World Journal of Agricultural Sciences 17 (4): 308-316, 2021
ISSN 1817-3047

DOI: 10.5829/idosi.wjas.2021.308.316

Effect of Overhead Plastic Covering on Bud Fertility and Yield Quality of Early Sweet, Star Light and Superior Grapevines

Rafaat S.S. El-Gendy, Ola A. Ahmed and Ansam S. Abd El-Rahman

Viticulture Research Department, Horticulture Research Institute,
Agricultural Research Center, Giza, Egypt

Abstract: This investigation was conducted for four consecutive seasons (2017, 2018, 2019 & 2020) in a private vineyard located at El-Sadat City, Menoufia governorate, to study the effect of overhead plastic covering on bud fertility and yield quality of Early Sweet, Star light and Superior grapevines. The chosen vines were seven years old, spaced at 2 X 3 meters apart, grown in a sandy loamy soil and irrigated by the drip irrigation system. During the fourth week of December, Early Sweet and Star light grapevines were spur pruned, while Superior grapevines were cane pruned with a load of 72 buds/vine and trellised according to the Spanish Parron system. Covering with plastic film 100 micron UV+IR (Ultra violet + Infra-red) type of polyethylene after dormex application at 5% during the first week of January till before two weeks of harvest. All grape cultivars grown in the open field (uncovered) were regarded as controls. The results showed that plastic covering significantly enhanced the harvesting date for all cultivars during the four seasons, which it hastened ripening for 18-20 days in Early Sweet grape cultivar, 17-19 days in Star light grape cultivar and 14-16 days in Superior grape cultivar compared to uncovered ones. Plastic covering of all studied grape cultivars was more effective in improving vegetative growth aspects, yield and fruit quality attributes than outdoor grown ones, but its effect on the coefficient of bud fertility differed according to the cultivar, as the fertility coefficient of Superior grape cultivar was decreased, especially with the continuation of the covering for the following seasons. So, it can be recommended to grow table grapes under plastic covering conditions for its better effect on early harvest, which is reflected in increasing profitability and marketing for a longer period, especially export to European markets. Yet, further investigations should be done for increasing bud fertility, especially cultivars that suffer from low fertility under plastic covering conditions.

Key words: Plastic covering · Early Sweet · Star light · Superior · Yield · Fruit quality · Grapevines

INTRODUCTION

The global market is characterized by an increasing demand of fresh extra-seasonal products and early ripening fruits, which it achieve a better economic income. There is a definite need to supply grapes for much earlier times, both for export and for local markets. The harvest date may be advanced by inducing a precocious bud break. This is obtained by managing the vineyard as a protected cultivation, that is, by covering the vineyard with transparent plastic films, which allow a high fraction of solar radiation to pass through and then are able to retain a good portion of energy by limiting the convective and radiative thermal dispersions. Hence, the air temperature increases and induces a faster accumulation of growing degree-days, which, in turn, stimulate an earlier vine bud break [1].

There is a window of opportunity for fresh table grapes in the foreign market, especially in the European Union (EU). For a period of two months (May and June), the supply of table grapes is reduced in Europe accompanied by an increase in product price, due to scarcity. Therefore, Egyptian producers and exporters are using this opportunity to their advantage as the early harvest by expanding the cultivation of early cultivars under with covering the vines with plastic, which is characterized by an advance in the maturity about two weeks than outdoor grown vines [2].

Corresponding Author: Rafaat S.S. El-Gendy, Viticulture Research Department, Horticulture Research Institute, Agricultural Research Center, Giza, Egypt

Protected cultivation of grapevines under plastic covers to advance the maturity is of great importance. This procedure has a potential value for early ripening of table grapes under plastic covers [3-5].

Coban [4] and Salem *et al.* [5], stated that the grapes of plastic covered vines ripen earlier by 16-19 days in Black Bagdad grape cultivar, 15-17 days in Perlett grape cultivar, 26-33 days in Round Seedless grape cultivar and 17-22 days in Flame Seedless grape cultivar than outdoor grown vines.

In Egypt, there are several early cultivars suitable for export. Among these cultivars are Early Sweet, Star light (light red colour) and Superior, which are distinguished by good fruit quality attributes, which undoubtedly add a high marketing value and acceptable to the local or foreign markets [6].

The ultimate target of this investigated was to study the effect of overhead plastic covering on bud fertility, vegetative growth traits, yield and fruit quality attributes of Early Sweet, Star light and Superior grapevines.

MATERIALS AND METHODS

This investigation was conducted for four consecutive seasons (2017, 2018, 2019 & 2020) in a private vineyard located at El-Sadat City, Menoufia governorate, to study the effect of overhead plastic covering on bud fertility and yield quality of Early Sweet, Star light and Superior grapevines. The chosen vines were seven years old, spaced at 2 X 3 meters apart, grown in a sandy loamy soil and irrigated by the drip irrigation system. During the fourth week of December, Early Sweet and Star light grapevines were spur pruned, while Superior grapevines were cane pruned with a load of 72 buds/vine and trellised according to the Spanish Parron system. Four replicates for each cultivar were taken where each replicate consisted of nine vines.

Covering with plastic film 100 micron UV+IR (ultra violet + Infra-red) type of polyethylene after dormex application at 5% during the first week of January till before two weeks of harvest. All grape cultivars grown in the open field (uncovered) were regarded as controls. The number of bunches was adjusted to 35 bunches/vine.

The Following Characteristics Were Studied:

Bud Behavior: During the spring of each season, number of bursted buds/vine and number of bunches per vine were counted, then the percentage of bud burst and coefficient of bud fertility were calculated according to Bessis [7]. Bud burst% was calculated by number of bursted buds per vine divided by the total number of buds per vine left at pruning. Moreover, coefficient of bud fertility was calculated by dividing average number of bunches per vine by the total number of buds/vine.

Morphological Characteristics of Vegetative Growth: In the first week of June, the following morphological studies were carried out on four fruitful shoots/the conducted vines: average shoot length (cm), average number of leaves/shoot and average total leaf area/vine (m^2) was determined by multiplying average number of leaves/shoot by the number of shoots per vine then by average leaf area of the apical 5^{th} and 6^{th} leaves, which was determined by CI-203- Laser Area-meter made by CID, Inc., Vancouver, USA.

Chemical Characteristics of Vegetative Growth:

- Leaf content of total chlorophyll: During the second week of June, leaf samples were obtained from the 5^{th} and 6^{th} apical leaves on the main shoot/vine, total chlorophyll was determined using the Minolta non-destructive chlorophyll meter SPAD 502 according to Wood *et al.* [8].
- Cane content of total carbohydrates and total nitrogen: During winter pruning (the 1^{st} week of January): total carbohydrates were determined according to Smith *et al.* [9] and total nitrogen was estimated using the modified micro-Kjeldahl method according to Pregl [10]. Then C/N ratio was also calculated.

Harvesting Date: It was estimated by calculating gained earliness of harvesting under covering condition from bud burst until harvest date.

Yield and Bunch Weight: A representative random sample of six bunches/vine were taken at maturity when TSS reached about 16-17% according to Tourky *et al.* [11].

Yield/vine (kg) expressed as number of bunches/vine X average bunch weight (g) were determined.

Physical Properties of Berries: Average berry weight (g), average berry size (cm^3) and average berry dimensions (length and diameter) (cm) were estimated.

Chemical Properties of Berries: Total soluble solids (T.S.S.) (%) by hand refractometer and total titratable

acidity as tartaric acid (%) in berry juice were determined according to A.O.A.C. [12], then TSS /acid ratio was calculated. Total anthocyanin of berry skin (mg/100g fresh weight) was determined according to Husia *et al.* [13].

Experimental Design and Statistical Analysis: The completely randomized design was adopted for the experiment. The statistical analysis of the present data was carried out according to Snedecor and Cochran [14]. Averages were compared using the T test at 5% level [15].

RESULTS AND DISCUSSION

Bud Behavior: As shown in Table (1), it is obvious that bud behaviour measurements expressed as bud burst (%) and coefficient of bud fertility were significantly affected by covering for Early Sweet, Star light and Superior grape cultivars during the four seasons.

Concerning percentage of bud burst, the highest percentage of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

With respect to coefficient of bud fertility, plastic covering generally had no significant effects on bud fertility coefficient during the four seasons for all cultivars except Superior grape cultivar, which gradually decreased. This decline started in the 2nd season until the minimum value in the 4th season than vines grown in the open field (uncovered ones).

The coefficient of the bud fertility may be due to the high accumulation of sequestered substances, especially carbohydrates in the canes [16].

The results are in line with those reported by Banoub [17] and El-Morsi *et al.* [3], they found that overheat plastic sheet covering of the vineyard advanced bud break.

Vegetative Growth Characteristics: Data presented in Table (2) indicated that plastic covering of Early Sweet, Star light and Superior grape cultivars significantly affected all vegetative growth traits *i.e.* shoot length, number of leaves/shoot and total leaf area/vine compared to uncovered ones during the four seasons.

In all cultivars, plastic covering achieved significantly the highest values of these parameters than vines grown in the open field (uncovered ones) during the four seasons.

The increments in growth parameters may be due to covering lead to increasing temperature around the vines and thereby increased heat units accumulation which induced higher vegetative growth [3].

These results are in accordance with those reported by Coban [4]; Chavarria *et al.* [18] and Salem *et al.* [5]; they found that the plastic covered vines have leaves with larger area than outdoor grown vines.

Chemical Characteristics of Vegetative Growth: As shown in Table (3) and Figure (1), it is obvious that leaf content of total chlorophyll and cane content of total carbohydrates, total nitrogen and C/N ratio were significantly affected by covering for Early Sweet, Star light and Superior grape cultivars during the four seasons.

With respect to leaf content of total chlorophyll, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons (Figure 1).

Concerning cane content of total carbohydrates, plastic covering achieved significantly the highest values of this estimation than vines grown in the open field (uncovered ones) for all cultivars during the four seasons.

As regards cane content of total nitrogen, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

With respect to C/N ratio, plastic covering generally had no significant effects on C/N ratio during the four seasons for all cultivars except Superior grape cultivar, which gradually decreased. This decline started in the 2nd season until the minimum value in the 4th season than vines grown in the open field (uncovered ones).

The positive effect of covering on increasing total chlorophyll in the leaves may be attributed to covering increases the temperature around the vines, which leads to a higher photosynthesis in the leaves, which is directly reflected in the production of more total carbohydrates in the canes [3].

These results are in harmony with those reported by El-Morsi *et al.* [3]; Chavarria *et al.* [19] and Salem *et al.* [5], they showed that leaf content of total chlorophyll was increased under plastic covered than outdoor grown vines.

Harvesting Date: Data presented in Figure (2) indicated that plastic covering of Early Sweet, Star light and Superior grape cultivars significantly advanced the harvesting date compared to uncovered ones during the four seasons. Plastic covering hastened ripening for 18-20 days in Early Sweet grape cultivar, 17-19 days in Star light grape cultivar and 14-16 days in Superior grape cultivar than vines grown in the open field (uncovered ones) during the four seasons.

Table 1: Effect of plastic covering on bud behaviour of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
Bud burst (%)	88.3	86.9	1.3	88.5	87.5	1.2	91.7	89.4	1.7	92.5	91.2	1.1
Coefficient of bud fertility	0.60	0.57	N.S.	0.66	0.61	N.S.	0.69	0.65	N.S.	0.75	0.71	N.S.
						Star light						
Bud burst (%)	84.9	83.4	0.9	87.9	85.1	1.5	89.2	88.3	0.8	88.3	86.5	1.3
Coefficient of bud fertility	0.51	0.48	N.S.	0.54	0.52	N.S.	0.55	0.53	N.S.	0.60	0.57	N.S.
						Superior						
Bud burst (%)	83.4	81.3	1.2	85.6	84.7	0.8	88.7	86.1	1.4	83.7	82.9	0.7
Coefficient of bud fertility	0.45	0.43	N.S.	0.41	0.42	0.01	0.38	0.42	0.03	0.35	0.39	0.02

Table 2: Effect of plastic covering on vegetative growth characteristics of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
Average shoot length (cm)	185.3	168.9	11.4	188.1	178.9	9.1	192.3	179.6	10.3	195.6	181.2	10.9
Average number of leaves/shoot	31.2	26.6	4.1	31.6	27.3	3.7	32.2	28.8	3.3	33.1	29.7	2.9
Average total leaf area/vine (m^2)	33.2	26.5	6.3	34.2	28.0	6.1	37.1	30.9	5.8	39.5	33.0	6.2
						Star light						
Average shoot length (cm)	179.5	163.7	12.8	182.3	171.6	11.7	186.4	167.7	12.3	189.1	179.7	9.1
Average number of leaves/shoot	30.8	26.3	4.4	31.3	26.7	4.1	32.7	27.2	4.9	33.9	27.9	5.3
Average total leaf area/vine (m^2)	30.1	24.0	5.8	32.1	25.4	6.2	35.0	27.5	6.7	36.5	28.2	7.4
						Superior						
Average shoot length (cm)	191.2	174.3	15.1	194.1	179.2	14.7	198.5	182.4	15.4	201.1	185.9	14.8
Average number of leaves/shoot	32.7	27.9	4.3	33.2	28.3	4.7	34.7	29.1	5.1	37.8	30.2	6.4
Average total leaf area/vine (m^2)	33.8	26.7	6.9	35.7	28.9	6.7	39.7	30.8	7.5	41.5	31.5	8.1

Table 3: Effect of plastic covering on chemical characteristics of vegetative growth of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
Total carbohydrates (%)	26.1	25.3	0.7	26.4	25.8	0.5	26.9	26.3	0.4	27.3	26.8	0.3
Total nitrogen (%)	1.33	1.29	0.03	1.39	1.34	0.04	1.41	1.37	0.02	1.47	1.42	0.03
C/N ratio	19.62	19.61	N.S.	18.99	19.25	N.S.	19.08	19.20	N.S.	18.57	18.87	N.S.
						Star light						
Total carbohydrates (%)	24.3	23.8	0.4	24.9	24.4	0.2	25.3	24.9	0.3	25.8	25.5	0.2
Total nitrogen (%)	1.41	1.36	0.03	1.47	1.42	0.04	1.53	1.47	0.02	1.56	1.51	0.03
C/N ratio	17.23	17.50	N.S.	16.94	17.18	N.S.	16.54	16.94	N.S.	16.54	16.89	N.S.
						Superior						
Total carbohydrates (%)	24.9	24.3	0.4	25.7	25.2	0.2	27.3	26.7	0.3	27.8	27.4	0.2
Total nitrogen (%)	1.31	1.27	0.03	1.36	1.33	0.02	1.44	1.38	0.05	1.53	1.46	0.04
C/N ratio	19.01	19.13	N.S.	18.90	18.95	0.04	18.96	19.35	0.07	18.17	18.77	0.09

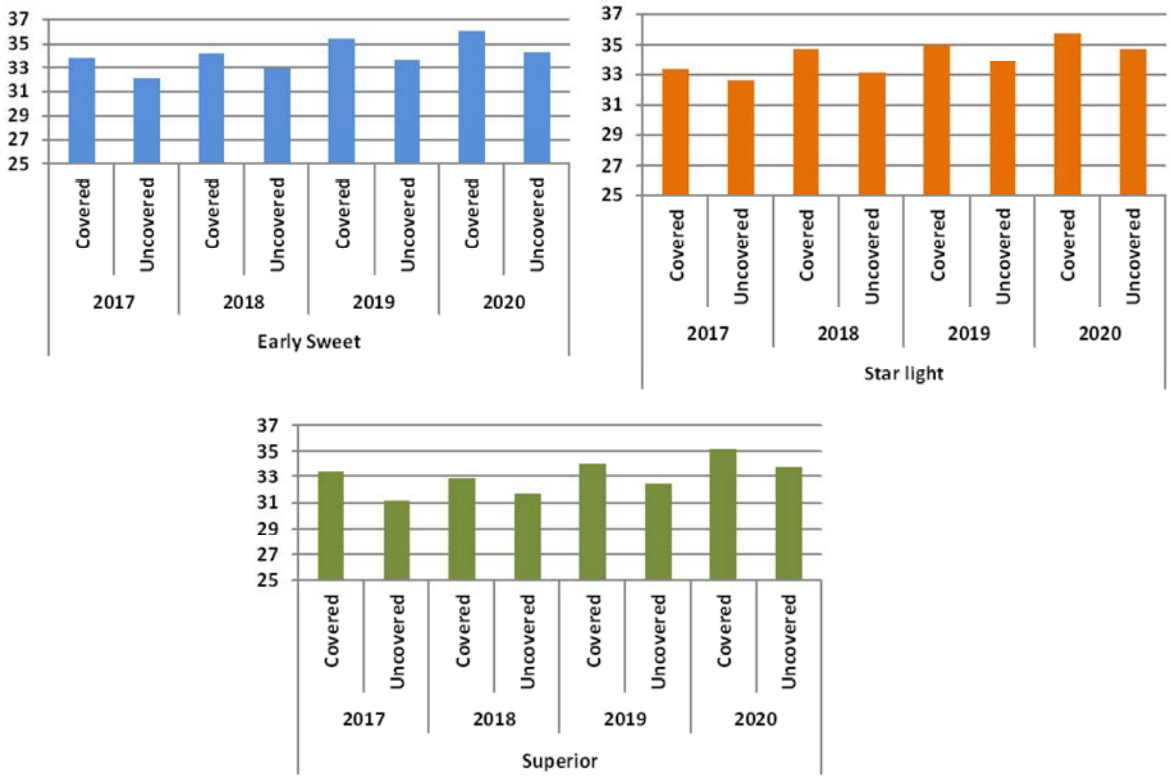

Fig. 1: Effect of plastic covering on total chlorophyll (SPAD) of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019, & 2020 seasons

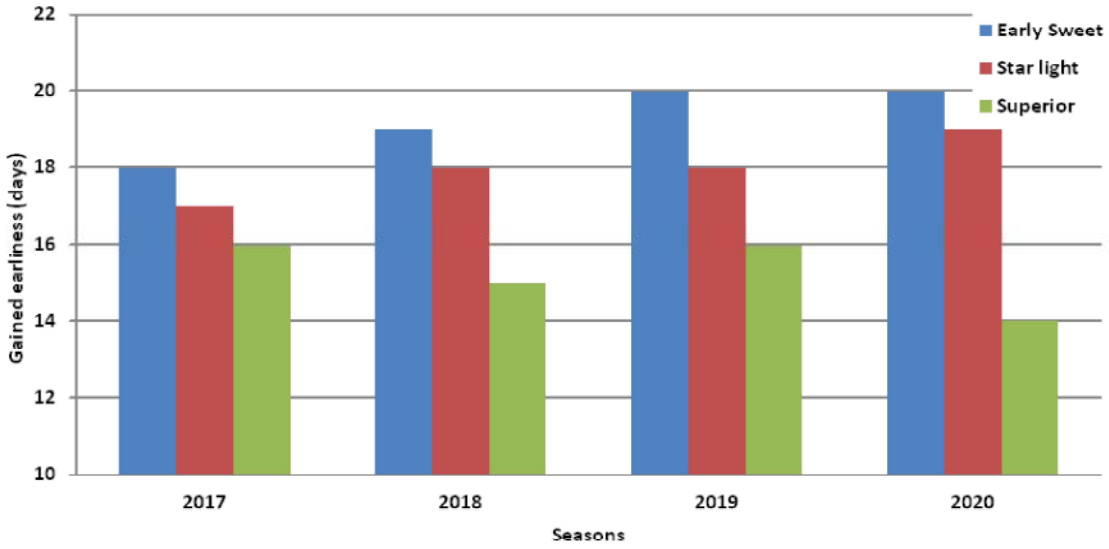

Fig. 2: ffect of plastic covering on gained earliness (days) from bud burst to harvest of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

The gained earliness of harvesting under covering condition during the four seasons could be interpreted by the accumulated heat units during the day and covering which resulted in higher temperature surroundings the buds and earlier bud burst, flowering and berry set thereby earlier harvest. Similar results were reported by Coban [4] and Salem *et al.* [5], they stated that the grapes of plastic covered vines ripen earlier by 16-19 days in

Table 4: Effect of plastic covering on yield and its components of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
Average bunch weight (g)	463.1	448.5	14.3	455.6	442.9	12.6	451.7	438.3	13.2	443.9	431.7	12.1
Yield/vine (kg)	19.97	18.55	1.39	21.54	19.59	1.51	22.30	20.41	1.47	23.97	22.03	1.42
						Star light						
Average bunch weight (g)	611.4	604.3	6.9	609.8	594.3	11.3	601.2	589.7	9.1	597.4	583.1	9.8
Yield/vine (kg)	22.45	20.88	1.34	23.56	22.20	1.27	23.86	22.69	1.13	25.76	23.98	1.42
						Superior						
Average bunch weight (g)	635.7	621.3	13.9	629.3	614.9	13.4	623.4	608.1	14.2	611.7	599.3	12.3
Yield/vine (kg)	20.49	19.43	0.57	18.38	18.79	0.39	17.26	18.44	0.43	15.51	16.88	0.49

Black Bagdad grape cultivar, 15-17 days in Perlett grape cultivar, 26-33 days in Round Seedless grape cultivar and 17-22 days in Flame Seedless grape cultivar than outdoor grown vines.

Yield and Bunch Weight: Data presented in Table (4) indicated that plastic covering of Early Sweet, Star light and Superior grape cultivars greatly affected yield and average of bunch weight compared to uncovered ones during the four seasons.

Concerning average of bunch weight, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

With respect to yield/vine, plastic covering increased significantly yield/vine for all cultivars during the four seasons except Superior grape cultivar, which gradually decreased. This decline started in the 2nd season until the minimum value in the 4th season than vines grown in the open field (uncovered ones).

The positive influence of covering on the yield/vine could be ascribed mainly to the increase in bunch weight of Early Sweet and Star light grape cultivars during the four seasons and Superior grape cultivar in the first season only, whereas it was decreased in the 2nd 3rd and 4th seasons of Superior grape cultivar than one grown in the open field. This decrease in the yield/vine can be attributed to the low number of bunches/vine, which reflects the decline in coefficient of bud fertility, which is due to lower C/N ratio.

These results are consistent with those stated by Novello *et al.* [20]; Shrestha *et al.* [21]; Colapietra [22]; El-Morsi *et al.* [3] and Salem *et al.* [5], they mentioned that vine grown under covering condition produced higher bunch weight.

Physical Properties of Berries: As shown in Table (5), it is obvious that all physical properties of berries expressed average of berry weight, size and dimensions were significantly affected by covering for Early Sweet, Star light and Superior grape cultivars during the four seasons.

With respect to average berry weight, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

Concerning average berry size, plastic covering achieved significantly the highest values of this estimation than vines grown in the open field (uncovered ones) for all cultivars during the four seasons.

As regards average berry length, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

With respect to average berry diameter, plastic covering achieved significantly the highest values of this estimation than vines grown in the open field (uncovered ones) for all cultivars during the four seasons.

These results are in harmony with those reported by El-Morsi *et al.* [3]; Chavarria *et al.* [19] and Salem *et al.* [5], they stated that berry weight was greater when vines were covered with plastic film.

Chemical Properties of Berries: Data presented in Table (6) and Figure (3) indicated that plastic covering of Early Sweet, Star light and Superior grape cultivars greatly affected all chemical properties of berries compared to uncovered ones during the four seasons.

As regards juice TSS percentage, the highest percentage of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

With respect to juice acidity percentage, plastic covering achieved significantly the lowest percentage of this estimation than vines grown in the open field (uncovered ones) for all cultivars during the four seasons.

Table 5: Effect of plastic covering on berry physical properties of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
Average berry weight (g)	4.86	4.82	0.03	4.87	4.83	0.02	4.90	4.85	0.04	4.94	4.87	0.06
Average berry size (cm3)	4.81	4.78	0.02	4.83	4.79	0.03	4.88	4.82	0.05	4.87	4.82	0.04
Average berry length (cm)	2.41	2.39	0.02	2.43	2.41	0.01	2.44	2.41	0.02	2.47	2.43	0.03
Average berry diameter (cm)	1.92	1.89	0.01	1.94	1.91	0.02	1.94	1.92	0.01	1.96	1.93	0.01
						Star light						
Average berry weight (g)	4.94	4.91	0.02	4.95	4.92	0.01	4.98	4.94	0.03	5.01	4.95	0.05
Average berry size (cm3)	4.90	4.86	0.03	4.92	4.88	0.02	4.93	4.89	0.03	4.97	4.91	0.04
Average berry length (cm)	2.41	2.37	0.02	2.43	2.38	0.03	2.43	2.39	0.02	2.47	2.42	0.04
Average berry diameter (cm)	2.01	1.98	0.01	2.04	2.00	0.03	2.07	2.02	0.02	2.09	2.03	0.04
						Superior						
Average berry weight (g)	2.78	2.74	0.03	3.80	3.77	0.02	3.83	3.79	0.03	3.88	3.83	0.04
Average berry size (cm3)	3.73	3.69	0.03	3.78	3.73	0.04	3.81	3.76	0.02	3.83	3.78	0.03
Average berry length (cm)	2.17	2.12	0.04	2.18	2.14	0.03	2.18	2.15	0.01	2.21	2.17	0.02
Average berry diameter (cm)	1.70	1.64	0.05	1.72	1.67	0.04	1.73	1.69	0.02	1.77	1.72	0.04

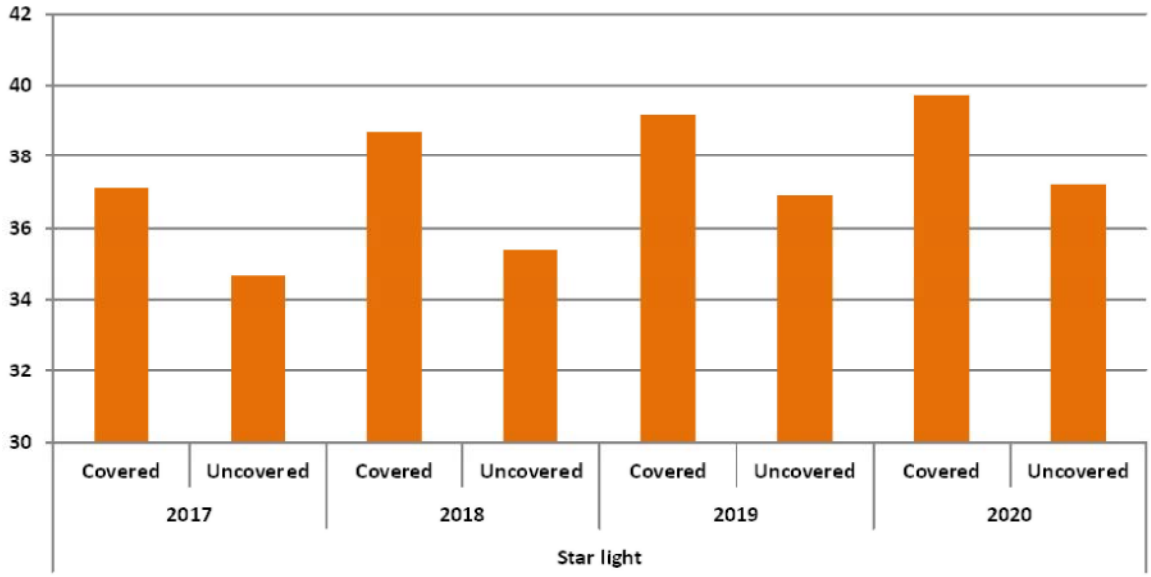

Fig. 3: Effect of plastic covering on total anthocyanin (mg/100g F.W.) of Star light grape cultivar in 2017, 2018, 2019 & 2020 seasons

Table 6: Effect of plastic covering on berry chemical properties of Early Sweet, Star light and Superior grape cultivars in 2017, 2018, 2019 & 2020 seasons

	2017			2018			2019			2020		
Characteristics	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test	Covered	Uncovered	T. test
						Early Sweet						
TSS (%)	16.6	16.2	0.3	16.7	16.3	0.2	17.0	16.5	0.4	17.1	16.7	0.3
Acidity (%)	0.55	0.57	0.01	0.54	0.55	0.01	0.52	0.54	0.02	0.50	0.53	0.01
TSS/acid ratio	30.2	28.4	1.5	30.9	29.6	1.2	32.7	30.6	1.6	34.2	31.5	1.8
						Star light						
TSS (%)	16.0	15.7	0.2	16.2	15.8	0.3	16.3	16.0	0.2	16.6	16.1	0.4
Acidity (%)	0.58	0.59	0.01	0.56	0.58	0.01	0.55	0.58	0.02	0.52	0.56	0.03
TSS/acid ratio	27.6	26.6	0.9	28.9	27.2	1.3	29.6	27.6	1.7	31.9	28.8	1.6
						Superior						
TSS (%)	15.7	15.3	0.3	15.8	15.4	0.2	16.0	15.7	0.2	16.3	15.9	0.3
Acidity (%)	0.62	0.64	0.01	0.60	0.63	0.02	0.59	0.61	0.01	0.57	0.60	0.01
TSS/acid ratio	25.3	23.9	1.3	26.3	24.4	1.4	27.1	25.7	1.1	28.6	26.5	1.7

With respect to juice TSS/acid ratio, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for all cultivars during the four seasons.

Regarding total anthocyanin content of the berry skin, the highest value of this estimation was obtained from plastic covered vines compared to uncovered ones for Star light grape cultivar during the four seasons (Figure 3).

These results are in harmony with those reported by El-Morsi *et al.* [3]; Coban [4]; De Souza *et al.* [23]; Abd Elwahed *et al.* [24] and Salem *et al.* [5], they showed that plastic house treatment had positive effect on increasing TSS% and reducing acidity in berry juice under plastic covered than outdoor grown vines.

CONCLUSION

In conclusion, it was found that plastic covering advanced the harvesting date and improved vegetative growth traits, yield and fruit quality attributes compared to open field conditions, but its effect on the coefficient of bud fertility differed according to the cultivar, as the fertility coefficient of Superior grape cultivar was decreased, especially with the continuation of the covering for the following seasons. Therefore, it can be recommended to grow table grapes under plastic covering conditions for its better effect on early harvest, which is reflected in increasing profitability and marketing for a longer period, especially export to European markets. Yet, further investigations should be done for increasing bud fertility, especially cultivars that suffer from low fertility under plastic covering conditions.

REFERENCES

1. Novello, V. and L. De Palma, 2008. Growing grapes under cover. Acta Hort., 785: 353-362.
2. Diab, Y.A.A., M.A.A. Mousa, D.F. Warnock and D.E. Hahn, 2009. Opportunities for producing table grapes in Egypt for the export market: a decision case study. International Food and Agribusiness Management Review, 12(2).
3. El-Morsi, F.M., R.S.S. El-Gendy and M.A. Ali, 2006. Effect of two rootstocks on growth, yield and bunch quality of Superior Seedless scion cultivar under conditions of the open field and overhead plastic covering. Egypt J. Appl. Sci., 21(10B): 662-689.
4. Coban, H., 2007. Effects of plastic covering on yield, physical and chemical characteristics of some table grapes (*Vitis vinifera* L.). Asian Journal of Chemistry, 19(5): 4052-4058.
5. Salem, E.H., F.M. Gouda and M.A.A. Abdel-Raman, 2021. Effect of plastic covering and potassium fertilization source on growth and fruiting of Flame Seedless grapevines. SVU-International Journal of Agricultural Sciences, 3(2): 89-100.
6. Fayek, M.A., A.A. Rashedy, R.A. Mahmoud and E.M. Ali, 2017. Biochemical indicators related to grafting compatibility in grapevine. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 8(3): 575-583.
7. Bessis, R., 1960. On different models quantitative expression of fertility in vines. Acta, pp: 828-882.
8. Wood, C.W., D.W. Reeves and D.G. Himelrick, 1992. Relationships between chlorophyll meter readings and leaf chlorophyll concentration. N status and crop yield. A review: Proc. Agro. Soc. N.Z., 23: 1-9.
9. Smith, F., M.A. Gilles, J.K. Hamilton and P.A. Gedess, 1956. Colorimetric methods for determination of sugar and related substance, Anal. Chem., 28: 350-356.
10. Pregl, F., 1945. Quantitative Organic Micro-Analysis. 4th Ed J. and A. Churchill, Ltd., London.
11. Tourky, M.N., S.S. El-Shahat and M.H. Rizk, 1995. Effect of Dormex on fruit set, quality and storage life of Thompson Seedless grapes (*Banati grapes*) J. Agric. Sci., Mansoura Univ., 20(12): 5139-5151.
12. Association of Official Agricultural Chemists, 2005. Official Methods of analysis, 18th ed. Published by A.O.A.C., Benjamin Franklin Station, Washington DC, USA.
13. Husia, C.L., B.S. Luh and C.D. Chichester, 1965. Anthocyanin in free stone peach. J. Food Science, 30: 5-12.
14. Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. 7th ed., The Iowa State Univ. Press. Ames., Iowa, U.S.A., pp: 593.
15. Steel, R.G. and J.H. Torrie, 1980. Reproduced from principles and procedures of statistics. Printed with the permission of C. I. Bliss, pp: 448-449.
16. Ahmed, F.F., 1985. Effect of alar as growth retardant and pinching on vegetative growth and the yield of Roomy red grapevines. Ph.D. Thesis. Fac. Agric., Minia, Univ.
17. Banoub, M.M., 2003. Studies on prolonging the marketing period of some table grape cultivars. Ph.D. Thesis, Fac. of Agric., Zagazig Univ.

18. Chavarria, G., H.P. Santos, J. Felippeto, G.A.B. Marodin, H. Bergamasch, L.S. Cardoso and F.B. Fialho, 2008. Water relations and leaf gas exchange in vineyard with plastic overhead cover. Revista Brasileira De Fruticultura, Jaboticabal, 30: 1022-1029.
19. Chavarria, G., H.P. Santos, L.A.S. Castro, G.A.B. Marodin and H. Bergamaschi, 2012. Anatomy, chlorophyll content and photosynthetic potential in grapevine leaves under plastic cover Revista Brasileira de Fruticultura, 34(3): 661-668.
20. Novello, V., L. De Palma, L. Tarricone, G. Vox and L. De Palma, 2000. Effects of different plastic sheet covering on microclimate and berry ripening of table grape cv. Maltilde. J. Internat. Sciences of the Vine and Wine, 34(2): 49-55.
21. Shrestha, G.K., S. Nilnond, L. Phavaphutanon, N. Juntawong, C. Sukumal, N. Surasak, P. Lop, J. Niran and S. Choopong, 2000. Influence of plastic roof on fruit quality and yield of Beauty Seedless grape during dry and rainy seasons. Kasetsart J. Natural Sci., 34(2): 179-189.
22. Colapietra, M., 2003. Protection of table grapes in order to hasten ripening. Rivista di Frutticolturea edi Ortofloricultura, 65(4): 8-15, 23.
23. De Souza, C.R., R.V. Da Mota, F.A.N. Dias, E.T. De Melo, R.M.A. Pimentel, L.C. De Souza and R.M. De Albuquerque, 2015. Physiological and agronomical responses of Syrah grapevine under protected cultivation. Bragantia, 74(3): 270-278.
24. Abd Elwahed, M.S., H.M. El-Saeed, H.F. Abou ziena and Z.A. Ali, 2015. Increasing the opportunities of early grape production for exportation using some protection treatments in Egypt. Int. J. Chem. Tech. Res., 8(4): 1601-1609.