Comparing HVI Fiber Properties With Conventional Methods

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ABSTRACT

Four commercial Egyptian cotton cultivars representing the two length groups (Giza 70, Giza 88, Giza 86 and Giza 89) with three lint grades for each variety were used in the present investigation., the Fiber properties for the two seasons 2002 and 2003 were tested, following standared methods, by both the High Volume Instrument (HVI) system and the conventional instruments.

The attained results revealed highly significant differences between the two studied determining (HVI and Conventional methods) in all studied traits, except 2.5 % span length and elongation percentage. High average differences in length uniformity ratio and proportion of maturity (PM) were detected between the two methods. Over estimations in the HVI values for those traits were noticed and the values did not corresponded to grade within each variety in the two seasons. On the contrary, lower estimations in fiber bundle strength by the same determining method (HVI) were noticed in the two seasons.

Also, a slight average differences between the two determining methods in 50 % span length and micronaire reading were detected in both seasons.

All tested fiber properties by conventional instruments were significantly affected by the cotton variety in both seasons, except length uniformity ratio in the first season. Also, all studied HVI fiber properties were significantly influenced by the same factor, except length uniformity in both seasons and bundle strength in the first season as well as elongation percentage and proportion of maturity (PM) in the second season.

The cotton grade significantly affected 2.5 % span length, micronaire reading and proportion of maturity (PM) which determined by conventional methods in the two seasons, as well as 50 % span length and Pressely index in the

first season. All studied HVI length parameters and elongation percentage in both seasons, besides bundle strength in the first season were not significantly affected by cotton grade.

INTRODUCTION

The world wide spread of the High Volume Instrument (HVI) testing systems, with their ability to provide rapid and economical measurements of the most important cotton fiber properties, has stimulated efforts to obtain the maximum benefits from those systems.

Research has proceeded in two directions : investigating the accuracy and reproducibility of the data obtained from those systems(9,10,11), and development of regression equations relating HVI properties to yarn or fabric quality parameters (2, 3, 4).

HVI measurements are in account with the standard test method of the American Society for Testing and Materials (A.S.T.M.). Research has shown that combinations of HVI measured fiber properties can account for 80 to 95 % of known variation in yarn strength and 75 to 85 % in fabric strength (5).

In the current USA cotton classing system, cotton color is evaluated both instrumentally and visually. The colorimeter of the High Volume Instrument (HVI) is used to measure the reflectance Rd and yellowness +b of cotton to provide color grade based on Nickerson-Hunter color diagram. The color grade is then double checked by classer in reference to the universal standards. When the two grades conflict the classer grade is the final call for the sample (6, 12).

The HVI-classer disagreements may arise mainly from differences in the process of color evaluation in these two methods. A classer can examine a much larger sample area than HVI colorimeter,

and is able to eliminate the influence of regular regions (spots and trash particles). The color change by HVI may yield a shift in color grade, especially when the color measurement is near the boundary between two grades. New colorimeters should include functions to eleminante spots and trash particles from color measurements (14).

Also, cotton fiber perimeter measured from cross-sections could be considered as the intrinsic fiber fineness. On the other hand, fiber wall area and degree of wall thickening (è) were significantly affected by the cotton grade (1).

The main objective of this study is further investigating the comparison between the HVI system and the conventional methods e.g. the Digital Fibrograph, Pressely, Stelometr, and Shirley Fineness/Maturity Tester (F.M.T.) in determinig the important cotton fiber properties and clarifying the difference significancy in the Egyptian cotton.

MATERIALS AND METHODS

Four commercial Egyptian cotton cultivars representing the length groups were involved in the present investigation. The extra-long staple cultivars were Giza 70 and Giza 88, while, the long staple cultivars were Giza 86 and Giza 89. Three lint grades namely, Good + ¼ (G+1/4), Good and Good –1/4 (G –1/4) for each cotton variety were used. Each grade was represented by three replicates, 250 gm for each.

The studied cotton samples were obtained from ALCOTAN Cotton Trading Company for the two seasons 2002 and 2003.

Studied fiber properties:

The High Volume Instrument (Premier 9000 V2.13SP) system, ICC calibrated, was used for testing the following fiber properties according to the standard method, at the Modern Nile Company Lab. at Alexandria: 2.5 % and 50 % Span lengths, length uniformity ratio, micronaire reading, fiber proportion of maturity (PM), bundle strength and elongation. Besides, the colour attributes: reflectance degree (Rd %) and yellowness degree (+b) for the studied samples.

The same samples were tested by the conventional instruments for the same traits at the Cotton Arbitration and Testing General Organization (C.A.T.G.O.) Labs, Smouha, Alexandria as follows:

1- Fiber length parameters: The Digital Fibrogaph 530, was used for measuring the fiber 2.5 % and 50 % span lengths in mm and the length uniformity ratio was calculated according the standard method of the A.S.T.M. (D-1447- 79).

2- Fiber bundle strength and elongation:

i-The Pressely instrument was used for determining the pressely index (PI) according to the standard method.

ii-The Stelometer was used for determining the fiber bundle strength (in g/tex) and the elongation percentage at 1/8 in gauge as directed in the standard method of the A.S.T.M.(D-1445-75).

3- Fiber fineness and maturity:

The micronaire reading and the proportion of maturity (PM) for the studied samples were determined using Shirley Fineness/Maturity Tester (FMT) as described in the A.S.T.M. (D-381-79).

Statistical procedure:

The present investigation was out lined in a completely randomized design, the attained data were analyzed as a factorial

experiment according to Steel and Torrie (1961). The comparison between the two studied fiber properties determining methods, the HVI and the conventional methods, was conducted using **t test in pairs** method.

RESULTS AND DISCUSION

The attained results will be presented and discussed herin in three main categories and the effect of cotton variety, grade and their interaction will be discussed under each category as follows:

I-The conventional methods:

A- Varietal effect:

Mean values of studied fiber properties determined by the conventional methods as influenced by cotton variety, grade and their interaction for the two studied seasons were shown in Table (1).

All studied fiber characters determined by the conventional methods, e.g. Fibrograph, Pressely, Stelometer and FMT, were significantly affected by the cotton variety in both seasons, except length uniformity ratio in the first season.

It is obvious that the cotton variety Giza 88 possessed the highest mean values of 2.5 % and 50 % span lengths, Pressely index and the fiber bundle strength besides, the lowest mean values of elongation percentage and the micronaire reading. Both Giza 70 and Giza 86 cotton varieties recorded the highest mean values of the length uniformity ratio in the first season. Meanwhile, the lowest mean values of length parameters and the highest mean values of the micronaire reading and

the proportion of maturity (PM) were recorded for Giza 89 cotton variety in the two studied seasons as illustrated in Table (1).

B-Grade effect:

The cotton grade significantly affected the span length 2.5 %, micronaire reading and proportion of maturity (PM) in the two seasons, as well as 50 % span length and Pressely index in the first season. The other studied characters were not significantly affected by this factor as shown in the aforementioned table.

The highest mean values of 2.5 % span length and Pressely index in the first season as well as the micronaire reading and proportion of maturity (PM) in both seasons were given by the highest studied cotton grade (G+1/4). The pressely index, micronaire reading and the proportion of maturity (PM) correspondingly decreased as the cotton grade decreased as presented in Table (1).

These results were in the same line with those obtained by Beheary (1993), who stated that the fiber wall area and degree of wall thickening (è) were affected by cotton grade.

C-Variety and grade interaction effect:

The interaction between cotton variety and grade was not significant for all tested fiber properties by conventional methods, except, 2.5 % span length, micronaire reading and maturity (PM) in the two seasons, as well as 50 % span length and bundle strength in the first season (Table 1).

Mean values of studied traits as affected by the aforementioned interaction in the two studied seasons were indicated in Table (3).

II- H.V.I. system:

Mean values of the studied fiber properties determined by the High Volume Instrument (HVI) system were shown in Table (2).

A- Varietal effect:

It could be noticed that all studied fiber characters were, also, significantly affected by cotton variety, except length uniformity in both seasons and bundle strength in the first season as well as elongation percentage and proportion of maturity (PM) in the second season.

Giza 88 cotton variety recorded the highest mean values of 2.5 % span length and the colour yellowness degree (+b) in the two seasons and bundle strength in the first season. The lowest mean values of micronaire reading and colour brilliance (Rd %) were also given by the same cotton variety in the two studied seasons.

The highest mean values of the proportion of maturity (PM) in the first season and 50 % span length in the second season were possessed by Giza 70 cotton variety. Whereas, the highest mean values of micronaire reading and colour reflectance degree (Rd %) were reached by the cotton variety Giza 89 as presented in Table (2).

B-Grade effect:

With regard to Table (2), it is clear that the cotton grade did not significantly affect all studied length parameters and elongation percentage in both seasons, besides bundle strength in the first season. The highest mean values of micronaire reading and colour reflectance degree (Rd %) were possessed by the highest cotton grade (G+1/4) in the two seasons as well as proportion of maturity (PM) in the first season only. Values of the aforementioned traits were correspondingly

decreased as the cotton grade decreased. These results disagree with those of Beheary (1993).

On the other hand, the studied colour attributes, reflectance (Rd %) and yellowness (+b), were significantly influenced by cotton grade in the two seasons, except yellowness degree (+b) in the second season as shown in Table (2). The highest mean values of the colour reflectance degree (Rd %) in both seasons was recorded by the highest cotton grade (G+1/4), then the values declined as the grade decreased. No specific trend for yellowness degree with the cotton grade was detected.

These results were in the same line with those of Xu *et al* (1998) who stated that a classer can examine a much larger sample area than HVI colorimeter, and is able to eliminate the influence of irregular regions (spots and trash particles).

C-Variety and grade interaction effect:

All studied HVI fiber properties were not significantly influenced by the aforementioned interaction, except, micronaire reading and reflectance degree (Rd %) in both seasons, as well as 2.5 % span length and yellowness degree (+b) in the first season Table 2).

The mean values of the studied fiber characters as affected by the same interaction for the two seasons were shown in Table (3).

III- Comparing HVI with conventional methods:

Mean values of studied fiber properties, determined by HVI and conventional methods side by side in comparison, as influenced by variety and grade interaction for the two seasons, besides the average difference and t test in pairs were presented in Table (3).

Highly significant differences between the two studied determining (HVI and Conventional) methods in all studied traits, except

2.5 % span length and elongation percentage were detected from t test in pairsof the whole data of the two seasons.

High average differences in length uniformity ratio and proportion of maturity (PM) were detected between the two determining methods. Over estimation in the HVI values for those traits could easily be noticed, in addition, those values did not corresponded to the cotton grade within each variety in the two seasons.

Also, slight average differences between the two determining methods in 50 % span length and micronaire reading could be observed in both seasons as indicated in the aforementioned table.

On the contrary, lower estimation in fiber bundle strength by the same determining method (HVI) were noticed in the two studied seasons as presented in Table (3).

These results could be explained on the basis that the HVI system calculates proportion of maturity (PM) from the mironaire reading, but the FMT calculates this value from the double compression air flow data. Besides, the different mechanism of fiber bundle breakage in the HVI and Stelometer.

Concerning colour attributes, data presented in Table (3) revealed that within each cotton variety, slight differences in reflectance (Rd %) and yellowness degree (+b) among studied cotton grades were found. The highest mean values of those traits were obtained for the highest cotton grade (G+1/4) of the cotton variety Giza 89 and the lowest grade (G-1/4) of the cotton variety Giza 88 in the first season, respectively. Meanwhile, the lowest mean value of reflectance degree (Rd %) was recorded by the cotton grade (Good) of the cotton variety Giza 88, also, in first season.

As for yellowness degree (+b), the lowest mean values were possessed by all studied grades of Giza 89, the highest and lowest grades of Giza 86 and first and second grades of Giza 70 cotton variety.

These results confirm the findings of Xu et al (1998), who concluded that the redness (a) of cotton constitutes from 10 % of chroma in the white category to 30 % in the tinged category. Spots and trash particles can bring about various degrees of change in cotton color, depending on their size and color in the scene.

It could be concluded that inspite of the ability HVI systems to provide rapid and economical measurements of the more important cotton fiber properties in printed reproducible form, it is not so accurate as the conventional determining methods.

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Table (1): Mean values of studied fiber properties determined by the **conventional methods** as affected by cotton variety, grade and their interaction for the two seasons 2002 and 2003.

Variety / Grade	2.5 % Span Length(mm)		50 % Span Length(mm)		Length U.R.		Pressely Index		Strength (g/tex)		Elongation (%)		Micronaire Reading		Proportion of Maurity (PM)	
Season	02	03	02	03	02	03	02	03	02	03	02	03	02	03	02	03
Variety (V)	**	**	**	**	N.S	N.S	**	**	**	**	**	**	**	**	**	**
Giza 70	34.75 a	34.11 b	16.92a	17.01 a	48.5 a	49.8 a	11.3 b	11.4 b	34.7 b	34.4 b	5.2 b	5.7 b	3.77b	3.78 b	79.7 a	77.0 b
Giza 88	34.72 a	34.67 a	17.2 a	17.13 a	49.4 a	49.2 a	11.5 a	11.5 a	35.5 a	35.4 a	5.1 b	5.2 c	3.53 c	3.47 c	75.7 b	76.2 b
Giza 86	31.88 b	31.86 c	15.68b	15.92 b	49.0 a	49.8 a	10.7 c	11.0 c	30.2 c	32.3 c	6.3 a	6.1 a	3.60 c	3.98 a	74.8 b	77.3 b
Giza 89	30.08 c	31.45 d	14.85c	15.40 c	49.3 a	48.8 a	10.4 d	10.4 d	29.1 d	28.9 d	6.4 a	6.3 a	3.88 a	4.09 a	79.6 a	82.5 a
Grade (G)	*	*	N.S.	*	N.S	N.S.	N.S.	**	N.S.	N.S.	N.S.	N.S.	**	**	**	**
G 1/4	33.06 a	33.19 a	16.38 a	16.52 a	49.4 a	49.6 a	11.0 a	11.1 a	32.4 a	32.7 a	5.7 a	5.8 a	4.08 a	4.10 a	83.3 a	82.5 a
Good	32.73 b	33.47 a	16.00 a	16.58 a	48.7 a	49.4 a	11.0 a	11.1 a	32.4 a	32.7 a	5.6 a	5.8 a	3.46 c	3.96 b	73.7 c	78.3 b
G 1/4	32.80 ab	32.41 b	16.13 a	15.99 b	49.1 a	49.3 a	11.0 a	11.0 b	32.2 a	32.8 a	5.8 a	5.8 a	3.54 b	3.42 c	75.5 b	74.0 c
Interaction V X G	**	*	**	N.S.	N.S.	N.S.	N.S.	N.S.	*	N.S.	N.S.	N.S.	**	**	**	*

Means designated with the same letter in each column are not significantly varied at 0.05 level of probability.
** = significant at 0.01, * = significant at 0.05 of probability and N.S. = not significant.

Table (2): Mean values of studied fiber properties determined by the **HVI system** as affected by cotton variety, grade and their interaction for the two seasons 2002 and 2003.

Variety/ Grade	2.5 % Span Length(mm)		50 % Span Length(mm)		Length U.R.		Micronaire Reading		Strength (g/tex)		Elongation (%)		Colour				Proportion of Maurity (PM)	
													Rd%		+b			
Season	02	03	02	03	02	03	02	03	02	03	02	03	02	03	02	03	02	03
Variety	**	*	**	**	N.S.	N.S	N.S.	**	N.S.	*	N.S.	N.S.	**	**	**	**	**	N.S.
Giza 70	33.39 a	35.08a	17.33ab	17.94 a	51.9a	51.1a	3.92a	3.90b	32.2 a	32.1a	7.2a	5.6a	73.4b	69.4b	8.3 b	10.5 b	87.1a	87.0a
Giza 88	34.01a	35.18 a	18.25a	17.59 ab	53.7a	50.0a	3.68b	3.66c	30.9 a	33.8a	7.2 a	5.5a	65.0c	67.1c	13.4a	13.3a	85.9b	86.7a
Giza 86	31.06 b	32.76b	16.09b	16.67 bc	51.7a	50.9a	3.85a	4.13a	29.9 a	32.5a	7.2 a	5.6a	73.6a	71.1a	8.3 b	9.4c	85.9b	87.7a
Giza 89	29.42 c	32.20b	14.54 c	16.14 c	49.5a	50.0a	3.93a	4.16a	29.4 a	28.4b	7.0 b	5.5a	73.6a	71.5 a	8.2 c	9.2 c	86.0b	86.4a
Grade	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	*	*	N.S.	*	N.S.	N.S.	**	**	**	*	*	**
G+1/4	31.68a	34.14a	16.85a	17.47a	53.2a	51.1a	4.21a	4.21a	30.6a	30.1b	7.2a	5.6a	72.1a	71.8a	9.6b	10.8a	87.3a	87.0b
Good	32.05a	33.80a	16.80a	17.29a	52.2a	51.2a	3.65b	4.12a	31.1a	32.5a	7.2a	5.6a	71.1b	69.9b	9.5c	10.3a	85.8b	87.9a
G-1/4	32.17a	33.48a	16.01a	16.49a	49.7a	49.2a	3.67b	3.56b	30.0a	32.5a	7.1a	5.5a	71.1b	67.5c	9.6a	10.5ab	85.8b	85.9c
Interaction																		
V X G	**	N.S.	N.S.	N.S.	N.S.	N.S.	*	**	N.S.	N.S.	N.S.	N.S.	**	**	**	N.S.	N.S.	N.S.

Means designated with the same letter in each column are not significantly varied at 0.05 level of probability.
** = significant at 0.01, * = significant at 0.05 of probability and n.s = not significant.

Table (3): Mean values of studied fiber properties determined by HVI and conventional methods (C.M.) as affected by variety and grade interaction in the two season 2002 and 2003.

Variety/Grade		2.5% Span Length(mm)		50% Span Length(mm)		Length Uniformity		Strength (g/tex)		Elongation (%)		Micronaire Reading		PM (%)		HVI	
		HVI	C.M.	HVI	C.M.	HVI	C.M.	HVI	C.M.	HVI	C.M.	HVI	C.M.	HVI	C.M.	Rd%	+b
2002	G+1/4	33.2	34.9	17.3	17.4	52.2	49.7	30.9	34.6	7.3	5.2	4.36	4.15	88	85	73.7	8.3
Giza 70	Good	34.1	35.4	18.5	17.2	54.3	48.3	33.3	34.8	7.2	5.1	3.82	3.72	87	79	73.3	8.3
	G-1/4	32.9	33.9	16.2	16.2	47.7	47.7	32.3	34.6	7.2	5.4	3.59	3.45	86	75	73.3	8.4
	G+1/4	34.3	34.9	18.6	17.3	54.4	49.3	32.8	36.1	7.3	5.1	4.05	4.04	88	85	67.4	13.5
Giza 88	Good	33.8	34.7	18.2	17.1	53.8	49.0	29.5	35.7	7.1	5.2	3.48	3.03	85	69	63.7	13.2
	G-1/4	33.9	34.4	17.9	17.2	52.9	50.0	30.3	34.8	7.1	5.1	3.52	3.25	85	74	64.0	13.6
	G+1/4	30.4	31.7	16.5	15.6	54.4	49.0	30.4	30.1	7.2	6.4	4.18	3.88	87	79	73.7	8.3
Giza 86	Good	31.5	31.5	16.2	15.5	51.4	49.0	30.1	30.3	7.2	6.1	3.64	3.28	85	70	73.6	8.4
	G-1/4	31.2	32.3	15.4	15.9	49.3	49.0	29.2	30.1	7.1	6.4	3.75	3.64	85	76	73.6	8.3
	G+1/4	28.8	30.5	14.9	15.1	51.6	49.7	28.4	29.1	7.0	6.5	4.28	4.27	87	85	73.8	8.3
Giza 89	Good	28.7	29.5	14.2	14.2	49.4	48.7	31.4	28.9	7.1	6.3	3.68	3.55	86	77	73.6	8.3
	G-1/4	30.6	30.5	14.5	15.2	47.5	49.7	28.3	29.3	7.0	6.5	3.83	3.83	85	77	73.5	8.3
2003	G+1/4	35.3	34.5	19.1	17.3	54.1	50.0	28.4	34.4	5.6	5.8	4.18	4.13	86	82	72.5	10.5
Giza 70	Good	35.5	34.4	17.5	17.2	49.2	50.0	35.2	34.5	5.6	5.7	3.92	3.86	88	75	67.9	10.4
	G-1/4	34.5	33.4	17.3	16.5	50.1	50.0	32.7	34.5	5.5	5.7	3.62	3.35	86	74	67.7	10.6
	G+1/4	35.8	34.5	18.3	17.2	51.0	49.0	33.1	35.5	5.5	5.2	4.00	3.88	88	82	69.4	13.4
Giza 88	Good	34.9	35.1	17.9	17.2	51.1	49.0	33.5	35.4	5.5	5.4	3.66	3.39	87	75	66.7	13.0
	G-1/4	34.8	34.3	16.6	17.0	48.0	49.0	34.8	35.4	5.5	5.2	3.35	3.14	86	71	65.1	13.5
	G+1/4	32.9	32.5	16.5	16.2	50.4	50.0	31.3	32.1	5.7	6.2	4.57	4.40	88	83	72.6	10.3
Giza 86	Good	32.3	32.3	16.8	16.2	52.1	50.0	33.8	32.2	5.6	6.1	4.24	3.97	89	77	73.7	9.0
	G-1/4	33.1	30.8	16.6	15.3	50.3	50.0	32.5	32.6	5.6	6.1	3.60	3.58	86	72	67.0	8.8
	G+1/4	32.6	31.3	15.9	15.4	49.0	49.0	27.8	29.0	5.5	6.1	4.12	4.00	86	83	72.9	9.2
Giza 89	Good	32.5	32.0	17.0	15.6	52.5	49.0	27.8	28.8	5.6	6.3	4.68	4.63	87	86	71.5	9.0
	G-1/4	31.6	31.1	15.3	15.1	48.6	49.0	29.8	29.0	5.5	6.4	3.70	3.64	85	78	70.2	9.3
Average difference		0.0501388 N.S.		0.5628 **		1.897 **		1.5444 **		0.5625 N.S.		0.1713 **		8.6528 **			

مقارنة خواص الألياف المختبرة بجهاز ال H.V.I. و الأجهزة التقليدية

دكتور/ مشحوت جناب اسماعيل بحيرى

قسم الانتاج النباتى كلية الزراعة (سابا باشا)، جامعة الاسكندرية

استخدم فى هذا البحث أربعة أصناف تجارية من القطن المصرى تمثل مجموعتى الطول (جيزة 70 ، جيزة 88 ، جيزة 86 و جيزة 89) مع ثلاث رتب من كل صنف. تم اختبار صفات الألياف باستخدم جهاز ال H.V.I. والأجهزة التقليدية وفقا للطرق القياسية.

أوضحت النتائج المتحصل عليها فروق عالية المعنوية بين طريقتى التقدير (ال H.V.I. والأجهزة التقليدية) فى جميع صفات الألياف التى درست ، عدا امتداد الطول عند 2.5 % و نسبة الاستطالة وذلك من اختبار t للنتائج الاجمالية للموسمين. وجدت متوسطات فروق كبيرة فى نسبة انتظام الطول ونضج الألياف بين طريقتى التقدير. لوحظت زيادات فى القيم المقدرة بال H.V.I. لهذه الصفات وأن القيم لا تتماشى مع الرتبة داخل كل صنف ، وعلى العكس فقد لوحظ انخفاض لقيم متانة الخصلة مقدرة بنفس الطريقة فى الموسمين. كما وجدت متوسطات فروق بسيطة بين الطريقتين فى الطول الممتد عند 50 % وقراءة الميكرونير فى كلا الموسمين.

جميع الصفات التى قدرت بالطرق التقليدية قد تأثرت معنويا بصنف القطن فى الموسمين ، عدا نسبة انتظام الطول فى الموسم الأول ، وقد تأثرت أيضا جميع صفات الألياف المقدرة بال H.V.I. معنويا بهذا العامل ، عدا نسبة انتظام الطول فى الموسمين و متانة الخصلة فى الموسم الأول وكذا نسبة الاستطالة ونضج الألياف فى الموسم الثانى.

أثرت رتبة القطن معنويا على امتداد الطول عند 2.5 % ، قراءة الميكرونير و النضج المقدرة بالطرق التقليدية فى الموسمين ، وكذا الطول الممتد عند 50 % ومعامل بريسلى فى الموسم الأول ، لم تتأثر معنويا برتبة القطن جميع مؤشرات الطول بجهاز ال H.V.I. ونسبة الاستطالة فى الموسمين الى جانب متانة الخصلة فى الموسم الأول.