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Effect of Different Plastic Covers on Vegetative Growth and Yield Quality of Cucumber Plants (*Cucumis sativus* L.)

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Abstract: Greenhouse films have traditionally used an absorber of short wavelength UV as a part of the stabilizer package. Replacing or augmenting this with alternative absorbers can broaden the band of UV absorption up to wavelengths of 370 to 380nm and this is the principle used in some greenhouse film for insect and/or fungal control. Plant responses to light spectral quality can be exploited to deliver a range of agronomical desirable end points in protected crops. The work reported here has characterized the response of commercial cucumber cultivars, Hesham F1 and Brengy F1 when grown under diffused Anti Fog UV-Opaque film (THB AF UV-O), clear Anti Fog UV-Opaque film (UV-O), diffused UV-Opaque film (THB UV-O) and polyvinyl chloride (P.V.C). Our results indicated that, diffused Anti Fog UV-Opaque film (THB AF UV-O) significantly increased plant height, number of leaves per plant and the average plant leaf area of both cucumber cultivars when compared to the other plastic covers. The highest total yield and number of fruits per square meter was achieved by cladding greenhouse by diffused Anti Fog UV-Opaque film (THB AF UV-O) one. Meanwhile, the lowest mean values of fruit yield and its components were attained by using polyvinyl chloride (P.V.C)

Key words: Cucumber · Greenhouse film · Ultraviolet radiation

INTRODUCTION

One of the most interesting developments in commercial protected cropping in recent years is the introduction of spectral filters in horticultural industry. The development of these plastic filters used to a clad tunnels in the growing systems which can select absorb or transmit specific wavelengths with particular to UV region giving a good opportunity to study effects of the spectral quality and quantity on growth, morphology and yield of many plant species. Published results indicated that ultraviolet (UV) radiation can be a stressful factor to plants, inducing plant morphology, physiology and crop yield [1] as a reduction in leaf expansion is one of the most consistent responses of plant exposure to solar UV-B that this may contribute to reductions in plant growth and development [2-4]. Conversely, lettuce plants grown in reduced UV radiation showed an increase in vegetative growth [5]. Luminance thermal heat barrier (THB) is considered a new generation of crop covers which designed to manipulate the transmission of infra-red radiation (IR) through the film specifically to reduce peak day-time temperatures while maintaining higher night-time temperatures. Luminance THB achieves these effects while allowing over 85% of useful light in the photosynthetic active radiation (PAR) range to reach the crop ensuring plants to receive all the sunlight they need to grow. In addition to Luminance THB's thermal properties, it incorporates novel additives that diffuse over 90% of incoming light which reduce the chance of leaf scorching while increasing photosynthetic efficiency in the crop canopy. This ensures growers produce a good uniform crop and maximum possible yields [6]. Polyvinyl chloride (P.V.C.) film has very high emissivity for long-wave radiation, which creates slightly higher air temperatures in the greenhouse at night. Ultra violet (UV) inhibitors can increase the life of the film. It is more expensive than polyethylene film and tends to accumulate dirt, which must be washed off in winter for better light transmission [7]. This work aims to investigate the response of cucumber plants to different plastic covers of diffused Anti Fog UV-Opaque film (THB AF UV-O),

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diffused UV-Opaque film (THB UV-O), clear Anti Fog UV-Opaque film (UV-O) and polyvinyl chloride film (P.V.C) to study their effects on growth and productivity of cucumber.

MATERIALS AND METHODS

The experiments were conducted during the two winter seasons of 2008/ 2009 and 2009/2010. This study aims to investigate the response of cucumber plants to different plastic covers of diffused Anti Fog UV-Opaque film (THB AF UV-O), diffused UV-Opaque film (THB UV-O), clear Anti Fog UV-Opaque film (UV-O) and polyvinyl chloride film (P.V.C). The characteristics of each type of the plastic covers are given in Table 1.

Seeds of the two cucumber cultivars (Hesham F_1) and (Brengy F_1) were sown in the nursery in foam trays filled with a mixture of peat moss and vermiculite (1:1 volume) on 28 of October, in both seasons. Seedlings of 22 days old were transplanted in the plastic houses. Plastic house area was 270 m^2; 9 m in width and 30 m in length. Plastic houses were divided into six ridges 1 m wide, 40 cm space between ridges and 50 cm between plants. Cucumber transplants were grown in double rows. Each plastic house was divided into 2 sections of plastic cover, 10 m long. Each section was divided into two cultivars. Main plots consisted of four types of plastic covers, whereas the sub-plots were allocated to the two used cultivars. Each sub-plot consisted of two ridges, 4.0 m long including 32 plants and occupying an area of 8 m^2. All Agricultural practices such as cultivation, plant training and disease and pest control were carried out whenever it was necessary according to the recommendations of the commercial production of green house cucumber as outlined by Ministry of Agriculture and Land Reclamation-Arab Republic of Egypt [8]. The air temperatures out and inside plastic house daily through the two winter seasons was recorded using a Digital Hygro-Thermometer and the light intensity (Lux) out side and under plastic house daily during the two winter of seasons (2008/2009) and (2009/2010) was recorded using a Digital light meter.

After one hundred days after transplanting, five plants from each experimental unit were randomly chosen for growth measurements such as plant height (cm), number of leaves $plant^{-1}$ average leaf area/plant (cm^2) total yield m^{-2} and number of fruits m^{-2}. In addition to chemical analysis such as Leaves chlorophyll content according to the method described by Yadava [9] using a Minolta SPAD chlorophyll meter model, dry matter content of leaves and fruits according to A.O.A.C. [10] and mineral contents of leaves and fruits nitrogen and phosphorus were determined calorimetrically using spectrophotometer at 662 and 650 nm; according to Evenhuis [11] and Murphy and Riley [12], respectively. Potassium and calcium were measured using a flam photometer as explained by Chapman and Pratt [13].

Experimental Design and Statistical Analysis: The experimental layout was a split-plot system in a randomized complete blocks design (RCBD) with three replications. All obtained data were statistically analyzed, according to the analysis of variance as illustrated by Snedecor and Cochran [14] and the Revised LSD test at 0.05 level was used to compare the differences among the means of the various treatments combinations, as illustrated by El-Rawy and Khalf-Allah [15].

Table 1: The characteristics of the used plastic cover types

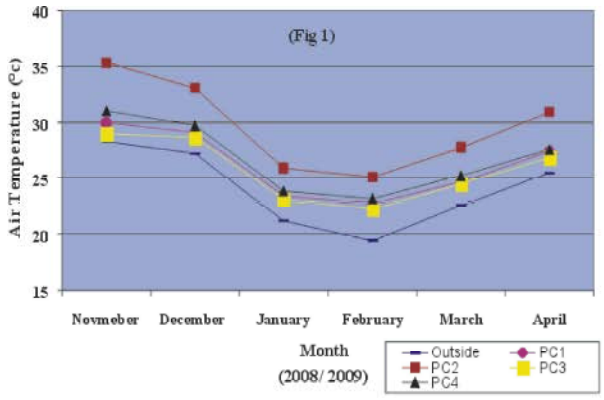
Plastic types	Thickness (micron)	Light transmission (%)		Light Diffusion (%)
(THB AF UV-O)	200	87%	0% UVB	> 90%
			10% UV A	
			95% PAR	
(P.V.C) (Control treatment)	200	85-90%	4 % UVB	30-40%
			47% UVA	
			93% PAR	
(UV-O)	200	90%	0% UVB	25%
			10% UV A	
			95% PAR	
(THB UV-O)	200	87%	2% UVB	> 90%
			42% UV A	
			89% PAR	

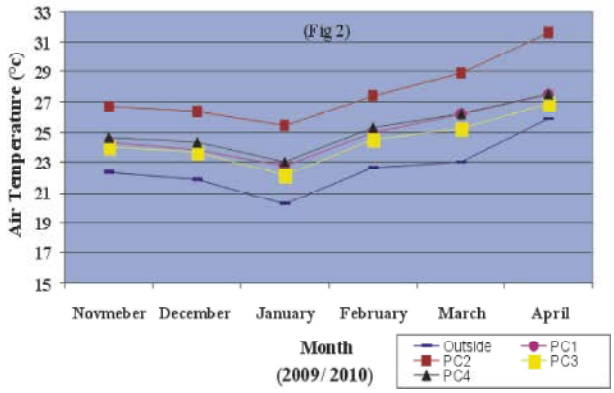
Diffused Anti Fog UV-Opaque film (THB AF UV-O), Diffused UV-Opaque film (THB UV-O), Clear Anti Fog UV-Opaque film(UV-O) and Polyvinyl chloride film (P.V.C) were supplied by Arid Agri Tech green houses Films Company, U. K.(WWW.aridagitec.com) Polyvinyl chloride (P.V.C) was obtained from Agro Tech Company, Egypt.

RESULTS AND DISCUSSION

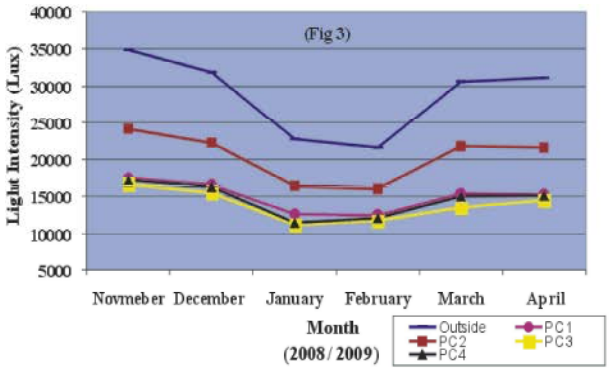
Data in Fig.1 illustrate the effects of the different plastic covers on air temperature around the two cucumber cultivars throughout the growing period in the two winter seasons of 2008/ 2009 and 2009/ 2010. Higher air temperature was generated under Polyvinyl chloride film (P.V.C), followed by diffused UV-Opaque film (THB UV-O) than all other types of plastic covers throughout the period from November to April, in both seasons. However, Clear Anti Fog UV-Opaque film (UV-O) recorded the lowest air temperature compared to the other cover types, in both seasons. Also the effects of the plastic covers on light intensity in the two winter seasons of 2008/2009 and 2009/2010 are listed in Fig.1 Also, the recorded data clarified that all used types of plastic covers caused clear decrease in average light intensity compared to the outside of the plastic house during the period from November to April, in both seasons are listed in Fig.2. Higher light intensity was recorded under Polyvinyl chloride film (P.V.C), followed by Diffused Anti Fog UV-Opaque film (THB AF UV-O) than the other types of plastic covers, in both seasons. However, Clear Anti Fog UV-Opaque film (UV-O) recorded the lowest mean values of light intensity compared to the other cover types, in both seasons (Fig. 3 and 4).

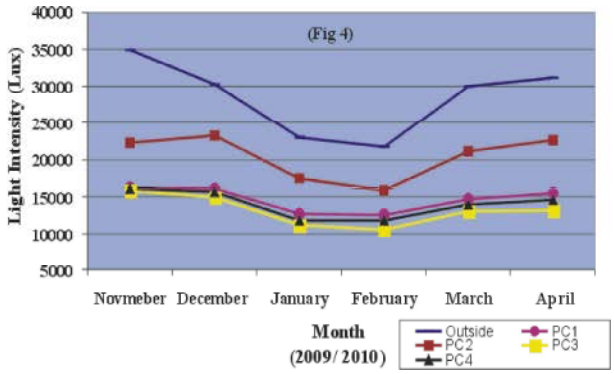
Vegetative Growth Characters: Diffused Anti Fog UV-Opaque film (THB AF UV-O) significantly increased plant height (cm) and total leaf area (cm^2) of cucumber plants, in the two winter seasons of 2009 and 2010. The only exception was for the number of leaves $plant^{-1}$ season, where the differences among plastic cover were not so high enough to be significant in the first season (Table 2). Such results were confirmed by Baytorun *et al.* [7], who showed that diffused Anti Fog UV-Opaque film (THB AF UV-O)allows over 85% of useful light in the photosynthetic active radiation (PAR) range to reach





Figs. 1 and 2: The air temperature (°C) under and outside plastic house, during two winter seasons of 2009 and 2010. Diffused Anti Fog UV-Opaque film (THB AF UV-O), Diffused UV-Opaque film (THB UV-O), Clear Anti Fog UV-Opaque film (UV-O) and Polyvinyl chloride film (P.V.C).





Figs. 3 and 4: The light intensity (Lux) under and outside plastic house during two winter seasons of 2009 and2010. Diffused Anti Fog UV-Opaque film (THB AF UV-O), Diffused UV-Opaque film (THB UV-O), Clear Anti Fog UV-Opaque film (UV-O) and Polyvinyl chloride film (P.V.C).

Table 2: Vegetative growth characters of cucumber plants grown under plastic house conditions as affected by plastic cover types and cultivars during the two winter seasons of 2008/2009 and 2009/2010

Characters	Plant height (cm)		No. of leaves plant^{-1}		Leaf area plant^{-1} (cm^2)	
Treatments	2008/2009 season	2009/2010 season	2008/2009 Season	2009/2010 season	2008/2009 season	2009/2010 season
Plastic cover types						
(THB AF UV-O)	219.00 A	220.50 A	32.49 A	32.92 A	306.78 A	309.04 A
(P.V.C)	211.33 B	211.83 B	30.66 A	30.50 B	281.97 C	281.08 C
(UV-O)	217.33 A	217.58 A	31.33 A	31.73 A	287.14 B	287.54 B
(THB UV-O)	217.50 A	218.33 A	31.50 A	31.83 A	286.94 B	287.33 B
Cultivars						
Hesham	222.00 A	220.33 A	33.33 A	33.59 A	303.86 A	303.38 A
Brengy	210.58 B	213.79 B	29.66 B	29.90 B	277.55 B	279.06 B

*Values followed by the same alphabetical letter(s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

the crop ensuring plants to receive all the sunlight they need to grow. In addition to Luminance THB's thermal properties, it incorporates novel additives that diffuse over 90% of incoming light which reduce the chance of leaf scorching while increasing photosynthetic efficiency in the crop canopy. The present results matched well with those obtained by Hemming and Reinders [16], who found that plants growing under diffused light conditions are able to use that diffused light more efficiently due to several internal mechanisms within the plant leaves.

The detected inferiority of P.V.C film on vegetative growth characters could be attributed to its higher light transmission of UVA and UVB (UVA 47% and UVB 4%) as well as the relatively lower light diffusion (30-40%) as shown in (Table 1) which causes negative effects on vegetative growth. This explanation seemed to be in agreement with the results recorded by Teramura [17], who reported that UV radiation can be regarded as a stress factor which is capable of significantly affecting plant growth characteristics; plant height and leaf area which were decreased in response to UVB radiation. In this concern [18] found that at 15°C, the increase in plant leaf area was 15 cm^2/10 day, conversely at 23°C, the increase in plant area was 25 cm^2/ 20 day. In the same line Ministry of Agriculture and Land Reclamation-Arab Republic of Egypt [19] reported that the plant stem elongation increases as P_{FR}/P_R decreases and the light intensity of UV light decrease. Recently, Wang *et al.* [20] demonstrated that the transpiration rate of cucumber leaf under red and blue light is higher compared with the other light UV-A and UV-B. Under UV-B light, the stoma conduction, transpiration rate and the CO_2 concentration between cells as well as the photosynthesis rate were decreased. At the same time, the germinating rate, fresh and dry weight, plant height and flower differentiation number were restrained distinctly; while the stomata density and thickness of cucumber leaf were greatly increased. Tsormpatsidis *et al.* [5] suggested that the growth reduction in an UV environment could be due to the damage of the photosynthetic apparatus. Recently, Yann *et al.* [21] showed that growth rate of the cucumber crop depends on the average 24-h temperature, the higher average air temperature the faster the growth. The larger the variation in day night air temperature, the taller the plant and the smaller the leaf size.

Fruit Yield and its Components: The number of fruits m^{-2}and total yield (kg m^{-2}) in the two winter seasons of 2009 and 2010 were achieved by cladding greenhouse by diffused Anti Fog UV-Opaque film (THB AF UV-O) (Table 3). However, the lowest early and total yields were obtained when Polyvinyl chloride film (P.V.C) was applied, in both seasons. Such an increase in total yield might be due to the positive influence of diffused Anti Fog UV-Opaque film (THB AF UV-O) on vegetative growth and flowering (Table 3) which led to increase in number of fruits m^{-2} and total yield(kg m^{-2}). Such finding is in agreement with those obtained by Tsormpatsidis *et al.* [5], who found an increase in number of cucumber fruits plant^{-1} when UVA and UVB were absent. Also, who suggested that the growth reduction in an UV environment could be due to damage to the photosynthetic apparatus. Hesham cultivar had total yield than those of Brengy cultivar, in both seasons. The obtained results are in harmony with those reported by El-Aidy *et al.* [22], who referred the superiority of Petostar hybrid one in early fruits yield (as number and weight) to the increase in vegetative growth and number of female flowers as compared to Primo one.

Table 3: Number of fruits m^{-2} and total yields (kg m^{-2}) of cucumber plants grown under plastic house conditions as affected by plastic cover types, cultivars and their interactions, during the two winter seasons of 2008/2009 and 2009/2010

Characters	Number of fruits m^{-2}		Total yield (kg m^{-2})	
Treatments	2008/2009 season	2008/2009 Season	2008/2009 season	2009/2010 season
Plastic cover types				
(THB AF UV-O)	140.04 A	134.60 A	11.68 A	11.27 A
(P.V.C)	118.15 C	114.30 C	9.78 C	9.48 C
(UV-O)	125.37 B	124.04 B	10.49 B	10.45 B
(THB UV-O)	125.51 B	122.40 B	10.35 B	10.24 B
Cultivars				
Hesham	128.77A	125.02 A	11.05 A	10.73 A
Brengy	125.76 B	122.65 B	10.11 B	9.99 B
Plastic cover types x Cultivars				
(THB AF UV-O) x Hesham	143.75 a	135.60 a	12.33 a	11.65 a
(THB AF UV-O) x Brengy	136.34 b	133.61 a	11.04 b	10.90 b
(P.V.C) x Hesham	121.70 d	115.73 d	10.39 d	9.87 e
(P.V.C) x Brengy	114.59 e	112.87 e	9.18 f	9.09 f
(UV-O) x Hesham	124.98 c	124.84 b	10.77 c	10.77 bc
(UV-O) x Brengy	125.76 c	123.24 b	10.22 de	10.13 d
(THB UV-O) x Hesham	124.66 cd	123.92 b	10.69 c	10.64 c
(THB UV-O) x Brengy	126.37 c	120.88 c	10.02 e	9.85 e

*Values followed by the same alphabetical letter(s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

Table 4: Leaf's chlorophyll content(mg/ 100 g f. w) and leaf's dry matter content (%) of cucumber plants grown under plastic house conditions as affected by plastic cover types, cultivars and their interactions during the two winter seasons of 2008/2009 and 2009/2010

Character	Leaves chlorophyll content (mg/100 g f. w)		Leaves dry matter content (%)	
Treatments	2008/2009 season	2008/2009 season	2008/2009 season	2009/2010 season
Plastic cover types				
(THB AF UV-O)	41.76 A	17.36 A	17.36 A	16.47 A
(P.V.C)	39.11 B	13.31 C	13.31 C	12.40 D
(UV-O)	39.34 B	14.76 B	14.76 B	14.72 B
(THB UV-O)	39.89 B	14.36 B	14.36 B	14.27 C
Cultivars				
Hesham	41.29 A	16.19 A	16.19 A	15.39 A
Brengy	38.76 B	13.70 B	13.70 B	13.53 B
Plastic cover types x Cultivars				
(THB AF UV-O) x Hesham	43.54 a	18.68 a	18.68 a	16.96 a
(THB AF UV-O) x Brengy	39.99 bc	16.05 b	16.05 b	15.98 b
(P.V.C) x Hesham	40.34 b	14.77 c	14.77 c	13.23 e
(P.V.C) x Brengy	37.89 d	11.84 e	11.84 e	11.57 g
(UV-O) x Hesham	40.18 b	15.96 bc	15.96 bc	15.93 b
(UV-O) x Brengy	38.50 d	13.56 d	13.56 d	13.51 d
(THB UV-O) x Hesham	41.11 b	15.35 bc	15.35 bc	15.45 c
(THB UV-O) x Brengy	38.67 cd	13.37 d	13.37 d	13.09 f

*Values followed by the same alphabetical letter(s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

Chemical Constituents of Leaves: Data recorded in Table 4 showed the highest significant mean values of leaves chlorophyll content were recorded with the interaction treatment including diffused Anti Fog UV-Opaque film (THB AF UV-O) and Hesham cultivar, in both seasons. However, the lowest leaf's chlorophyll content was resulted from the interaction treatment namely; Polyvinyl chloride film (P.V.C) control treatment and Brengy cultivar, in the both seasons. The results concerning the effect of different plastic covers on total

chlorophyll content of cucumber leaves indicted significant differences among the used four types of plastic cover in leaf's chlorophyll content. Higher significant mean values of leaf's chlorophyll content were obtained by using of diffused Anti Fog UV-Opaque film (THB AF UV-O) with Hesham cultivar. Under Polyvinyl chloride film (P.V.C), the leaf's chlorophyll content of Brengy cultivar exhibited lower mean values than diffused Anti Fog UV-Opaque film (THB AF UV-O). Similar results were found by Krizek *et al.* [23], who noticed that the inhibition of growth by ambient UV radiation has been reported in cucumber. Such growth inhibition is associated with damage to the photosynthetic apparatus and reduction of photo system efficiency. Lichtenthaler [24] showed that under normal conditions, most of the solar energy absorbed by leaf pigment (chlorophylls and carotenoids) is used for photosynthesis and small amount is released as infrared radiation (heat and as red chlorophyll fluorescence). Under stress conditions, photosynthesis declines, while heat emission and chlorophyll fluorescence increase considerably. Such findings could be interpreted on the basis that that the photosynthesis system responds to light most sensitively. Photosynthetic pigment content in higher plants is an important indicator for determining plants, physiological state. Chlorophyll loss is associated to environmental stress and the ratio of chlorophyll A to B is widely used as an indicator of plants response to stress [25]. The highest significant dry matter content of cucumber leaves were obtained by the application of diffused Anti Fog UV-Opaque film (THB AF UV-O). Meanwhile, the lowest mean values of leaf's dry matters percentage were resulted from growing cucumber under Polyvinyl chloride plastic film, in both seasons. The highest significant leaf's dry matter content was obtained by using diffused Anti Fog UV-Opaque film (THB AF UV-O) or growing Hesham cultivar, in both seasons. However, the lowest values of dry matters percentage were obtained by the treatment namely polyvinyl chloride film (P.V.C) × Brengy, in both seasons. These results are in agreement with those recorded by Marcelis [26, 27], who noticed that cucumber dry matter content increased with increasing irradiance and decreasing temperature.

The results in Table 5 showed that application of diffused Anti Fog UV-Opaque film (THB AF UV-O) tended to increase leaves N content comparing with the other types of plastic, in both seasons. Leaves P, K and Ca contents, however, did not reflect any significant response. Hesham cultivar contained higher leaves N content than Brengy one. The highest leaves N content was obtained when Hesham cultivar was covered by diffused Anti Fog UV-Opaque film (THB AF UV-O), in both seasons. Meanwhile, the highest leaves P content was recorded when Hesham cultivar was grown under Polyvinyl chloride film (P.V.C), in both seasons. On the other hand, the highest leaf's K content was recorded when Brengy cultivar was grown under diffused Anti Fog UV-Opaque film (THB AF UV-O). On the other extreme, the combination having Polyvinyl chloride film (P.V.C) and Brengy cultivar seemed to be associated with the highest leaves Ca content, in the second season only. Such results were obtained by Hochmuth [28], who noticed that the greenhouse cucumber grow quickly and should never be allowed to suffer from lack of water or nutrients. Thus, nutrient uptake rate under greenhouse condition is very high.

Chemical Constituents of Fruits: Results showed that fruit's dry matter content did not significantly affect by different plastic covers. Hesham cultivar tended to

Table 5: Leaves mineral content of cucumber plants grown under plastic house conditions as affected by plastic cover types and cultivars, during the winter season of 2008/2009

Seasons	2008/2009 season				2009/2010 season			
Treatments	N (%)	P (%)	K (%)	Ca (mg/ 100 g D.W)	N (%)	P (%)	K (%)	Ca (mg/ 100 g D.W)
Plastic cover types								
(THB AF UV-O)	3.37 A	0.501 A	3.01 A	1.21 A	3.29 A	0.513A	3.01 A	1.19 A
(P.V.C)	3.00 C	0.515 A	2.86 A	1.27 A	2.93 D	0.528 A	2.96 A	1.25 A
(UV-O)	3.16 B	0.501 A	2.95 A	1.17 A	3.15 B	0.505 A	2.94 A	1.10 A
(THB UV-O)	3.13 B	0.509 A	2.95 A	1.25 A	3.10 C	0.521 A	2.97 A	1.21 A
Cultivars (C1)Hesham	3.26 A	0.508 A	2.95 A	1.22 A	3.19 A	0.519 A	2.98 A	1.21 A
(C2)Brengy	3.07 B	0.506 A	2.94 A	1.23 A	3.04 B	0.514 A	2.96 A	1.17 A

*Values followed by the same alphabetical letter(s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

Table 6: Fruit's dry matter content(%) of cucumber plants grown under plastic house conditions as affected plastic cover types, cultivars and their interactions, during the two winter seasons of 2008/2009 and 2009/2010

Character	Fruit's dry matter content (%)	
Treatments	2008/2009 season	2009/2010 season
Plastic cover types		
(P.C1)Luminance THB AF UV Blocker	5.17 A	5.19 A
(P.C2) Polyvinyl chloride P.V.C	5.13 A	5.12 A
(P.C3) Clear AF UV Blocker	5.17 A	5.17 A
(P.C4)Luminance THB	5.16 A	5.15 A
Cultivars		
(C1) Hesham	5.31 A	5.15 A
(C2) Brengy	5.00 B	5.16 A

*Values followed by the same alphabetical letter(s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

Table 7: Fruit's mineral content of cucumber plants grown under plastic house conditions as affected by plastic cover types and cultivars, during the winter season of 2009/2010

Seasons	2008/2009 season				2009/2010 season			
Treatments	N (%)	P (%)	K (%)	Ca (mg/ 100 g D.W)	N (%)	P (%)	K (%)	Ca (mg/ 100 g D.W)
Plastic cover types								
(THB AF UV-O)	2.00 A	0.385 AB	3.35 A	0.812 BC	2.10 A	0.395 A	3.44 A	0.824 A
(P.V.C)	1.99 A	0.394 A	3.17 C	0.869 A	2.04 A	0.403 A	3.15 C	0.889 A
(UV-O)	2.01 A	0.378 B	3.26 B	0.801 C	2.06 A	0.392 A	3.26 B	0.807 A
(THB UV-O)	2.04 A	0.392 AB	3.20 C	0.836 AB	2.09 A	0.396 A	3.40 A	0.878 A
Cultivars (C1) Hesham	2.04 A	0.390 A	3.30 A	0.901 A	2.12 A	0.402 A	3.35 A	0.879 A
(C2)Brengy	1.98 B	0.386 A	3.20 B	0.758 B	2.02 B	0.391 A	3.28 A	0.820 A

*Values followed by the same alphabetical letter (s) in common, within a particular group of means in each character, do not significantly differ, using Revised LSD test at 0.05 level of probability.

contain higher fruit's dry matter content than Brengy one. In addition, the obtained results revealed that the highest significant mean values of fruit's dry matters content were recorded when Hesham cultivar was grown under diffused Anti Fog UV-Opaque film (THB AF UV-O(, in the first season only. However, the lowest significant mean values were recorded when Brengy cucumber cultivar was grown under Polyvinyl chloride film (P.V.C). These results are in agreement with those recorded by Hao and Papadopoulos [29], who found that the cucumber fruit dry matter content increased with increasing irradiance and decreasing temperature (Table 6).

Results presented in Table 7 showed that fruit's N content, in both seasons and fruit's P and Ca contents in the second season, were not significantly affected by the different plastic covers. However, fruit's K content exhibited significant differences due to the application of plastic covers. Results, also, showed that fruit's K content was significantly higher with the application of diffused Anti Fog UV-Opaque film (THB AF UV-O) comparing with the other types of plastic, in both seasons.. Fruits of Hesham cultivar contained higher N, K and Ca contents than Brengy ones, in the first season. It was noticed that the highest fruit's N, P and K contents were obtained when Hesham cultivar was grown diffused Anti Fog UV-Opaque film (THB AF UV-O (in both seasons. The obtained results were previously supported by Jones *et al.* [30], who found that nitrogen concentration decreases with light at low temperatures, but increases at higher temperatures. The concentrations of P, Ca and S were found to be positively related to light, although the effect of light on Ca was small.

CONCLUSIONS

Hesham cucumber cultivar under diffused Anti Fog UV-Opaque film (THB AF UV-O) as a new generation of plastic cover seemed to be considered the best efficient combination treatments which achieved better fruit yield and its components with good fruit quality characteristics.

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