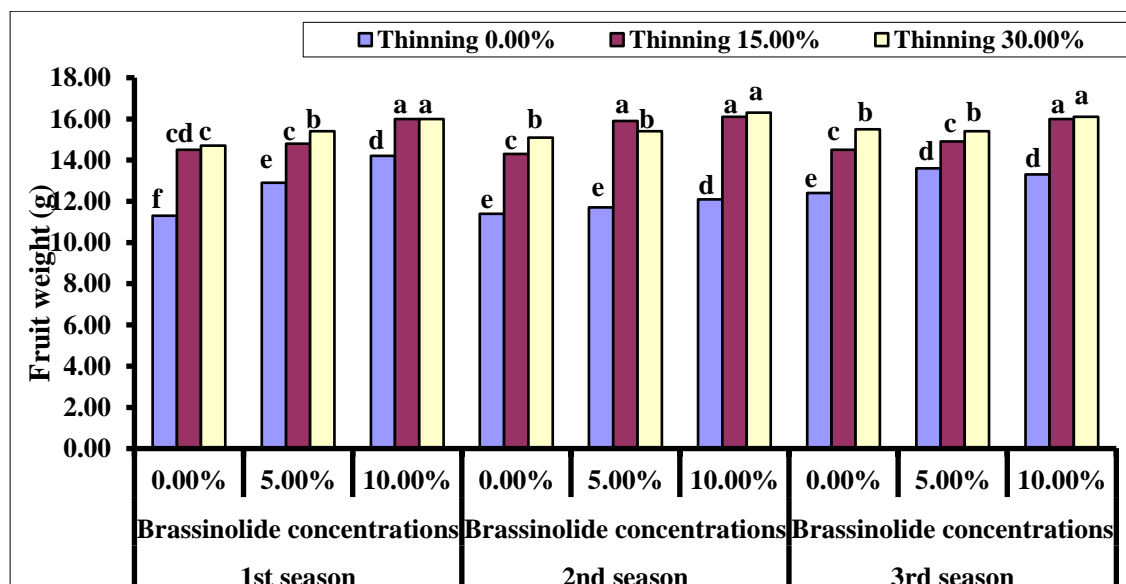


Fig. (3): Effect of thinning treatments and brassinolide concentrations on fruit weight (kg) of Sewi date palm cv. at three seasons

## 6.2. Flesh weight and flesh %

Applied 15% thinning increased significantly fruit flesh weight and flesh %. Also, the effect of 10 % brassinolide spray increased significantly fruit flesh weight and flesh %. As for interaction effect by thinning and spraying showed that the highest values of fruit flesh weight and flesh % was significantly induced by (15% strand thinning and 10 % brassinolide spray) as recorded (87.6%, 88.2% and 86.6%) during the time of study. These results are in the same line with findings of (Moustafa *et al.*, 2019) revealed that, the application of thinning treatment by removing 15 or 30% of the total number of strands from the bunch center improved flesh weight and flesh % of Khadrawi date palm cultivar. Also, El Badwy *et al.* (2018) found that, the highest fruit weight (g) was induced by 8 bunches/palm + 30 % strands thinning of Sewi date palm.

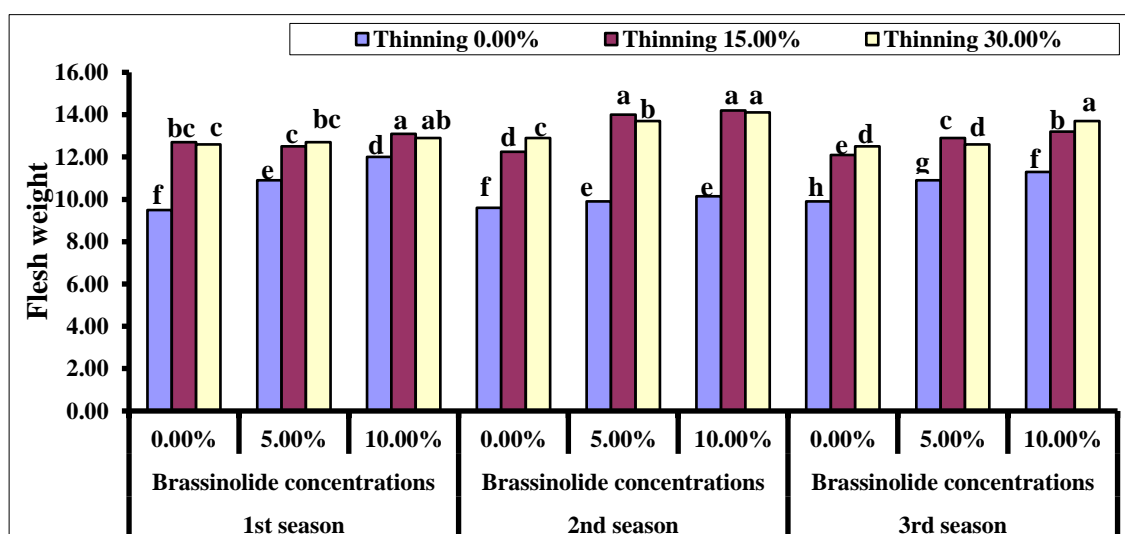


Fig. (4): Effect of thinning treatments and brassinolide concentrations on flesh weight (kg) of Sewi date palm cv. at three seasons

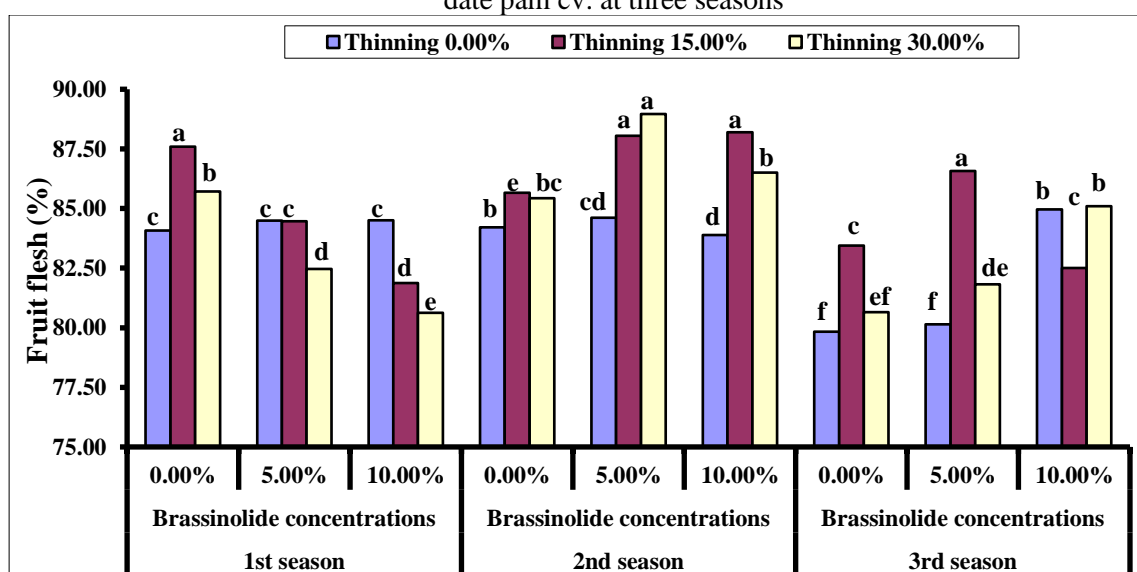


Fig. (5): Effect of thinning treatments and brassinolide concentrations on fruit flesh (%) of Sewi date palm cv. at three seasons

### 6.3. Fruit dimensions (length & diameter)

The influence of strand thinning /bunch, Figures (6&7) reveals obviously that the fruit length and diameter increased significantly by removing 15% strand thinning of the total number of strands of the bunch center after 30 days from pollination which gave statistically the highest values of fruit dimension during three seasons of study. Also, brassinolide spray treatment at 10% after 30 days from pollination increased significantly fruit dimension ( length and diameter ) as recorded in the highest values of length (4.4, 4.4 and 4.3 cm, respectively) and diameter (2.3, 2.3 and 2.3 cm, respectively) in 2017, 2018 and 2019 seasons. These results were in harmony with Radwan, 2017 who noted that the thinning treatment can be due to a lowered level of competition between fruit for the absorption of water and nutrients, thereby accelerating fruit maturity and increasing the percentage of Tamar. The rise in average fruit weight that was attained through thinning may have been brought about by the fruits becoming less compact, which prevents them from accumulating within the bunch. As a result, these fruits seize the chance for organic expansion. When comparing the effects of thinning treatments on fruit weight, it was discovered that, during the analyzed seasons, removing 30% of the total number of strands from the bunch core greatly boosted the average fruit weight. The current findings on fruit dimensions are somewhat consistent with the finding of Al-Obeed *et al.*, (2005) observed that shortening 20 and 40% of strands at pollination time gave the highest values of fruit dimension of "Succary" date cultivar. Also, El Badwy *et al.* (2018) found that, the highest fruit weight (g) was induced by 8 bunches/palm + 30 % strands thinning of Sewi date palm.

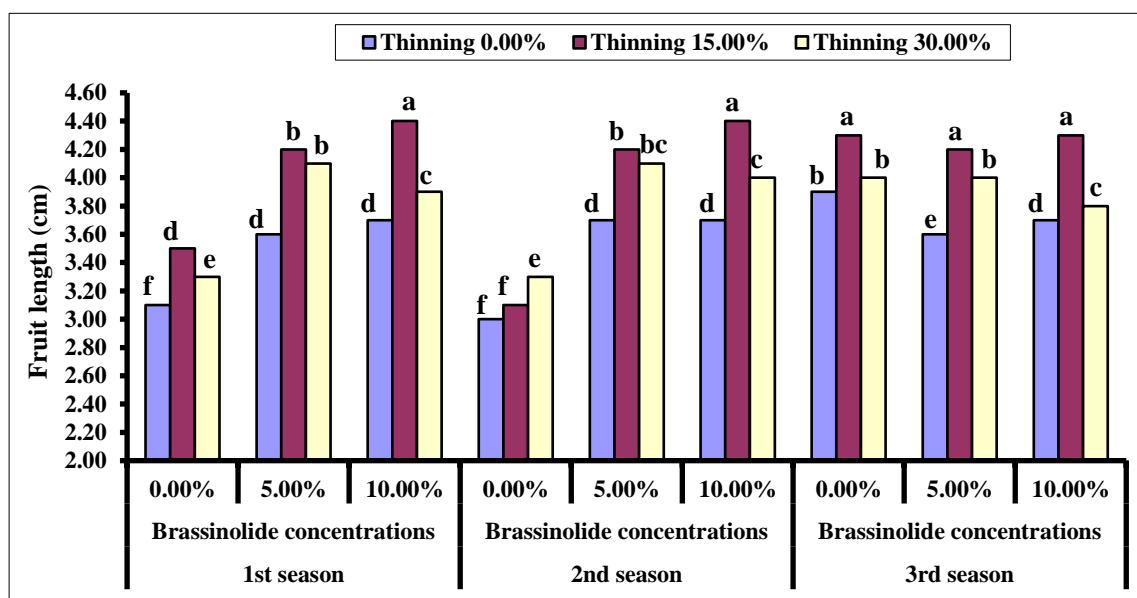


Fig. (6): Effect of thinning treatments and brassinolide concentrations on fruit length (cm) of Sewi date palm cv. at three seasons



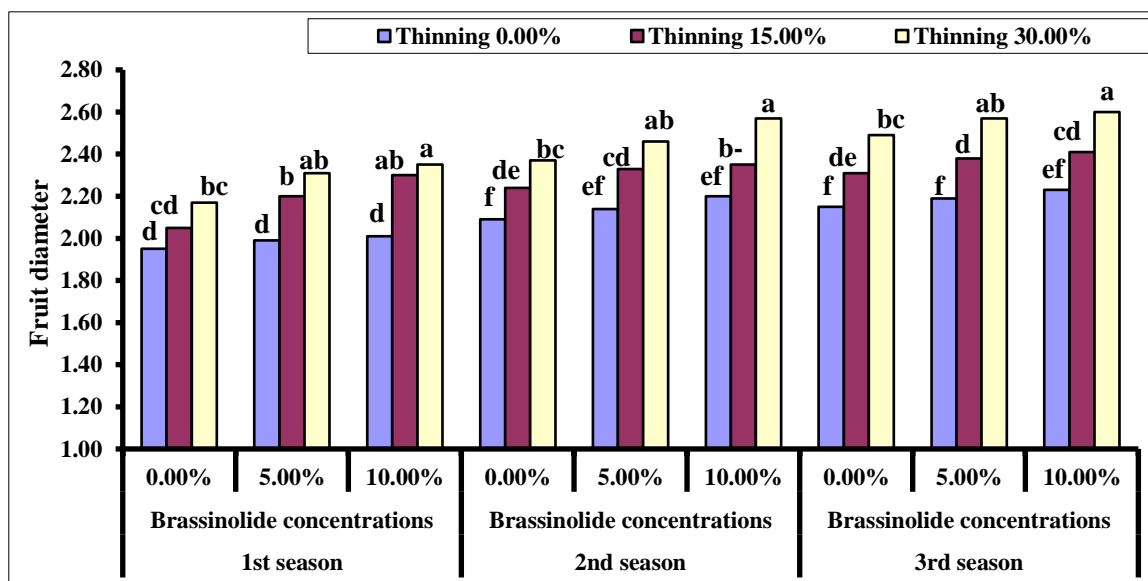


Fig. (7): Effect of thinning treatments and brassinolide concentrations on fruit diameter (cm) of Sewi date pam cv. at three seasons

## 7. Chemical properties

### 7.1. Soluble solids content (S.S.C %)

Concerning the specific effect of two investigated factors (strand thinning %/ bunch), as well as the interaction of their possible combinations on S.S.C % of Sewi date palm, data was obtained during studying seasons. Referring to the specific effect of thinning level on S.S.C % Fig (8) displays clearly that the highest value was exhibited by 15% strand thinning. Meanwhile, the lowest result was by zero thinning level during all seasons of study. Also, the same trend was exhibited by brassinolide spray. The interaction between thinning and brassinolide spraying appeared the highest value and significantly affect with 15%strand thinning/ bunches/palm + 10% brassinolide spray during 2017, 2018 and 2019 seasons. These results are in harmony with Radwan, 2017 found that, thinning treatment can be due to a lowered level of competition between fruit for the absorption of water and nutrients, thereby accelerating fruit maturity and increasing the percentage of tamr. Also, treatments for thinning had advanced S.S.C. (%), total sugars, these results are in harmony with those obtained by Mahmoud *et al.* (2003) on “Zaghloul”, Al-Obeed *et al.*(2005) on “Succary”, Soliman, *et al.* (2011) on “Khalas” and Soliman and Harhash (2012) on Succary, Bashir *et al.* (2014) on “Kur” date palm, El Badwy *et al.*(2018) on Sewi and Moustafa *et al.* (2019) on Khadrawi date palm cultivar.

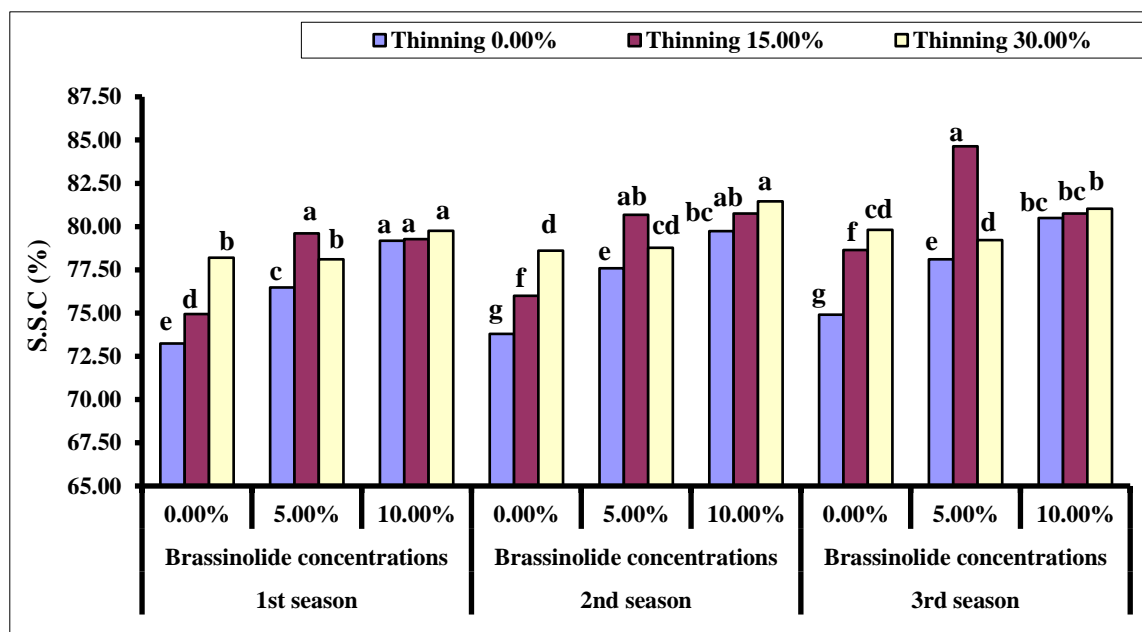


Fig. (8): Effect of thinning treatments and brassinolide concentrations on SSC (%) of Sewi date palm cv. at three seasons

## 7.2. Chemical analyses of sugars (total, reducing and non-reducing)

Total sugars Fig (9) display clearly that the highest total sugars (mg/100g FW) was featured by 15% strand thinning. Meanwhile, the lowest value was by zero thinning level. Also, results found that brassinolide spray exhibited the highest total sugar. The interaction between thinning and brassinolide spraying on total sugar showed that the highly significant with 15% strands thinning/ bunches/palm + 10% brassinolide spray. Referring to the response of reducing sugars and non-reducing sugar% for date palm Sewi cv. to the effect of two factors thinning or spraying with brassinolide and their combinations are presented in Figures (10 & 11). Respecting the effects of thinning rate and brassinolide spray level data in Fig (10 & 11) The highest values of reducing and non-reducing sugars were recorded at 30% strands thinning rate/bunch during three seasons. Concerning the sugars (reducing and non-reducing) % increase in response to the specific effect of brassinolide, data obtained during 2017, 2018 and 2019 seasons as shown display obviously that 10% brassinolide spray. With regard to the interaction effect of two investigated factors on reducing sugars and non-reducing sugar% date palm Sewi cv., it is quite clear that the specific effect of each factor was reflected directly on its own combinations. Anyhow, the highest reducing sugars and non-reducing sugar% were significantly coupled with 30% strands thinning rate/bunch and 10% brassinolide spray in all studied seasons. Also, thinning treatments had improved reducing sugars and non-reducing sugars. This work is in harmony with those obtained by El-Badawy *et al.* (2018) on Sewi date palm and Moustafa *et al.* (2019) on Khadrawi date palm cultivar.

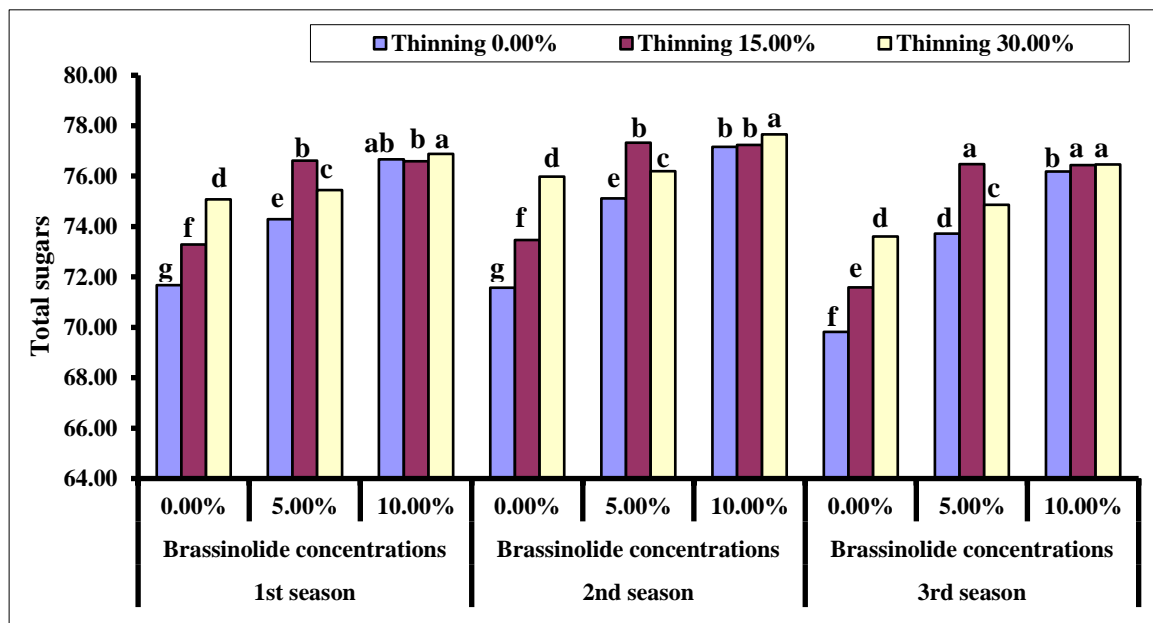


Fig. (9): Effect of thinning treatments and brassinolide concentrations on total sugars (%) of Sewi date pam cv. at three seasons

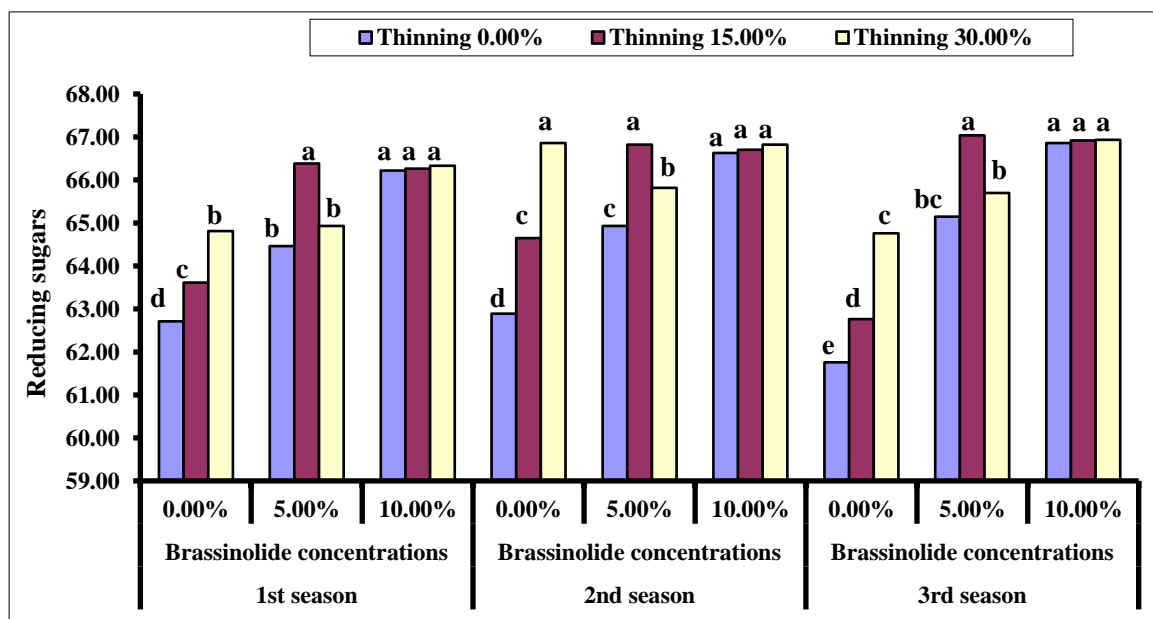


Fig. (10): Effect of thinning treatments and brassinolide concentrations on reducing sugars (mg/100g FW) of Sewi date pam cv. at three seasons

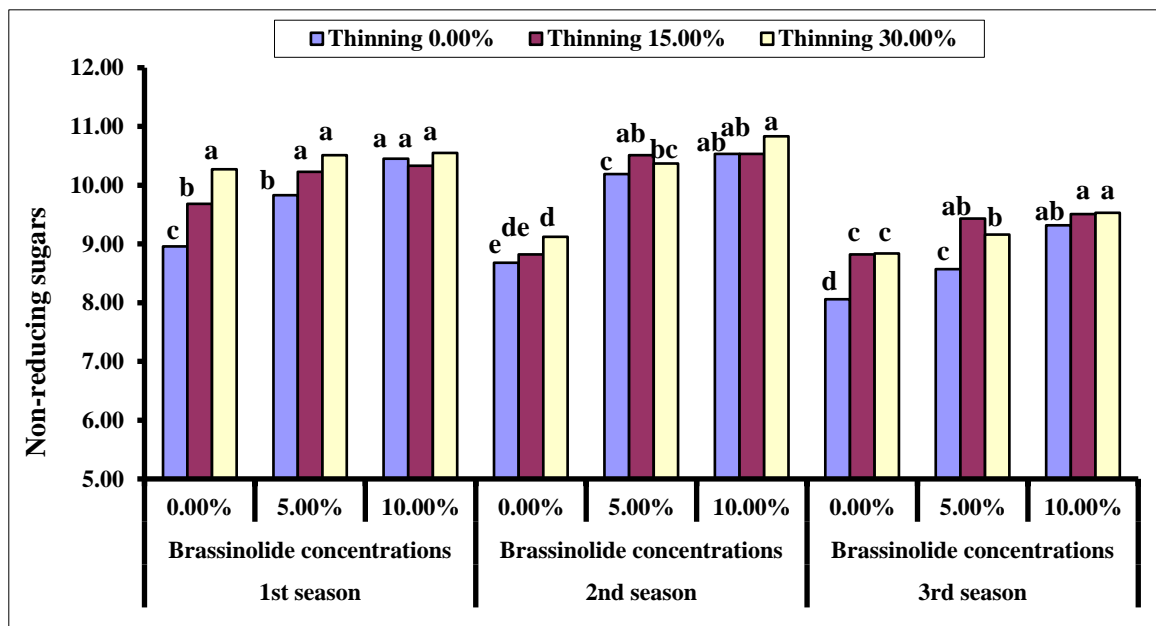


Fig. (11): Effect of thinning treatments and brassinolide concentrations on reducing sugars (mg/100g FW) of Sewi date palm cv. at three seasons

Due to their major role in promoting cell division and extension, flower bud differentiation, carbohydrate assimilation, photosynthesis, ethylene biosynthesis, nucleic acid and protein synthesis, and ATP activity, brassinosteroids may have positively affected fruits' physical and chemical properties. This may have improved vegetative growth, physiological status, and increased fruit yield and quality (Asghari and Rezaei-Rad, 2018).

### 8. Economic return (net income)

Table (1) showed that the highest net income was achieved with thinning at 15% combined with 10% brassinolide spray as given net income (133082. L.E./ fed/year) followed by thinning at 15% with 5%brassinolid as gave net income (132781.5 L.E./fed/year). While palms untreated (control) recorded the lowest income (77968.8 L.E./fed./year).

**Table (1):** Effect of strands thinning and brassinolide spray on net return of Sewi date palm

Treatment	Cost of thinning (pound)/ fed.	Cost of spray BR (pound)/fed.	Total	Yield /fed. price (pound)	Net income (pound)/ fed.
Control zero (Thin + BR)	0	0	0	77968.8	77968.8
Thin zero + 5 BR	0	2125	2125	121439.5	119314.5
Thin zero + 10 BR	0	4250	4250	136578	132328
Thin 15% + zero BR	2550	0	2250	109395	107145
Thin 15 % + 5 % BR	2550	2125	4675	137456.5	132781.5
Thin 15 % +5% BR	2550	4250	6800	139882.5	133082.5
Thin 30% + 10% BR	2550	0	2550	98897	96347
Thin 30% + 5% BR	2550	2125	4675	121881.5	117206.5
Thin 30% + 10% BR	2550	4250	6800	139230	132430

\* Thin=thinning; \*\*BR=brassinolide



Fig. (12): Effect of 15% strand thinning rate and 5%, 10% brassinolide concentrations on fruit quality of Sewi date palm



Fig. (13): Effect of 30% strand thinning rate and 5%, 10% brassinolide concentrations on fruit quality of Sewi date palm

## Conclusion

Overall, our findings indicated that both applications of strand thinning, brassinolide and their combinations had a positive impact on the quality characteristics of Sewi date palm. The combined treatments of 15% strand thinning + 10% brassinolide were the most effective for Sewi. This application significantly increased of bunch weight, yield and fruit weight. Furthermore, these applications increased soluble solid content and total sugar compared to untreated palms and gave the highest income (133082. L.E./fed/year). Finally, it was suggested that 15%strand thinning /bunch with 15% with 10%brassinolide spray could maintain the high yield and fruit quality in Sewi date palm.

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## تأثير خف السوباتات ورش البراسينولايد على المحصول والعائد الإقتصادي لنخيل التمر صنف السيوي

سامية صلاح الدين حسني<sup>1</sup> - خيري حسن عبد الرحمن<sup>1</sup> - عصام عبد الرحمن مدبولي<sup>2</sup> - محمد فاروق عبد الفتاح الخولي<sup>1</sup>

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### الملخص العربي

تمت دراسة تأثير إضافة البراسينولايد وخف الشماريخ على المحصول، والخصائص الفيزيائية والكيميائية للثمار وكذلك العائد الإقتصادي لنخيل التمر صنف "سيوي" خلال ثلاثة مواسم متتالية. رش البراسينولايد (بتركيز 5 و 10٪) ومعدل خف الشماريخ (15 و 30٪ / سوباتة) كل منها على حدة أو مجتمعة معها مقارنة مع الأشجار غير المعاملة (كنترول)، أجريت المعاملات بعد 30 يوماً من التلقيح اليدوي. أظهرت النتائج أن المعاملة المتفوقة كانت تخفيف الشماريخ بمعدل 15٪ مع رش 10٪ براسينولايد كزيادة معنوية في معدل المحصول (وزن السوباتة والمحصول / نخلة). وحافظت على جودة الثمار (وزن الثمار، الطول والقطر، وزن اللحم ومحتوى المواد الصلبة الذائبة٪، السكريات الكلية، السكريات المختزلة وغير المختزلة مقارنة مع الكنترول. كذلك، معاملة خف الشماريخ بمعدل 15٪ مع رش 10٪ براسينولايد أعطت أعلى نسبة للدخل الصافي (133082 جنية / سنة) مقارنة بالنخيل غير المعامل (كنترول) حيث سجل أقل دخل (77968.8 جنية / سنة)، وتشير الدراسة إلى أن خف الشماريخ بمعدل 15٪ مع رش 10٪ معالجة بالبراسينولايد يمكن أن يكون مرشح واعد للحفاظ على جودة الثمار والمحصول العالي لنخيل التمر السيوي.

**الكلمات الدالة:** نخيل التمر صنف السيوي، خف السوباتات، البراسينولايد، جودة الثمار، المحصول، العائد الإقتصادي