

Description and Evaluation of some Grape Cultivars under Egyptian Conditions

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Abstract: This investigation was conducted for three successive seasons (2008, 2009 & 2010) in a private vineyard located at El-Khatatba, Menoufiya governorate to description and evaluation four grape seedless cultivars namely: Thompson Seedless clone 2A, Fiesta, Melissa and Crimson Seedless grape cultivars under Egyptian conditions. The chosen vines were five years old, grown in a sandy loam soil, spaced at 2 X 3 meters apart, irrigated by the drip system, and cane-pruned and trellised by the Spanish Parron system. Some phenological aspects, description studies including (growing tips, leaves, tendrils, bunches and berries), yield and physical and chemical studies of bunches and berries and histological studies of percentage of predicted bud fertility at different bud positions lengthwise the cane were carried out. The results revealed that Thompson Seedless clone 2A and Fiesta grape varieties were the earliest varieties giving the lowest number of days with regard to the phenological dates (budburst, full bloom, fruit set, veraison and grape maturity) compared to Melissa and Crimson Seedless grape varieties which were the latest in this respect having the highest number of days through the three seasons of the study. All studied cultivars were characterized by good vegetative growth and bunch quality. The average bunch weight of Crimson Seedless cultivar was medium, whereas it was big in Thompson Seedless clone 2A, Fiesta and Melissa cultivars. Concerning berry weight and size, Thompson Seedless clone 2A and Fiesta cultivars were medium, while, Melissa and Crimson Seedless cultivars were big. As for the berry shape, Thompson Seedless clone 2A and Fiesta cultivars were rounded- spherical, while, Melissa and Crimson Seedless cultivars were oval-cylindrical. Concerning berry colour, it is clear that in Thompson Seedless clone 2A cultivar it was yellow, greenish yellow in Fiesta cultivar, yellowish green in Melissa cultivar and bright red in Crimson Seedless cultivar. Percentage of predicted bud fertility at different bud positions lengthwise the cane increased gradually from the basal buds to the middle buds of the cane where it reached its maximum then decreased gradually towards the distal buds in all studied cultivars.

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1. Introduction

Grape is considered as one of the most important fruit crops in the world. In Egypt, grape occupies the second rank after citrus. The total grape area in Egypt reached 167296 feddans with production of 1370241 Tons according to the latest statistics of Ministry of Agriculture (2009). Thirty years ago most of the grape area has been occupied by two main cultivars: Thompson seedless and Roumi Ahmer besides a small area cultivated with some local cultivars. In 1981 Ministry of Agriculture through the Agriculture Development system project A.D.S. introduced some new table grape cultivars which have been planted in different growing regions in Delta and desert areas; these cultivars were found to have different morphological characteristics and bunch quality.

Cultivars can be characterized by several methods: (1) Morphological description of parts

of the plants (shoots, leaves, bunches, berries, etc.) at different phonological stages (Olv, 1984). (2) Morphomerty based on the measurement of parameters of plant organs and Phenological dates, i.e. dates of budburst and harvesting (Galet, 1952 and Cabello *et al.* 1993). (3) Analysis of biochemical compounds either quantitatively or qualitatively. These examinations of some grapevine parameters remain the most important and easiest means for the identification of grape species, varieties and clones (Schneider, 1996).

Pervious trials dealt with the description and evaluation of grape cultivars (Olmo, 1946; Kamel, 1964; Winkler *et al.*, 1965; Brooks and Olmo 1972; Watt, 1983; Walker and Boursiquote, 1992; Abd El-Kawi and El-Yam, 1992 a, b and c; Abd El-Fatah and Kastor, 1993 a and b; Morrison, 1994; Tourky *et al.*, 1995; El

Sharkawy 1995; Fawzy 1998; Aisha *et al.*, 1998; Marwad, 2002 a and b; Gaser, 2006; Girgis 2007 and Sabry *et al.*, 2009).

The goal of this study was to describe and evaluate four grape cultivars namely: Thompson Seedless clone 2A, Fiesta, Melissa and Crimson Seedless grape cultivars under Egyptian conditions, with special stress on some morphological characteristics which may serve in distinguishing these cultivars.

2. Material and Methods

This investigation was conducted for three successive seasons (2008, 2009 & 2010) in a private vineyard located at El-Khatatba, Menoufiya governorate to describe and evaluate four grape seedless cultivars namely: Thompson Seedless clone 2A, Fiesta, Melissa and Crimson Seedless grape cultivars under Egyptian conditions. The chosen vines were five years old, grown in a sandy loam soil, spaced at 2 X 3 meters apart, irrigated by the drip system, and cane-pruned and trellised by the Spanish Parron system. The vines were pruned during the last week of December for the three seasons of the study so as to maintain a load of 84 buds/vine (7canes X 12 buds/vine). Three replicates for each cultivar were taken where each replicate consisted of five vines. The ampelographic studies were carried out according to the international Ampelographic Registered Schedule (Cosmo, *et al.*, 1958).

*The following characteristics were studied:

1) Phenological data

The considered aspects: the 1st, date of bud burst, i.e. opening of 50% buds; the 2nd, date of full bloom: the vines were considered to reach full bloom when the calyptra had fallen from 70-80% of the flowers; the 3rd, date of fruit set: when the fertilized flower begins to be a berry; the 4th, date of veraison: when the berries start to soften as they build up sugars and acids begin to fall or the berries reach the onset of colour stage; the 5th, date of harvesting: it takes place when the berries attain full colour stage and the TSS reach 16-17% according to Tourky *et al.*, (1995).

a) Phenological dates (budburst, full bloom, fruit set, veraison and physiological ripening); this was estimated periodically.

b) Number of days for phenological dates was calculated periodically by calendar year (Julian day).

2) Descriptive measurements

The morphological studies of the considered cvs were carried out according to the International Amelographic Registered

Schedule (Dalmasso and Cosmo, 1952 and Cosmo *et al.*, 1958). The following estimates were studied:

- a) The growing tip: It was classified according to Breider (1950).
 - Hairs: (Glabrous - Cob-webby - Downy - Wooly).
 - Colour: (Green - purple - Green with purple).
- b) The tendril: It was classified according to Kolenati (1946).
 - Sequence: (Continuous - Discontinuous - Intermittent).
 - Tip shape: (Simple – di-fed – Tri-fid - Tetra-fid).
- c) The leaf: The following characteristics were studied using the 5th and 6th leaf from the shoot apical. It was classified according to Bioletti (1929), Singh & Singh (1940), Kolenti (1946), Redrigues (1959) and Watt (1983).
 - Size: (Small): when leaf area is less than 100 cm².
(Medium): when leaf area is between 100-125 cm².
(Large): when leaf area is more than 125 cm².
 - Shape: (Orbicular – Reniform – Truncate – Cuneiform - Cordate).
 - Surface: (Smooth – rough).
 - Colour: (Yellowish green – Greenish yellow – Silvery white).
 - Pigments: (without pigments on veins - With pigments on veins - Pigment only on the petiole joint to leaf).
 - Thickness: (Thin – Medium – Thick).
 - Pubescence: (Glabrous - Cob-webby - Downy - Wooly).
 - Number of lobes.
 - Sinuses: Depth (Shallow – Medium – Deep).
Form (Closed – Perforate – Narrow - Wide).
 - Leaf Margin: Type (Dentate - Irregularly dentate - Regularly dentate – Serrate - Irregularly serrate - Regularly serrate-Erinate).
Teeth size (Narrow - Medium – Broad)
Apical tooth (Pointed - Blunt)
Number of Tooth: [(Few <50) – (Medium 50-80) – (Many > 80)].

- Petiole Shape (U-shaped - V-shaped - V-U-shaped)
 Petiole sinus (Closed – Medium – Narrow – Wide)
 Petiole length (P)
 Leaf length (L)
 Petiole/Leaf ratio (P/L): [Short < 0.5–Medium (0.5-0.8)–Long > 0.8]
- d) The bunch: Samples were taken for each cultivar to determine the following characteristics:
 - Weight: [(Very small < 50g) – (Small 50-250g) – (Medium 251-500g) – (Big 501-1000g) – Very big > 1000g].
 - Length: [(Very short < 6cm) – (Short 6-12cm) – (Medium 12-18cm) – (Long 18-24cm) – (Very long > 24cm)].
 - Shape: (Winged – Shouldered – Conical – Cylindrical).
 - Density: (Loose – Well filled – Compact – Very compact).
 - Peduncle: [(Short < 2.5cm) – (Medium 2.5-3.5cm) – (Long > 3.5cm)].
- e) The berry: Samples were taken for each cultivar was studied to determine the following characteristics:
 - Weight: [(Very small < 0.3g) – (Small 0.3-1.1g) – (Medium 1.1-3.3g) – (Big 3.3-7.0g) – Very big > 7.0g].
 - Size: [(Very small < 0.3cm³) – (Small 0.3-1.1 cm³) – (Medium 1.1-3.3 cm³) – (Large 3.3-7 cm³) – Very large > 7.0 cm³].
 - Shape: [Rounded (Spherical-Oblate) – Oval (Ellipsoidal–Cylindrical–Ovoid-Obovoid).
 - Colour: [Green (Light green - Yellowish green – Yellow - Golden yellow) – Red (Pink – Light red – Bright red – Brick red) – Black (Dull red – Purple – Reddish black – Bluish black)].
- 3) Yield and its components and berry physiochemical characteristics
 - Yield and bunch physical characteristics: Yield/vine (kg) was determined as number of clusters/vine X average bunch weight (g). Also, average bunch weight (g) and average bunch dimensions (cm) were determined.

• Berry physical and chemical characteristics: Average berry weight (g), berry size (cm³), berry dimensions (length and diameter) (cm), Total soluble solids in berry juice (T.S.S.) (%) by hand refractometer, total titratable acidity as tartaric acid (%) (A.O.A.C. 1985) and TSS/acid ratio were calculated.

4) Bud fertility

Predicted bud fertility was estimated at winter pruning time on dormant buds borne on 15 canes each of 12 buds for the four grape varieties by microscope binocular. The method was conducted through the handling faster anatomy described by Ambika and pondey, (1969).

Statistical analysis:

The completely randomized design was adopted for this investigation. The obtained data were statically analyzed according to Snedecor and Cochran (1980). Averages were compared using the new L.S.D. values at 5% level.

3. Results and Discussion

1) Phenological data

Data in (Table, 1 and Figure, 1) revealed that Thompson Seedless clone 2A and Fiesta grape varieties were the earliest varieties with regard to the phenological dates (budburst, full bloom, fruit set, veraison and grape maturity) compared to the other varieties whereas, Melissa and Crimson Seedless grape varieties were the latest in this respect in the three seasons of the study.

Data concerning number of days by calendar year (Julian day) for phenological dates as shown in (Table, 2 and Figure, 2) revealed a remarkable variation among varieties under investigation. In this respect, Thompson Seedless clone 2A and Fiesta grape varieties had the lowest number of days as compared to the other varieties. On the other hand, Melissa and Crimson Seedless grape varieties had the highest number of days in the three seasons of the study.

The obtained results in this connection are in harmony with those mentioned by Abd-El-Fattah and Kasstor (1993a) on Beauty Seedless and Black Monukka grape varieties; Abd-El-Fattah and Kasstor (1993b) on Black Rose and Ribier grape varieties; Aisha *et al.*, (1998) on Black Monukka and Ribier grape varieties; Marwad (2002a) on Black Rose and Ribier grape varieties and Marwad (2002b) on Beauty Seedless and Black Monukka grape varieties.

2) Descriptive measurements

Data concerning the evaluation and the morphological description of the studied cultivars are presented in Table (3) and illustrated in Figure (3).

- Growing tip:

- Hairs and colour:

The growing tip of Thompson Seedless clone 2A, Melissa and Crimson Seedless grape cultivars had cob-webby hairs with green colour except Crimson Seedless cultivar which was

green with purple colour while in Fiesta cultivar it had downy hairs with green colour.

- Tendrils:

- Sequence and tip shape

Sequence of tendrils in all cultivars was intermittent.

Tip shape of tendrils, in Thompson Seedless clone 2A cultivar it was di-fid, in Fiesta cultivar tri-fid and in Melissa and Crimson Seedless cultivars it was di-tri-fid.

Table (1): Dates of bud burst, full bloom, fruit set and harvest of four grape varieties in 2008, 2009 & 2010 seasons

Variety	50% Bud burst date			70% full bloom date			Fruit set date			Veraison date			Harvest date		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Thompson Seedless clone 2A	9/3	6/3	13/3	15/4	12/4	19/4	22/4	18/4	25/4	19/5	16/5	23/5	4/7	28/6	9/7
Fiesta	12/3	10/3	16/3	19/4	17/4	22/4	25/4	22/4	27/4	26/5	22/5	29/5	12/7	7/7	16/7
Melissa	16/3	13/3	20/3	25/4	22/4	29/4	2/5	28/4	5/5	28/5	25/5	2/6	8/8	2/8	13/8
Crimson Seedless	19/3	17/3	23/3	30/4	28/4	3/5	6/5	3/5	8/5	1/6	29/5	5/6	14/8	9/8	19/8

Table (2): Number of days by calendar year (Julian day) for dates of bud burst, full bloom, fruit set and harvest of four grape varieties in 2008, 2009 & 2010 seasons

Variety	50% Bud burst date			70% full bloom date			Fruit set date			Veraison date			Harvest date		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Thompson Seedless clone 2A	69	66	73	106	103	110	113	109	116	140	137	144	186	180	191
Fiesta	72	70	76	110	108	113	116	113	118	147	143	150	194	189	198
Melissa	76	73	80	116	113	120	123	119	126	149	146	154	221	215	226
Crimson Seedless	79	77	83	121	119	124	127	124	129	153	150	157	227	222	232

new LSD (0.05) = 5 4 5 6 7 6 5 6 5 8 7 8 9 11 9

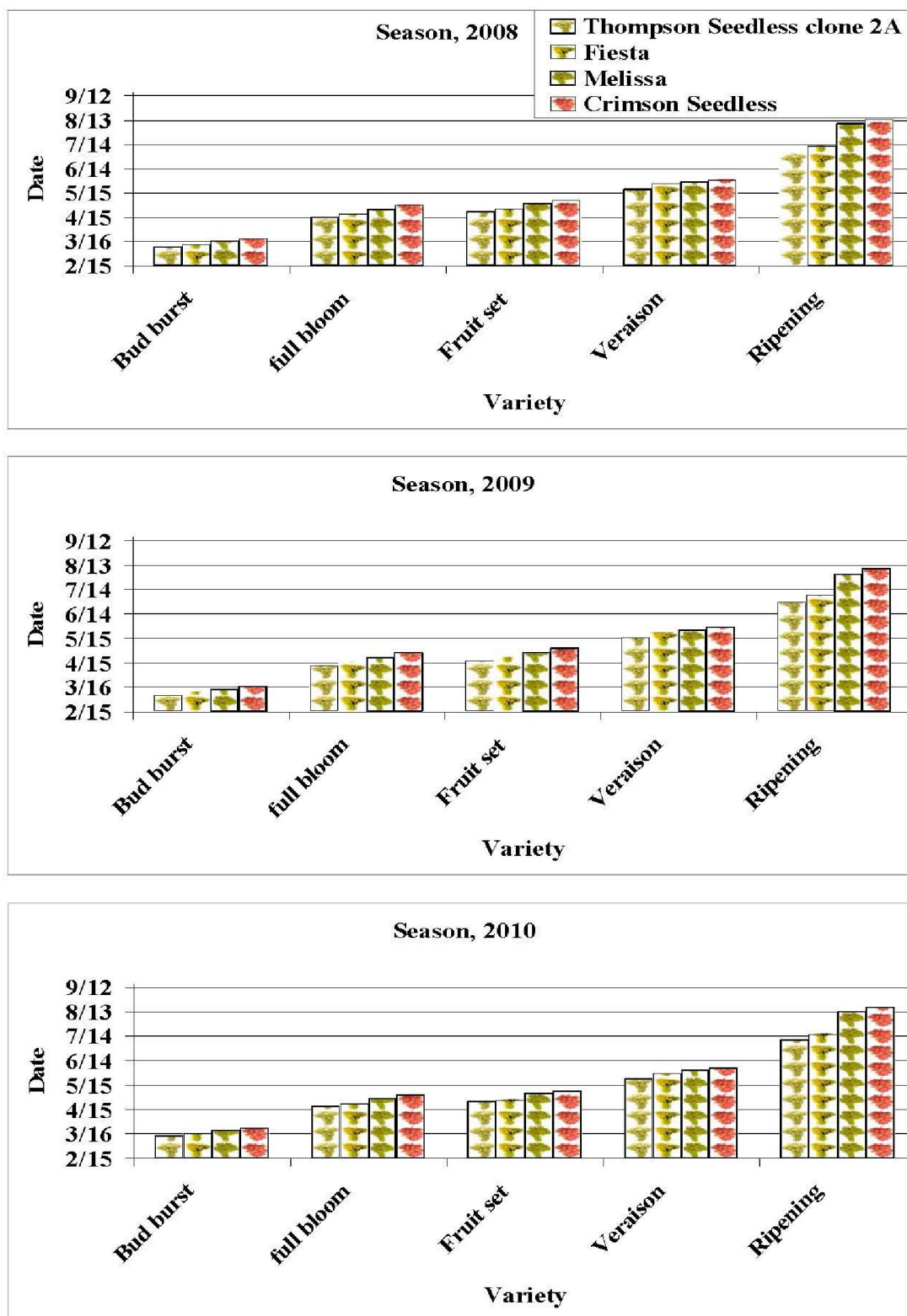


Figure (1): Dates of bud burst, full bloom, fruit set and ripening of four grape varieties in 2008, 2009 & 2010 seasons

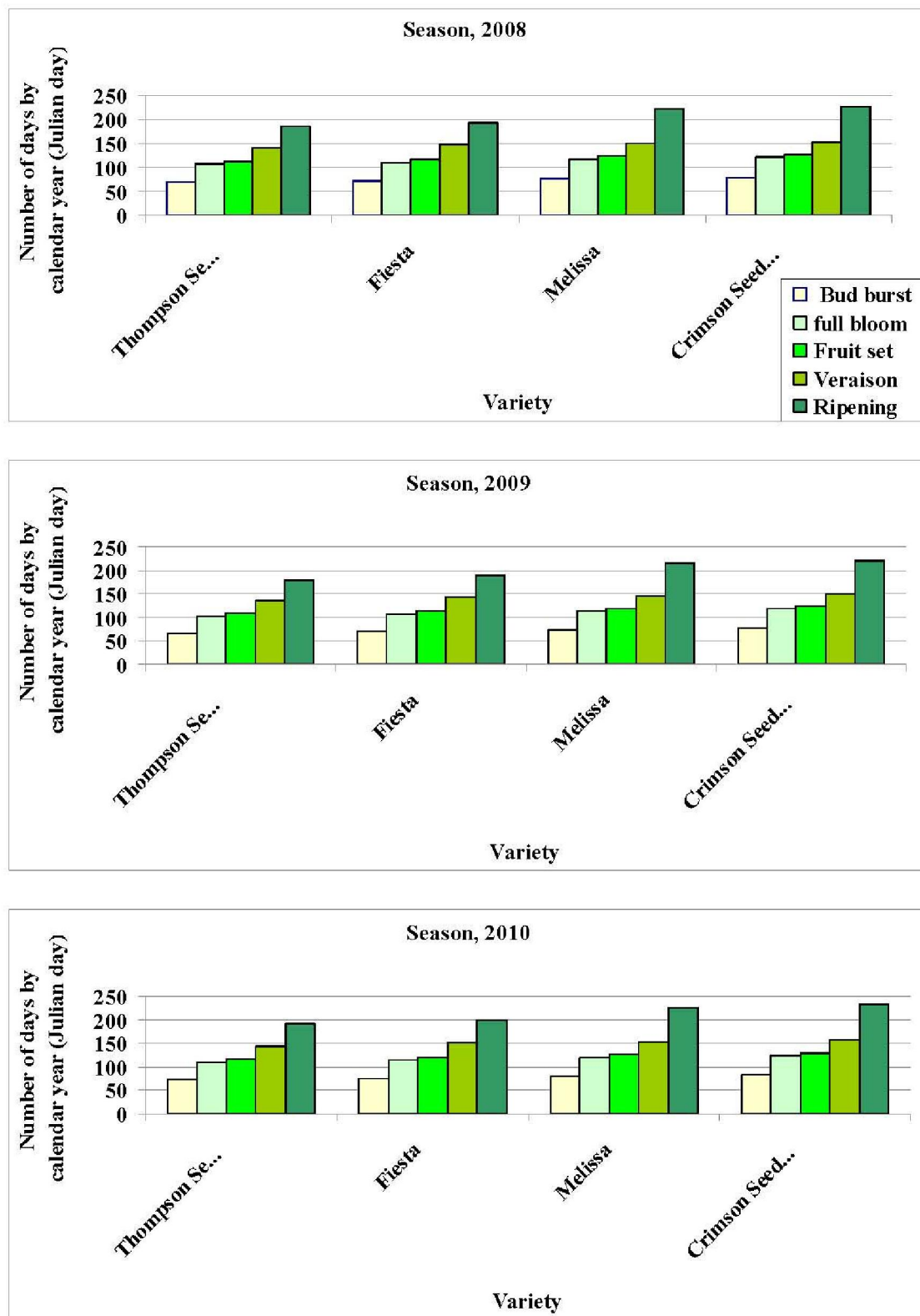


Figure (2): Number of days by calendar year (Julian day) for dates of bud burst, full bloom, fruit set and ripening of four grape varieties in 2008, 2009 & 2010 seasons

Table (3): Description and evaluation of four grape varieties

		Thompson Seedless clone 2A	Fiesta	Melissa	Crimson Seedless
Growing tip:	Hairs	Cob-webby	Downy	Cob-webby	Cob-webby
	Colour	Green	Green	Green	Green with purple
Tendrils:	Sequence	Intermittent	Intermittent	Intermittent	Intermittent
	Tip shape	di-fid	Tri – fid	di-tri-fid	di-tri-fid
Leaf:	Size	Large (184.2 cm²)	Large (181.9 cm²)	Large (175.1 cm²)	Large (213.4 cm²)
	Shape	Orbicular	Orbicular	Orbicular	Reniform
	Surface	Smooth	Smooth	Smooth	Smooth
	Colour	Yellowish green	Yellowish green	Yellowish green	Yellowish green
	Pigments	Without pigment on veins	Without pigment on veins	Without pigment on veins	Without pigment on veins
	Thickness	Thin	Thin	Medium	Medium
	Pubescence	Glabrous	Glabrous	Glabrous	Glabrous
	Number of lobes	5 lobes	5 lobes	5 lobes	5 lobes
	Leaf sinuses Depth Form	Shallow Perforate	Shallow Closed	Medium Perforate	Medium Perforate
	Leaf Margin Type Teeth size Apical tooth Number of Tooth	Regularly dentate Broad Pointed Medium (68)	Irregularly dentate Broad Pointed Medium (52)	Regularly dentate Broad Pointed Medium (62)	Irregularly dentate Medium Pointed Medium (74)
	Petiole Shape Sinus Petiole length (P) Leaf length (L) Petiole P/L	U-shaped Narrow 8.7 16.9 0.51 (Medium)	U-shaped Medium 9.6 17.2 0.56 (Medium)	U-shaped Narrow 8.4 17.1 0.49 (Short)	U-shaped Narrow 8.6 17.6 0.49 (Short)
Bunch	Weight	Big (641.6g)	Big (718.8g)	Big (686.5g)	Medium (487.5g)
	Length	Very long (29.1cm)	Very long (35.7cm)	Very long (32.8cm)	Long (23.1cm)
	Shape	Shouldered	Conical with shoulder	Conical with shoulder	Shouldered
	Density	Well filled	Compact	Compact	Well filled
	Peduncle	Medium (2.6cm)	Medium (3.2cm)	Medium (3.1cm)	Medium (2.7cm)
Berry	Weight	Medium (3.16g)	Medium (2.39g)	Big (4.85g)	Big (4.54g)
	Size	Medium (2.97 cm³)	Medium (2.17 cm³)	Large (4.68 cm³)	Large (4.36 cm³)
	Shape	Rounded-spherical	Rounded- spherical	Oval– Cylindrical	Oval– Cylindrical
	Colour	Yellow	Greenish yellow	Yellowish green	Bright red

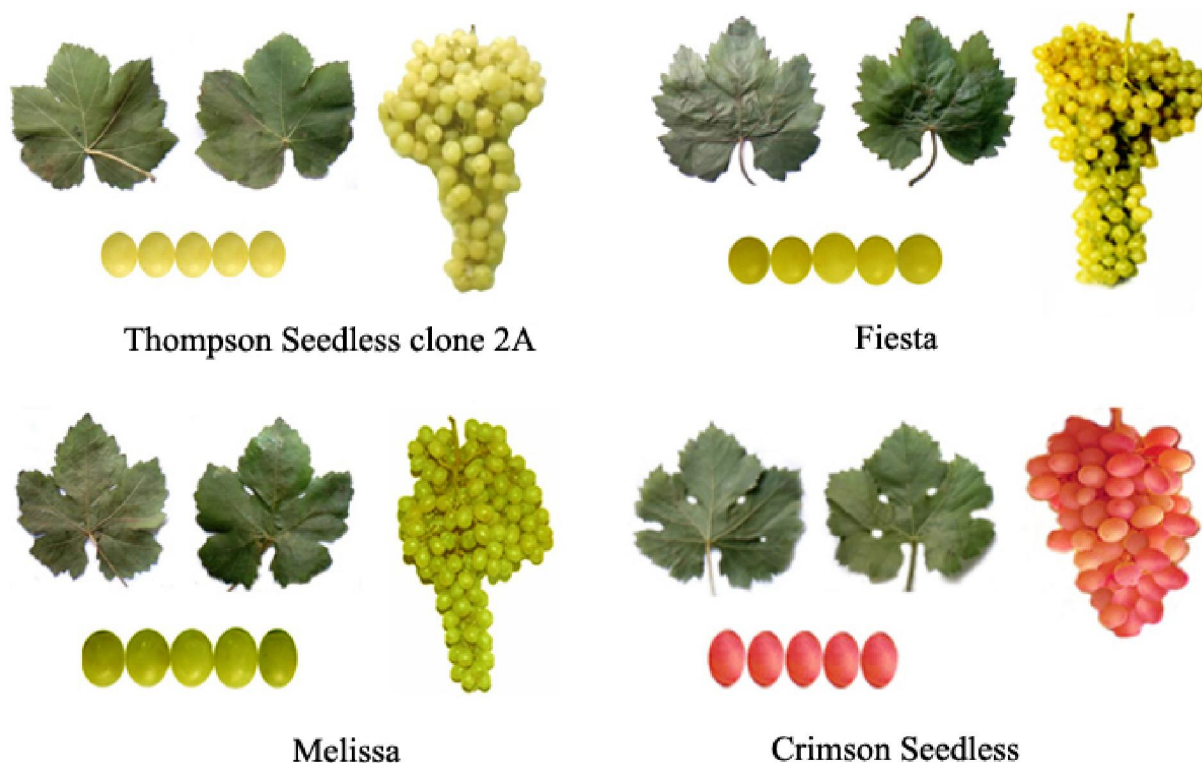


Figure (3): Leaf, bunch and berry of four grape cultivars

- Leaf:

- Leaf size and shape:

All cultivars had a large leaf area (more than 125 cm²) with orbicular shape except Crimson seedless which showed a reniform shape.

- Leaf surface, colour and pigments:

The studied cultivars showed a smooth leaf surface with yellowish green colour at the lower surface without pigments on veins.

- Leaf thickness and pubescence:

Leaf thickness of Thompson Seedless clone 2A and Fiesta cultivars were thin, whereas in Melissa and Crimson Seedless cultivars it was medium. Leaves of all cultivars were glabrous.

- Leaf lobes:

Number of leaf lobes in all cultivars under studied was five.

- Leaf sinuses:

With regard to depth of leaf sinuses, it was noticed that Thompson Seedless clone 2A and Fiesta cultivars were shallow in depth, when folding the lobe, the sinus reached less

than one third of the way to petiole, while Melissa and Crimson Seedless cultivars were medium in depth reaching half of the way to the petiole.

As for the form of sinuses, it was perforate in Thompson Seedless clone 2A, Melissa and Crimson Seedless cultivars, while in Fiesta cultivar it was closed.

- Leaf margin:

With regard to the types of margin, it was noticed that Thompson Seedless clone 2A and Melissa cultivars were regularly dentate, while Fiesta and Crimson Seedless cultivars were irregularly dentate.

Concerning teeth size, it was found that Thompson Seedless clone 2A, Fiesta, Melissa cultivars were broad i.e. breadth was more than length; while, Crimson Seedless cultivar was medium i.e. breadth was equal to length.

As for the apical tooth, it was noticed that in all studied cultivars it was pointed.

With respect to number of teeth, it was found that in Thompson Seedless clone 2A,

Fiesta, Melissa and Crimson Seedless cultivars it was medium (68, 52, 62 and 74) respectively.

- Petiole:

Concerning petiole shape, it was noticed that in all studied cultivars it was U shaped.

As for petiole sinus, it was found that in Thompson Seedless clone 2A, Melissa and Crimson Seedless cultivars it was narrow, while in Fiesta cultivar it was medium.

With regard to the ratio between petiole length to leaf length P/L, it was found that in Thompson Seedless clone 2A and Fiesta cultivars it was medium while, it was short in Melissa and Crimson Seedless cultivars.

- Bunch:

As for bunch weight, it is clear that Thompson Seedless clone 2A, Fiesta and Melissa cultivars were big (501-1000g) except Crimson Seedless cultivar which was medium (251-500g).

With regard to bunch length, it was found that in Thompson Seedless clone 2A, Fiesta and Melissa cultivars it was very long (more than 24 cm) while, in Crimson Seedless cultivar it was long (18-24g).

As for the bunch shape, it was noticed that in Fiesta and Melissa cultivars it was conical with shoulders and shouldered in Thompson Seedless clone 2A and Crimson Seedless cultivars.

Concerning bunch density, it is clear that in Thompson Seedless clone 2A and Crimson Seedless cultivars the bunch was well filled, while in Fiesta and Melissa cultivars it was compact.

With regard to peduncle of bunches, it was found that in all studied cultivars it was medium (2.5-3.5 cm).

- Berries:

Concerning berry weight, it is clear that in Thompson Seedless clone 2A and Fiesta cultivars it was medium (1.1-3.3g), while, in Melissa and Crimson Seedless cultivars it was big (3.3-7.0g).

As for berry size, it was found that in Thompson Seedless clone 2A and Fiesta cultivars it was medium (1.1-3.3cm³), while, in Melissa and Crimson Seedless cultivars it was large (3.3-7.0cm³).

With regard to berry shape, it was noticed that in Thompson Seedless clone 2A and Fiesta cultivars it was rounded-spherical, while, in Melissa and Crimson Seedless cultivars it was oval-cylindrical.

Concerning berry colour, it is clear that in Thompson Seedless clone 2A cultivar it was

yellow, greenish yellow in Fiesta cultivar, yellowish green in Melissa cultivar and bright red in Crimson Seedless cultivar.

The results in this respect are in line with those of many investigators working on different cultivars (Ismail, 1989, Tourky *et al.*, 1995; Fawzy, 1998; Aisha *et al.*, 1998 and Marawad 2002 a&b).

3) Yield and its components and berry physiochemical characteristics

- Yield and bunch physical characteristics:

Data concerning yield and bunch physical characteristics are presented in Table (4).

As for the yield, it was noticed that Thompson Seedless clone 2A, Fiesta and Melissa cultivars gave the highest significant values, while Crimson Seedless cultivar gave the lowest values in the three seasons of the study.

Concerning number of bunches/vine; it was found that the highest number of bunches was obtained from Melissa cultivar followed in a descending order by Thompson Seedless clone 2A and Crimson Seedless cultivars while, Fiesta cultivar gave the lowest yield in the three seasons of the study.

With regard to bunch weight, it was noticed that Thompson Seedless clone 2A, Fiesta and Melissa cultivars gave the highest significant values, whereas Crimson Seedless cultivar gave the lowest values in the three seasons of the study.

As for bunch length, it was noticed that Thompson Seedless clone 2A, Fiesta and Melissa cultivars gave the highest significant values, while Crimson Seedless cultivar gave the lowest values in the three seasons of the study.

Concerning bunch width; no significant difference could be detected among all studied cultivars in the three seasons of the study.

- Berry physical and chemical characteristics:

Data concerning berry physical and chemical characteristics are presented in Table (5).

As for average berry weight and size, it was noticed that Thompson Seedless clone 2A and Fiesta cultivars gave the highest significant values, while Melissa and Crimson Seedless cultivars gave the lowest values in the three seasons of the study.

With regard to berry dimensions, Thompson Seedless clone 2A and Fiesta

cultivars gave the highest significant values, whereas Melissa and Crimson Seedless cultivars gave the lowest values in the three seasons of the study.

Concerning berry shape index; Thompson Seedless clone 2A and Fiesta cultivars gave the highest significant values, while Melissa and Crimson Seedless cultivars gave the lowest values in the three seasons of the study.

As for the total soluble solids in berry juice, no significant differences were found among all studied cultivars in the three seasons of the study.

With regard to acidity in berry juice, Thompson Seedless clone 2A, Fiesta and Crimson Seedless cultivars gave the lowest significant values, whereas Melissa cultivar gave the highest values in the three seasons of the study.

The results are in harmony with those of many investigators working on different

cultivars (El Sharkawy 1995; Fawzy 1998; Aisha *et al.*, 1998; Marwad, 2002 a & b; Gaser, 2006; Girgis 2007 and Sabry *et al.*, 2009).

4) Bud fertility

With respect to percentage of predicted bud fertility at different bud positions lengthwise the cane, data in (Figure, 4) show that predicated bud fertility increased gradually from the basal buds up to the middle buds of the cane where it reached its maximum then decreased gradually towards the distal buds. A remarkable increase attaining its maximum percentage occurred from the 7th to the 10th bud for Thompson Seedless clone 2A, Fiesta and Melissa cultivars and from the 5th to the 7th bud for Crimson Seedless cultivar.

In this respect, Bessins (1965), Licul (1969), Monastra (1971), Abd el-Kawi and El-Yami (1992a) and Aisha *et al.*, (1998) found that bud fertility increased from the basal sector to the distal one of the cane.

Table (4):Yield and bunch physical characteristics of four grape varieties in 2008, 2009 & 2010 seasons

Cultivars	Characteristics	Yield/vine (kg)	No. of bunches	Average bunch weight (g)	Average bunch length (cm)	Average bunch width (cm)
Season, 2008						
Thompson Seedless clone 2A		24.3	38	639.3	29.1	18.5
Fiesta		25.8	36	715.7	34.8	18.2
Melissa		27.3	40	683.1	32.7	18.7
Crimson Seedless		18.6	38	488.4	23.1	18.3
New LSD at 5%		5.6	2	87.2	5.9	N.S
Season, 2009						
Thompson Seedless clone 2A		21.9	35	627.1	28.7	18.2
Fiesta		22.5	32	703.4	34.1	18.0
Melissa		25.6	38	672.9	32.5	18.5
Crimson Seedless		16.2	34	476.7	22.9	18.1
New LSD at 5%		5.3	3	81.9	5.7	N.S
Season, 2010						
Thompson Seedless clone 2A		25.7	39	658.5	29.6	18.7
Fiesta		28.0	38	737.2	35.2	18.4
Melissa		29.6	42	703.6	33.2	18.9
Crimson Seedless		19.4	39	497.3	23.4	18.6
New LSD at 5%		5.9	2	93.4	6.1	N.S

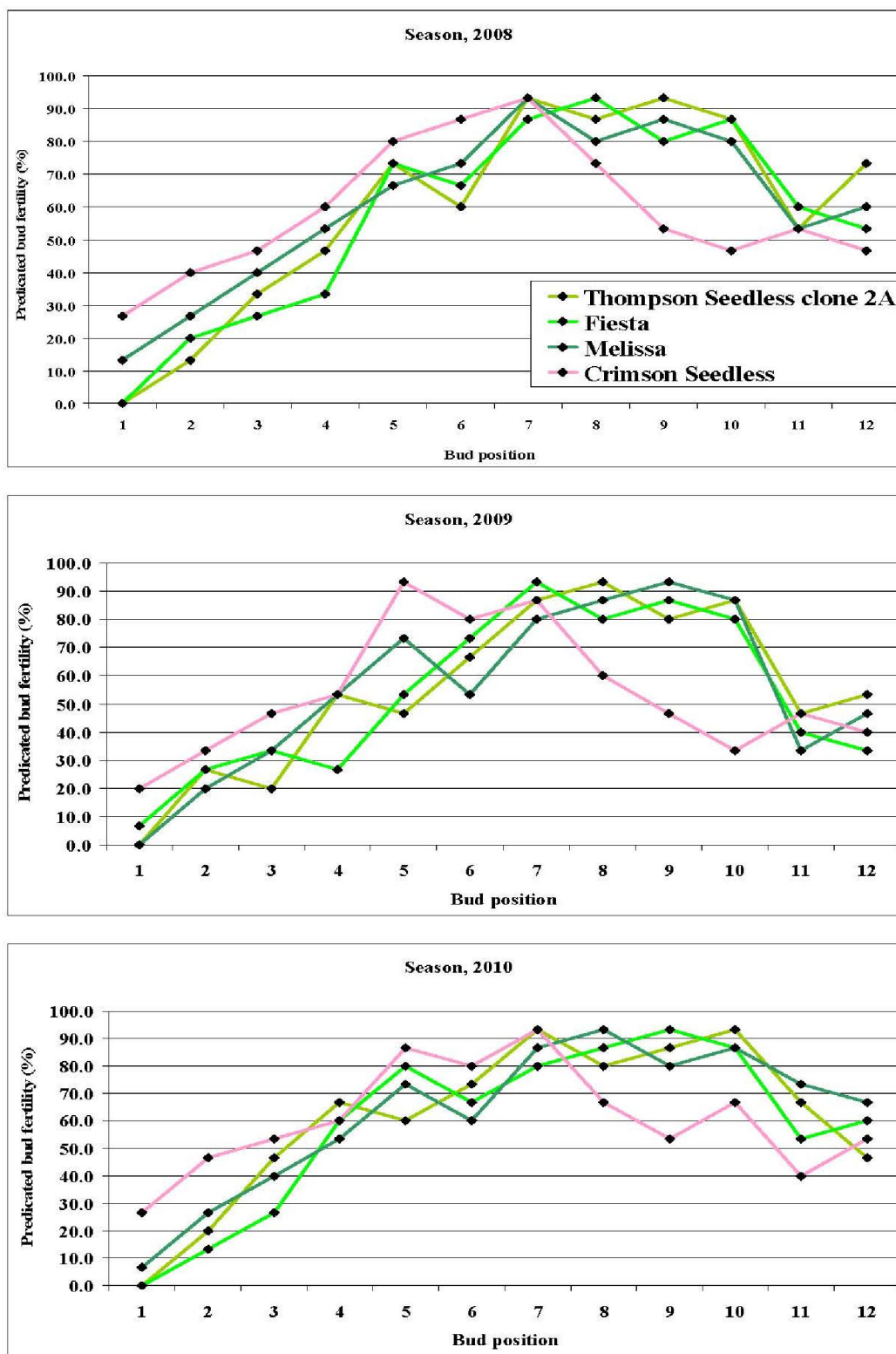


Figure (4): Percentages of predicted bud fertility at each bud position of four grape varieties in 2008, 2009 & 2010 seasons

Table (5): Berry physical and chemical characteristics of four grape varieties in 2008, 2009 & 2010 seasons

Cultivars Characteristics	Average berry weight (g)	Average berry Size (cm ³)	Average berry length (cm)	Average berry diameter (cm)	Average berry shape index	TSS (%)	acidity (%)	TSS/acid ratio
Season, 2008								
Thompson Seedless clone 2A	3.16	2.97	1.78	1.65	1.08	16.2	0.56	28.9
Fiesta	2.39	2.18	1.44	1.40	1.03	16.4	0.57	28.8
Melissa	4.83	4.66	2.37	1.89	1.25	16.3	0.60	27.2
Crimson Seedless	4.54	4.38	2.44	1.77	1.38	16.1	0.54	29.8
New LSD at 5%	0.91	0.95	0.43	0.29	0.19	N.S	0.05	2.3
Season, 2009								
Thompson Seedless clone 2A	3.15	2.94	1.75	1.64	1.07	16.1	0.59	27.3
Fiesta	2.36	2.14	1.42	1.39	1.02	16.5	0.61	27.0
Melissa	4.78	4.62	2.34	1.86	1.26	16.4	0.63	26.0
Crimson Seedless	4.42	4.25	2.41	1.71	1.41	16.3	0.56	29.1
New LSD at 5%	0.87	0.93	0.39	0.27	0.16	N.S	0.06	2.7
Season, 2010								
Thompson Seedless clone 2A	3.18	2.99	1.85	1.71	1.08	16.4	0.54	30.3
Fiesta	2.41	2.20	1.48	1.43	1.03	16.5	0.55	29.9
Melissa	4.95	4.77	2.42	1.93	1.25	16.3	0.58	28.1
Crimson Seedless	4.65	4.46	2.50	1.82	1.37	16.2	0.52	31.1
New LSD at 5%	0.97	0.99	0.45	0.32	0.22	N.S	0.05	2.9

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