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USING COLORED SHADE NETS AND ORGANIC MULCH TO IMPROVE MICROCLIMATE, GROWTH, AND YIELD OF YELLOW SWEET PEPPER

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ABSTRACT

The study was carried out to investigate the effect of using color shade nets and organic mulch on improvement microclimate, growth, yield, and its components and fruit quality of yellow sweet pepper cv. Yellow Star F1 under high temperature. The study was conducted at El- Arish Agriculture Research Station, Agric. Res. Center, North Sinai Governorate, Egypt, during the summer seasons of 2018 and 2019. The results indicated that application of color shade nets modified microclimate around pepper plants where decreased average monthly of air temperature and light intensity; however, increased air relative humidity compared with unshaded. On the other hand, using black, green, and white shade nets combined with dry vegetable residues mulch followed by barley straw mulch reflected the lowest soil temperature at depths 10 and 20 cm in both growing seasons. Also, the results showed that using green shade nets followed by black shade nets combined with dry vegetable residues or barley straw mulches recorded the highest values for a fresh and dry weight of pepper plant organs. Besides, the highest contents of Chlorophyll b in leaves and vitamin C in fruit juice were obtained when covered by green nets combined with dry vegetable residues mulch in both seasons. Also, results revealed that the interaction between shading of yellow fruit pepper plants by black and green color nets with dry vegetable residues mulch significantly increase average fruit weight and total fruit yield for marketable yield compared to the open field without mulching in the first and second season. For that, it is recommended using of shade color nets (Black and green) with organic mulch (dry vegetable residues mulch and/or barley straw mulch) under high-temperature regions for modifying microclimate conditions of pepper plants and soil to improve growth, productivity, and fruit quality traits.

Keywords: colored sweet pepper, color shade nets, organic mulches, microclimate, growth, yield, quality

INTRODUCTION

Sweet pepper (*Capsicum annuum* L.) is an important vegetable crop in Egypt. Its fruits rich in vitamins A, C, and E, thiamine, beta carotene, and folic acid, also is used in various purposes, green, spice, sauces, and pickles. Bell pepper is grown throughout the year in Egypt in an open field and under protected cultivation. Cultivation of colored pepper under Egyptian conditions from April to May (late spring and early summer) exposes it to high temperatures and solar radiation stress, which leads to some problems such as increase respiration rate of plants, evaporation of soil, decrease in production, and an increase in the occurrence of physiological disturbances that cause significant loss. Regardless of the stress level, light quality changes could alter the crop's physiological and biochemical processes, metabolite profile, and ultimately growth, development yield, and quality. The net shading application has become very popular around the world and in Egypt due to the high temperature (35-40°C) and intensity of solar radiation during the summer season caused by climate changes. Studies on shading reported that it increases plant growth and productivity (Rylski and Spigelman, 1986), water use efficiency by reduces water requirements in pepper (Moller and Assouline, 2007), improved production and quality through modifying the microenvironment of the crop (Castellano *et al.,* 2008), as well as extend the season of growth in bell pepper for fruit production (Hochmuth *et al.,* 2013). Color shad nets aimed to provide physical protection toward wind, hail, birds, and insects carrier virus diseases (Diaz-perez, 2014), reduces excessive solar radiation under a net which leads to reduces air temperature and transpiration rate and so reduces water consumption (Ahmed *et al.,* 2016). Fallik *et al.,* (2009) found that red, pearl, and yellow shad nets increased the yield of sweet pepper and its quality. Under pearl nets, Mashabela *et al.,* (2015) found increases in average fruit weight, chlorophyll content, and vitamin C content. Mulching is a critical management practice used in agriculture for different reasons, primarily for wind erosion control and water conservation in arid and semi-arid regions. The other benefits of using mulching are modifying soil temperature, weed control, improve physical, chemical, and biological properties of soil after decomposition of organic mulch.

Moreover, it can reduce water evaporation and nutrients loss (Jordan *et al.,* 2010). Organic mulch is one of the different mulch types derived from organic sources (plants or animals). Organic mulches, as previously mentioned, reduce nitrate leaching, supply organic matter and regulate temperature (Muhammed *et al.,* 2009). In this concern, Thakur *et al.,* (2000) showed an increase in plant growth of *Capsicum annuum* L. by application of

Lantana leaves and grass mulched compared to unmulched treatments. Under glyricidia mulch and crop residue mulch, Venkanna (2008) found an increase in leaf area and leaf area index of chili compared with bare soil. Therefore, this investigation aims to study the effect of using color shade nets and organic mulches on improvement microclimate, growth, yield, and its components and fruit physical characters and the fruit quality of sweet yellow pepper under high temperature.

MATERIALS AND METHODS

The study was carried out at the Agriculture Research Station, Veg. Res. Dept., Hort. Res. Inst., Agric. Res. Center, in El- Arish, North Sinai Governorate, Egypt, during summer seasons of 2018 and 2019 to study the influence of using shade color nets and organic mulches on the improvement of microclimate conditions, growth, yield, physical and fruit quality of yellow sweet pepper hybrid "Yellow Star F_1".

The experiment consists of two factors: The first factor, shade color nets, included four treatments, cultivation in an open field (control), cultivation under shade colored nets, i.e., white, black, and green nets with relative shading intensity of 40%, the shade color nets obtained from Al-Amir for Shade Net and Protection Company, Gharbeya, Egypt. The second factor, organic mulches, included three treatments, i.e., without mulching (control), crashed barley straw, and crashed dry vegetable residues "dry veg. res." (tomato, pepper, eggplant, cucumber, and squash). The treatments were arranged randomly in a split-plot design, whereas shade color nets treatments were randomly placed in the main plots, and organic mulch treatments were randomly distributed in subplots with three replicates in a Completely Randomized Block Design.

Seeds were sown in seedling trays on 1st April and 5th April, while transplanting was done on 15th and 20th May in 2018 and 2019 seasons, respectively, under drip irrigation system. Shade nets were subsequently installed above the plants after one day from transplanting in both seasons, and they were fixed on the wood standing structure about 2.50 m height and 4.0 m distance among stands in all directions with leaving a distance from the soil surface of 50 cm without covering on all sides for good ventilation. Organic mulch distributed homogenously above the soil surface after one week of transplanting at a rate of 6.5 kg/plots (50 cm width x 13 m length) for planting line with a rate of 2.1 ton/fed^{-1}. The experimental unit area was 13 m^2 (13 m long and 1 m wide), the seedling was transplanted in lines 1 m apart, and the distance between the plants in the same row line was 50 cm. The normal agricultural practices were done as needed and like those used in commercial pepper production. The experimental soil texture was sandy loam with pH 7.50, EC 0.70 dSm-1, organic matter 0.08 %, and $CaCo_3$ 9.80 % (average of two seasons). However, chemical analysis of irrigation water had EC 4.02 dSm^{-1} and pH 7.6 (over two seasons).

Data recorded

1. Microclimate measurements:

A) Light intensity was measured one time every day during a week at 1.00 pm using Lux meter (HI 97500, .001 to 199.9 Klux, Woonsocket RI, USA made in Europe, Romania).

B) Air relative humidity and air temperature were measured three times (7.00 am, 1.00 pm, and 6.00 pm) every day a week using digital thermometer device TP50**.**

C) Soil temperature was determined every day during a week in the soil at two depths (10 and 20 cm) under mulch and without mulching treatments using a digital thermometer device at 7.00 Am, 1.00 Pm, and 6.00 Pm. All-weather measurements previous were determined under shade nets and open field (control).

2. Vegetative growth

A random sample of 5 plants from each plot was taken after 90 days from transplanting, and the following data were recorded: Plant height (cm), Leaf area $plant^{-1}$ (m^2). fresh and dry weight of roots, stem, leaves, and branches as well as a total of them.

3. Leaves photosynthetic pigments content

(Chlorophyll a, b, and carotenoids) were extracted and determined at 75 days according to Moran's method (1982).

4. Fruit yield:

A) Marketable yield and its components: it was calculated from (number of fruits, fruit weight $plant^{-1}$ (g), average fruit weight, and total fruit weight ton/fed^{-1})**,**

B) Unmarketable yield: It includes fruits with physiological and unmarketable defects such as physiological disorders, especially blossom end rot (BER) and sunscald fruits

C) Total fruit yield: it was calculated from marketable and unmarketable yield.

5. Fruit quality

A random sample of ten fruits at the ripe stage (from the third picking) were taken from each treatment to determine Vitamin (mg/100 ml Juice), pH of fruit Juice, titratable acidity (%), and TSS (%) according to A.O.A.C. (1990).

6. Fruit physical measurements

samples from ten fruits at ripe stage of the third picking were randomly taken and following parameters: pericarp thickness (mm), fruit length (L. cm), fruit diameter (D. cm) were measured by using a caliper as well as fruit shape (L/D).

7. Statistical analysis

SA of the obtained data was carried out according to statistical analysis of variance (Snedecor and Cochran, 1980). Duncan's multiple range tests were used for comparison among means (Duncan, 1958).

RESULTS AND DISCUSSION

1.0 Microclimate measurements

1.1 Light intensity: The average monthly light intensity at 1.00 pm was affected by applied treatments as shown in Fig.1. The control (unshaded) exhibited the highest light intensity 108 and 100 Klux in the first and second seasons, respectively, followed by white, green, and black nets, respectively, in both studied seasons. The results indicated that color shading screens reduce incoming solar radiation by 34.7, 51.0, and 49.6 % (average of two seasons) for white, black, and green nets, respectively, resulting in reduce in air temperature, which leads to reduce water consumption, increase water use efficiency, enhances growth and productivity of pepper plants. In this respect, Ilic *et al.,* (2017) found that color shade nets reduced light intensity by at least 50 % compared to unshaded during summer months to levels similar to spring and fall.

1.2 Air relative humidity: Application of color shad nets increased air relative humidity percentage compared with unshaded (open field), the highest percentage found with white net, followed by green and black nets during the study months in both growing seasons (Fig 2). The increase of relative humidity under color shade nets may be owed to shading reduces wind speed and solar radiation compared with open field treatment; this leads to a reduction in evaporation rate and maintains the turgidity of cells which is helpful in enzyme activity reflects on the high vegetative growth and good yield. A similar trend was observed by (Ahmed *et al.,* 2016).

1.3 Air temperature: Effect of shading on average monthly air temperature was determined three times during the day (Fig.3). The highest air temperatures were recorded in an open field (control), followed by a white shade net, while both black and green nets showed the lowest ones during study months in both seasons. These results may be due to using darknets, which presented favorable microclimatic conditions through reducing heat stress on pepper plants during sunny months. Therefore, plants cultivated had good photosynthesis and low respiration rate, increasing vegetative growth and high productivity. In this concern, Rajasekar *et al.,* (2013) reported that plant height and number of branches per plant were highest under shade net house compared to open field.

1.4 Soil temperature

The interaction between color shading nets and organic mulch, i.e., dry vegetable residues "dry veg. res." or barley straw, hade significant effects on soil temperature at depths of 10 and 20 cm in three times (7.00 am, 1.00 pm and 6.00 pm) in both seasons (Fig.4 and 5).

The highest average monthly soil temperature was recorded with unshaded and without mulching treatment (control), while the lowest one was observed with black, green, and white shade nets combined with dry veg. res. Followed by barley straw mulch, these results were approximately similar in both seasons at 10 and 20 cm depths in all measuring times. The low degree of soil temperature under color shade nets and application of organic mulch may be due to the interaction between them to reduce the heat of solar radiation. In this concern, organic mulches treatments (grass straw, rice straw, rice husk, and sawdust) effectively reduced soil temperature compared to control (Nkansah *et al.,* 2003).

2.0 Plant height, both fresh and dry weight of plant organs and leaf area

2.1 Effect of shading: Data presented in Tables 1&2 show significant effects among shade color nets treatments on plant height, fresh and dry weight of plant organs, and leaf area for yellow sweet pepper plants in both growing seasons. It is evident that shading pepper plants by color nets, i.e., white, black, and green recorded the highest values of all vegetative growth traits compared with cultivated in the open field (unshaded). Yellow fruits sweet pepper plants, covered by green color nets, gave the highest results for all studied traits, followed by black and then white color nets, respectively in both seasons with no differences than applied black cover nets for both roots and leave dry weight in the 1st season, and for branches dry weight in the 2nd season. These results may be due to the role of shading color nets in a decrease in low in light intensity faller, and high air temperature (Fig.1 and 3) on leaves, therefore, may be avoided direct sunlight stressful, while the enhancement of photosynthesis process compared to plants which are grown under open field conditions which received the high air temperature and all light intensity faller on leaves this may produce a defect of the photosynthetic process. Also, leaf area under low light intensity (shading) tends to significant because of cells expanding more to receive light for the photosynthesis process. Covering bell pepper and tomato plants with shade nets gave the longer internodes, larger leaves, greater whole-plant leaf area, and thinner leaves (Kittas *et al.,* 2012; Díaz-Pérez, 2013). Also, stem elongation, leaf area index, and the leaf blade area increased with decreased light intensity Tinyane *et al.,* (2013). In this respect, Semida *et al.,* (2017) indicated that the cucumber plants covered by shade nets gave the highest values for the number of leaves plant^{-1}, leaf area, shoot length, stem diameter, and both shoots fresh and dry weight compared to unshaded plants.

2.2 Effect of organic mulch: For organic mulch, the same data in Tables 1&2 clearly showed highly significant differences among treatments applied of barley straw or dry veg. res. Mulches to the soil surface of yellow fruit sweet pepper plants resulting in an increase of all studied traits compared without mulching in both seasons, except for leaf area (Table 1) and branches

Table 1: Effect of shade color nets, organic mulch, and their interaction on plant height, fresh weight, and leaf area of yellow fruit pepper plants during 2018-2019 seasons.

Characters Treatments		**Plant height(cm)**	**Fresh weight (g)**				**Leaf area (m2)**
			Roots	Branches	Leaves	Total Plant	
Shade color nets			2018 season				
Open field		57.40c	20.07c	88.99c	109.57d	319.59d	2.74d
White		88.07b	25.04b	95.49b	129.65c	349.90c	3.66c
Black		107.96a	29.23a	97.14b	139.07b	365.34b	4.09b
Green		109.09a	29.68a	101.31a	146.13a	377.52a	4.42a
Organic mulches							
Without		79.64c	22.82c	93.88c	127.94b	345.31c	3.58b
Barley straw		92.57b	26.01b	95.62b	131.27ab	352.81b	3.73ab
Dry vegetable residues		99.68a	29.18a	97.69a	134.10a	361.14a	3.87a
Interactions							
Open field	Without	41.71f	16.79h	86.48i	107.20h	313.07j	2.63g
	Barley straw	56.29e	19.45g	89.27h	109.71h	318.21i	2.74g
	Dry veg. residues	74.22d	23.97e	91.22g	111.81h	327.48h	2.84g
White	Without	83.47c	21.81f	93.03f	125.41g	339.93g	3.46f
	Barley straw	87.58c	25.59d	95.07e	129.61fg	349.65f	3.66ef
	Dry veg. residues	93.18b	27.73c	98.35c	133.92ef	360.11e	3.86de
Black	Without	95.82b	26.15d	95.12e	136.26de	357.02e	3.96d
	Barley straw	112.97a	29.32b	96.67d	139.14c-e	365.21d	4.11cd
	Dry veg. residues	115.11a	32.22a	99.63b	141.82b-d	373.78c	4.22bc
Green	Without	97.60b	26.55cd	100.89a	142.91bc	371.20c	4.27bc
	Barley straw	113.46a	29.69b	101.48a	146.64ab	378.15b	4.44ab
	Dry veg. residues	116.20a	32.82a	101.56a	148.85a	383.20a	4.54a
Shade color nets			2019 season				
Open field		59.16c	20.95c	91.05c	112.88d	324.90d	2.89d
White		89.89b	26.04b	97.28b	133.77c	357.10c	3.85c
Black		111.59a	30.81a	99.58b	146.22b	376.60b	4.42b
Green		112.19a	32.86a	103.88a	152.84a	389.58a	4.73a
Organic mulches							
Without		81.95c	25.44b	95.97b	133.30b	354.73c	3.83a
Barley straw		95.42b	27.61b	97.79b	136.45ab	361.86b	3.97a
Dry vegetable residues		102.25a	29.93a	100.08a	139.54a	369.55a	4.11a
Interactions							
Open field	Without	43.59f	19.29f	88.73g	111.87i	319.91i	2.84e
	Barley straw	58.65e	19.67f	90.84f	112.11i	322.62i	2.86e
	Dry veg. residues	75.23d	23.90e	93.59e	114.66i	332.17h	2.97e
White	Without	86.91c	23.22e	94.81e	127.22h	345.26g	3.55d
	Barley straw	88.02c	27.17d	97.49d	134.37g	359.03f	3.88cd
	Dry veg. residues	94.73b	27.73cd	99.55c	139.73f	367.02e	4.12bc
Black	Without	98.76b	28.71b-d	97.65cd	143.92e	370.28e	4.32a-c
	Barley straw	117.49a	29.94bc	98.91cd	146.07de	374.93d	4.42a-c
	Dry veg. residues	118.52a	33.74a	102.17b	148.68c-d	384.60c	4.54ab
Green	Without	98.54b	30.56b	102.70b	150.21bc	383.47c	4.61ab
	Barley straw	117.51a	33.67a	103.93ab	153.24ab	390.85b	4.75a
	Dry veg. residues	120.54a	34.35a	105.00a	155.08a	394.43a	4.83a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.

Table 2: Effect of shade color nets, organic mulch, and their interaction on the dry weight of yellow fruit pepper plants during the 2018-2019 seasons.

Characters Treatments		Dry weight (g)							
		Roots	Branches	Leaves	Total Plant	Roots	Branches	Leaves	Total Plant
Shade color nets		2018 season				2019 season			
Control		7.11c	30.84d	40.31c	118.28d	7.14d	32.80c	42.71d	122.66d
white		10.18b	33.38c	45.91b	129.48c	10.26c	36.71b	51.34c	138.30c
Black		12.06a	35.70b	50.92ab	138.69b	11.82b	38.13ab	56.74b	146.69b
Green		13.51a	38.52a	53.37a	145.41a	13.96a	40.08a	65.31a	159.35a
Organic mulches									
Without		10.09a	34.14a	46.09a	130.32b	10.19b	36.32a	51.72c	138.23c
Barley straw		10.45a	34.57a	47.88a	132.92ab	10.88ab	36.76a	54.14b	141.65b
Dry vegetable residues		11.62a	35.12a	48.91a	135.66a	11.31a	37.70a	56.35a	145.37a
Interactions									
Control	Without	6.47f	30.42f	38.19g	115.08h	6.88h	32.28e	40.73i	119.91j
	Barley straw	6.96f	30.51f	40.59fg	118.05gh	7.18h	32.25e	42.31i	121.43j
	Dry veg. residues	7.91ef	31.61ef	42.17ef	121.70g	7.36h	33.87e	45.40h	126.64i
White	Without	9.47de	32.55d-f	44.78de	126.81f	9.67g	35.64d	48.44g	133.76h
	Barley straw	9.91c-e	33.59c-e	46.28cd	129.81ef	10.25fg	37.05cd	51.58f	138.89g
	Dry veg. residues	11.18b-d	34.01b-d	46.66cd	131.85e	10.85ef	37.40cd	54.01e	142.27f
Black									
	Without	11.50b-d	35.39bc	49.26bc	136.16d	11.25de	37.73c	55.91de	144.91f
	Barley straw	11.90bc	35.60bc	51.70ab	139.21cd	11.92cd	38.02bc	56.67d	146.61de
	Dry veg. residues	12.79ab	36.11b	51.80ab	140.72bc	12.29bc	38.64bc	57.63d	148.57d
Green	Without	12.91ab	38.19a	52.15ab	143.25bc	12.95b	39.62ab	61.81c	154.38c
	Barley straw	13.02ab	38.61a	52.97ab	144.61ab	14.19a	39.71ab	65.74b	159.66b
	Dry veg. residues	14.61a	38.77a	55.00a	148.39a	14.73a	40.91a	68.38a	164.02a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.

dry weight (Table 2) in the second season and for root, branches and leaves dry weight (Table 2) in the first season were no significant among without or with both types of mulches. From the same Table 1, data also recorded that dry vegetable residues mulch exhibited the highest values of plant height (99.68 and 102.25 cm), and fresh weight of roots (29.18 and 29.93 g), branches (97.69 and 100.08 g), leaves (134.10 and 139.54 g) and its total fresh weight (361.14 and 369.55 g) in two growing seasons, respectively as well as for all studied dry weight traits for yellow sweet pepper crop.

However, dry vegetable residues mulch achieved the highest values for leaves fresh weight (g) followed by barley straw mulch in both seasons, and the same previous results for leaf area (m^2) in the second season alone, moreover no significant differences between with or without mulching obtained in the second season alone. Probably applied of organic mulches to soil surface slows or impedes the infiltration of irrigation water through the far soil layers and utilization to longer time compared without mulching and thus maintains the moisture of the root zone for a long time and improves the physical and chemical properties and biological of soil that had improved the temperature balance as well as helps to the availability of nutrients in the root›s environment and thus reflected on improves of development, and plant growth. Sandy soils are often dry, nutrient deficient, and fast draining of irrigation water. Hence has a little ability to until kept retaining moisture in the around the root system, therefore, adding organic material can be the enhancement of nutrient provide and water-holding capacity in sandy soil (Bruand *et al.,* 2005).

2.3 Effect of interaction: The effect of the interaction between shade color nets and organic mulch had significant effects on all studied traits in both seasons Tables 1 and 2. Using green shade nets followed by black shade nets combined with dry veg. res. mulch followed by barley straw mulch recorded the highest values for plant height and all fresh and dry weight characters as well as leaf area in two growing seasons compared to white shade nets or the open field with or without mulching. These findings support the results of several earlier studies. Tafoya *et al.,* (2018) noticed that with the colored shade nets increased physiological activities concerning the gas exchange as transpiration rate, stomatal conducting, and photosynthetic CO_2 assimilation rate. Besides, many researchers have

Table 3: Effect of shade color nets, organic mulch, and their interaction on photosynthetic pigments (mg g-1FW) of yellow fruit pepper plants during 2018-2019 seasons.

Characters Treatments		Chlorophyll a	Chlorophyll b	Carotenoids	Chlorophyll a	Chlorophyll b	Carotenoids
Shade color nets		2018 season			2019 season		
Control		3.38d	2.69c	4.41d	4.02d	2.60c	4.97c
white		3.48c	2.79b	4.63c	4.15c	2.91a	5.44b
Black		3.68b	2.86a	5.47b	4.44b	2.88b	5.99a
Green		4.12a	2.88a	5.94a	4.62a	2.91a	5.97a
Organic mulches							
Without		3.64b	2.78b	4.98b	4.28b	2.75c	5.45c
Barley straw		3.61c	2.79b	4.96c	4.22c	2.84b	5.55b
Dry vegetable residues		3.74a	2.85a	5.40a	4.42a	2.89a	5.79a
Interactions							
Control	Without	3.30i	2.63i	4.32k	3.93l	2.28	4.92j
	Barley straw	3.41h	2.67h	4.41j	4.05k	2.75i	4.97i
	Dry veg. residues	3.42h	2.79f	4.52i	4.08j	2.78h	5.02h
White	Without	3.46g	2.84d	4.55h	4.16h	3.04a	5.30g
	Barley straw	3.47g	2.75g	4.18l	4.10i	2.83g	5.35f
	Dry veg. residues	3.52f	2.81f	5.17g	4.21g	2.86f	5.67e
Black	Without	3.55e	2.84d	5.26f	4.33f	2.82g	5.77d
	Barley straw	3.55e	2.86c	5.32e	4.35e	2.88e	5.97b
	Dry veg. residues	3.94d	2.91b	5.84c	4.65c	2.94c	6.24a
Green	Without	4.25a	2.82e	5.81d	4.73b	2.86f	5.78d
	Barley straw	4.03c	2.89b	5.95b	4.38d	2.90d	5.91c
	Dry veg. residues	4.11b	2.94a	6.09a	4.77a	2.98ab	6.23a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.

found in studies on different types of mulches, i.e. organic or plastic mulch has been achieved decrease soil moisture losses by low temperature and evaporation from the soil and, encourage favorable soil biotic activities, decrease hard soil tuning, and contributing plant nutrients (Bhella *et al.,* 1988; Chakraborty *et al.,* 1994; Pal *et al.,* 1994; Hooda *et al.,* 1999).

3. 0 Photosynthetic pigments

3.1 Effect of shading: Presented data in Table 3 indicated that photosynthetic pigment traits significantly affected by shading color nets in both growing seasons. Shading color nets gave the highest values for these traits compared to control (open field). It is obvious that the application of green covers recorded the highest results for chlorophyll a (4.12 and 4.62 mg/g fresh weight) in both seasons, respectively. As for chlorophyll b, the best values were obtained using green or black nets in the 1st season and green or white in the 2nd one with no differences between them in every season. For carotenoid pigment, in the first season, green nets showed the highest value (5.94 mg/g fresh weight), followed by black nets (5.47 mg/g fresh weight), however, covered by black or green nets exhibited the highest content (5.99 and 5.97 mg/g fresh weight) respectively in the second season. However, it can be said that the use of shading nets gave the highest values for the content of chlorophyll a, b, and carotenoids compared to the open field, and may be owing to the use of shade color nets attributes of all photosynthesis activity through optimum shading of the plant, whereas alleviating the effect of temperature and light intensity which increase in the summer season than about optimal required for the plant growth and consequently, the light receptor devices are destroyed in the chloroplast in the presence of high sunlight intensity Accordingly, the chlorophyll degeneration rate in plant leaves is higher than the synthetic rate, leading to a reduction in chlorophyll content as a result of chloroplast formation suppression.

Photoselective nets can modify the shading quality both by radiation dispersion and spectral composition (Shahak *et al.,* 2008). Shaded leaves in comparison with exposed leaves to the sun tend to show higher chlorophyll concentrations per unit of leaf weight (Fu *et al.,* 2012). A similar observation was found by Beneragama *et al.,* (2010), on lettuce, Ilic *et al.,* (2017), on sweet pepper, and Semida *et al.,* (2017), on cucumber. They found that for chlorophyll a, b, and carotenoid content in leaves recorded the lower in the open field and highest in plants covered by shade nets.

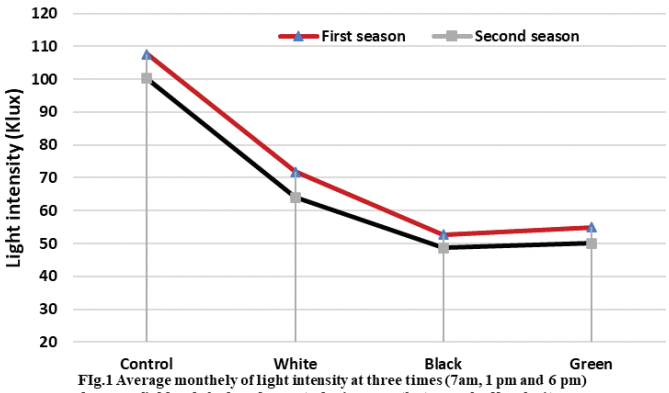

FIg.1 Average monthely of light intensity at three times (7am, 1 pm and 6 pm) under open field and shade colore nets during growth stages of yellow fruit pepper plants in 2018-2019 seasons.

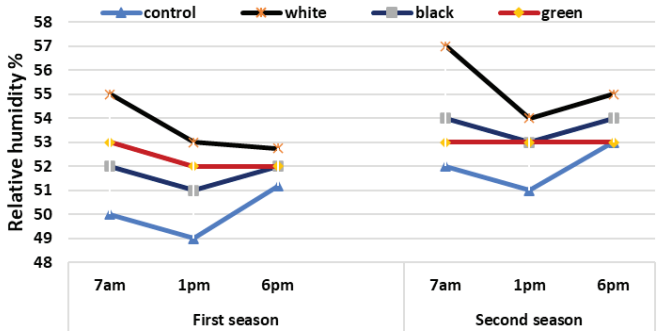

FIg.2 Average monthly of relative humidity at three times (7am, 1 pm and 6 pm) under open field and shade colore nets during growth stages of yellow fruit pepper plants in 2018-2019 seasons.

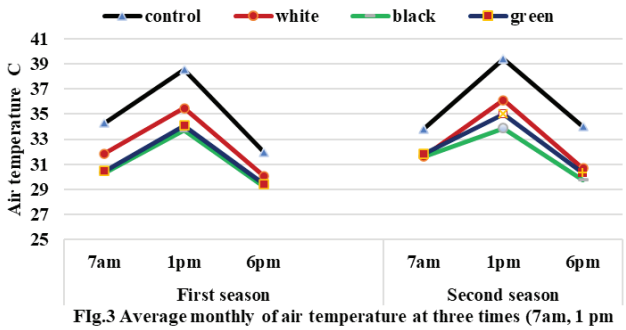

FIg.3 Average monthly of air temperature at three times (7am, 1 pm and 6 pm) under open field and shade colore nets during growth stages of yellow fruit pepper plants in 2018-2019 seasons.

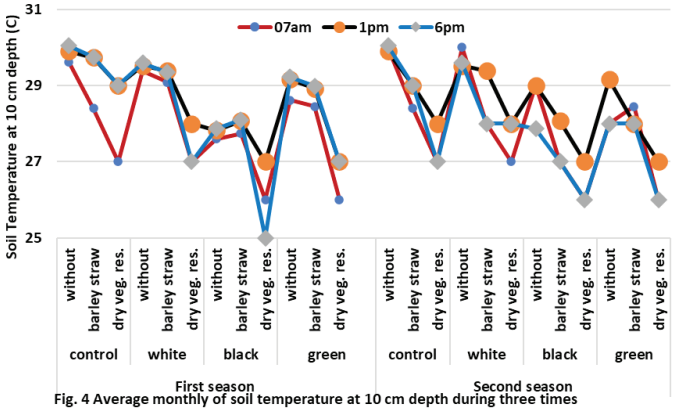

Fig. 4 Average monthly of soil temperature at 10 cm depth during three times (7am, 1 pm and 6 pm) under open field and shade colore nets during growth stages of yellow fruit pepper plants in 2018-2019 seasons.

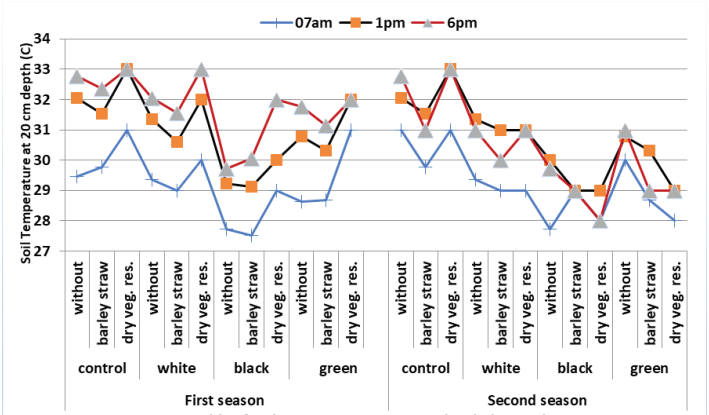

Fig. 5 Average monthly of soil temperature at 20 cm depth during three times (7am, 1 pm and 6 pm) under open field and shade colore nets during growth stages of yellow fruit pepper plants in 2018-2019 seasons.

3.2 Effect of organic mulch: Organic mulches had a significant effect on all study traits of photosynthetic pigments in two seasons as shown in Table 3. Results reveal that chlorophyll a, b and carotenoids were increased with the application of dry veg. res. mulch in both seasons. On, cucurbitaceae (cucurbit, or gourd family) vegetables the fastest growing and highest yielding plants are those on the mulch from polyethylene film, followed by wheat straw, as compared to unprotected soil (Bucki and Siwek, 2019).

3.3 Effect of interaction: The same data in Table 3 illustrated that chlorophyll a, b, and carotenoids significantly affected by the interaction treatments between shade color nets and organic mulch in both seasons, whereas photosynthetic pigments i.e., chlorophyll a recorded the highest values (4.25 and 4.73 mg/g fresh weight) by the interaction between black shade nets and without mulching, and the highest values (4.11 and 4.77 mg/g fresh weight) with using shade green nets combination with dry veg. res. mulch soil surface these results were obtained in the first and second season respectively. Also, the results indicated that the highest content of Chlorophyll b in pepper leave when covered by green nets combined with dry veg. res. mulch (2.94 and 2.98 mg/g fresh weight) in the first and second seasons respectively, and shade by white nets combined without mulching (3.04mg/g fresh weight) in the 2nd year. Pepper plants cultivated under green nets and dry veg. res. mulch gave the highest content of carotenoids (6.09 mg/g fresh weight) in the first season, however, the maximum content of carotenoids (6.24 mg/g fresh weight) in the second season obtained by black nets combined with dry veg. res. mulch, followed by green shade nets with the same mulch (6.23 mg/g fresh weight) with no differences between them. In general, these results indicated that all shade color nets with organic mulches were superior treatments compared to open field, these results may be due to the role for shade color nets in photoselective, and different the penetration of the color for both there, also the responses of yellow fruit sweet pepper plants to photoselective of color nets, on the other hand, the vital role played by added organic mulches to the soil and the

Table 4: Effect of shade color nets, organic mulch, and their interaction on marketable yield and its components of yellow fruit pepper plants during 2018-2019 seasons.

Characters Treatments		Marketable yield and its components							
		Number of fruits plant-1	Total fruit weight plant -1 (g)	Average fruit weight	Total fruit weight fed-1. (ton)	Number of fruits plant-1	Total fruit weight plant -1 (g)	Average fruit weight	Total fruit weight fed-1. (ton)
Shade color nets		2018 season				2019 season			
Open field		6.17b	716.49d	118.38d	6.01c	7.27b	813.90d	113.77d	6.83c
White		9.20a	1707.04c	186.14c	14.33b	10.70a	1928.87c	180.53c	16.20b
Black		9.66a	2002.34a	207.57a	16.82a	10.91a	2212.67a	203.31a	18.58a
Green		9.78a	1995.61b	204.30b	16.76a	11.33a	2136.47b	190.33b	17.94ab
Organic mulches									
Without		8.38a	1463.17c	167.74c	12.29b	9.87b	1601.92c	157.22c	13.45b
Barley straw		8.82a	1570.91b	173.27b	13.19b	10.21a	1744.96b	166.43b	14.65ab
Dry vegetable residues		8.91a	1782.02a	196.27a	14.96a	10.07a	1972.05a	192.31a	16.56a
Interactions									
Open field	Without	5.21c	549.91l	107.58h	4.62e	6.21i	635.28l	103.68j	5.34e
	Barley straw	6.54b	744.41k	114.54g	6.25d	7.96g	852.42k	107.44i	7.16de
	Dry veg. residues	6.77b	855.14j	133.02f	7.18d	7.66h	953.99j	130.21h	8.01d
White	Without	8.80a	1564.33i	179.85e	13.14c	10.82d	1844.43i	171.06f	15.49c
	Barley straw	9.19a	1710.917h	186.31d	14.37bc	10.52f	1914.21h	182.07e	16.08bc
	Dry veg. residues	9.62a	1845.87g	192.26c	15.50b	10.77de	2027.97e	188.46d	17.03bc
Black	Without	9.68a	1872.50e	193.63bc	15.73b	10.65ef	1986.80f	186.89d	16.69bc
	Barley straw	9.72a	1918.19c	197.89b	16.11b	11.19b	2177.02c	193.85c	18.28b
	Dry veg. residues	9.59a	2216.33a	231.19a	18.61a	10.85d	2474.18a	229.21a	20.78a
Green	Without	9.84a	1865.93f	189.93cd	15.67b	11.82a	1941.16g	167.24g	16.30bc
	Barley straw	9.84a	1910.15d	194.35bc	16.04b	11.18b	2036.21d	182.37e	17.10bc
	Dry veg. residues	9.67a	2210.75b	228.62a	18.57a	11.01c	2432.04b	221.39b	20.43a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.

previous benefits mentioned. In this respect, on cucumber plant, Semida *et al.,* (2017) found that the photosynthetic pigments as chlorophyll a, chlorophyll b, total chlorophyll (a+b), and, carotenoids, increased with increased shade levels.

4. 0 Fruit yield

4.1 Marketable, unmarketable and its components and total fruit yield

4.1.1 Effect of shading: Results in Tables 4&5 indicated that all marketable, unmarketable, and total fruit yield (unmarketable + marketable yield) and its components were significantly affected by using different shade color nets compared to an open field (without shading). In general, data shows that the highest values for total fruit weight plant^{-1} (g), average fruit weight and total marketable fruit weight fed^{-1} of marketable regarding the highest productivity fed^{-1} (Table 5) included unmarketable and marketable yield (17.79 and 19.54 ton) obtained when covering plants by black color nets, followed by green color nets in both seasons. On the other hand, the number of total fruits plant^{-1} (marketable yield component) significantly increased by the application of green color nets, followed by black and white color nets, respectively compared without shading treatments in both seasons. In opposite, under open field and white nets recorded the highest values for some unmarketable yield components (Table 5), *i.e.,* the number of total fruits plant^{-1} (3.76 and 2.88), total fruit weight plant^{-1} (146.78 and 127.11g.) and total fruit weight fed^{-1} (1.23 and 1.06 ton.), respectively in the 1st season and for the previous traits in the 2nd season (3.99 and 3.09), (156.88 and 122.33 g.), and (1.32 and 1.02 ton.), respectively. The yellow fruit pepper plants cultivated in the open field (unshaded) exposed to high light intensity (Fig.1) and air temperature (Fig.3) so, increase unmarketable yield and physiological disorders (sun burn and blossom end rot). On the other hand. the increase in the total marketable of fruit yield may be due to the increase in fruit number and average fruit weight, and this may be due to the modification of microclimatic conditions under different shading color nets which it works to protect the fruits from physiological disorders, *i.e.,* sun scald , and blossom end root.....*etc*. through reduction of evapotranspiration rate, and improve plant water status, consequently, improve the photosynthesis process compared to open field conditions. Increased fruit size of sweet pepper was likely the result of reduced

Table 5: Effect of shade color nets, organic mulch, and their interaction on unmarketable and total yield of yellow fruit pepper plants during 2018-2019 seasons.

Characters Treatments		Unmarketable yield and its components				Total fruit weight (marketable + unmarketable) fed-1. (ton)
		Number of fruits plant-1	Total fruit weight plant -1 (g)	Average fruit weight	Total fruit weight fed-1. (ton)	
Shade color nets 2018 season						
Open field		3.76a	146.78a	38.84b	1.23a	7.24c
White		2.88a	127.11b	44.41b	1.06ab	15.39b
Black		1.18b	115.66b	109.17a	0.97b	17.79a
Green		1.35b	111.94b	92.10a	0.94b	17.70a
Organic mulches						
Without		2.16a	113.80a	65.77b	0.95c	13.24b
Barley straw		2.40a	125.08a	67.13b	1.05b	14.24b
Dry vegetable residues		2.32a	137.23a	80.48a	1.15a	16.11a
Interactions						
Open field	Without	3.28ab	129.85ab	39.25e	1.09c	5.71e
	Barley straw	4.00a	153.65a	38.05e	1.29a	7.54de
	Dry veg. residues	4.00a	156.84a	39.21e	1.31a	8.49d
White	Without	2.66b	113.23ab	43.85e	0.95d	14.09c
	Barley straw	3.02b	126.53ab	42.18e	1.06c	15.43bc
	Dry veg. residues	3.10b	141.59ab	47.19e	1.19b	16.69b
Black	Without	1.28c	108.58ab	96.03bc	0.91de	16.64b
	Barley straw	1.29c	111.54ab	99.81b	0.93d	17.04b
	Dry veg. residues	0.96c	126.85ab	131.66a	1.06c	19.67a
Green	Without	1.41c	103.57b	83.94d	0.87e	16.54b
	Barley straw	1.32c	108.58ab	88.50cd	0.91de	16.95b
	Dry veg. residues	1.31c	123.66ab	103.86b	1.04c	19.61a
Shade color nets 2019 season						
Open field		3.99a	156.88a	45.46b	1.32a	8.15c
White		3.09ab	122.33b	41.30b	1.02b	17.22b
Black		1.55b	114.55c	82.77a	0.96d	19.54a
Green		1.45b	119.98bc	85.34a	1.00c	18.94ab
Organic mulches						
Without		2.34a	129.10b	68.68a	1.08a	14.53b
Barley straw		2.65a	121.83c	55.96b	1.02a	15.67ab
Dry vegetable residues		2.57a	134.38a	66.51a	1.12a	17.68a
Interactions						
Open field	Without	3.33ab	156.66b	58.89e	1.31b	6.65e
	Barley straw	4.32a	134.12c	35.66h	1.13c	8.29de
	Dry veg. residues	4.33a	180.21a	41.83g	1.51a	9.52d
White	Without	2.99a-c	123.33de	45.88f	1.03d	16.52c
	Barley straw	2.95a-c	120.00ef	40.70g	1.00e	17.08bc
	Dry veg. residues	3.33ab	123.66d	37.33h	1.04d	18.07bc
Black	Without	1.66bc	116.33gh	78.16c	0.98f	17.67bc
	Barley straw	1.66bc	114.02h	75.16cd	0.96g	19.24b
	Dry veg. residues	1.33c	113.33h	95.20a	0.95g	21.73a
Green	Without	1.36c	120.09ef	91.82b	1.00e	17.03bc
	Barley straw	1.66bc	119.33fg	72.33d	1.00e	18.10bc
	Dry veg. residues	1.31c	120.53d-f	91.89b	1.01e	21.44a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test

Table 6: Effect of shade color nets, organic mulch and their interaction on fruit quality of yellow fruit pepper plants during 2018-2019 seasons.

Characters Treatments		Marketable yield and its components							
		Number of fruits plant-1	Total fruit weight plant -1 (g)	Average fruit weight	Total fruit weight fed-1. (ton)	Number of fruits plant-1	Total fruit weight plant -1 (g)	Av-erage fruit weight	Total fruit weight fed-1. (ton)
Shade color nets		2018 season				2019 season			
Control		178c	6.02a	0.42a	8.96a	175c	5.86a	0.32a	9.83a
white		173d	5.61b	0.38ab	8.69b	180bc	5.52b	0.27ab	8.89b
Black		186b	5.54c	0.33bc	8.33c	186b	5.43c	0.26ab	8.46c
Green		188a	5.43d	0.31c	7.56d	196a	5.26d	0.25b	7.76d
Organic mulches									
Without		177c	5.60c	0.37a	8.25c	182a	5.47c	0.29a	8.63c
Barley straw		181b	5.66b	0.35a	8.38b	184a	5.53b	0.28a	8.75b
Dry vegetable residues		186a	5.68a	0.35a	8.53a	187a	5.56a	0.26a	8.83a
Interactions									
Control	Without	173g	5.94c	0.43a	8.93b	174d	5.78c	0.36a	9.83b
	Barley straw	178f	6.07a	0.42ab	8.93b	176cd	5.88b	0.35ab	9.93a
	Dry veg. resi-dues	184de	6.04b	0.41ab	9.03a	176cd	5.93a	0.27c	9.73c
White	Without	166h	5.56f	0.40a-c	8.63d	176cd	5.46f	0.26c	8.73e
	Barley straw	172g	5.59e	0.37b-d	8.73c	179cd	5.53e	0.28c	8.73e
	Dry veg. resi-dues	182e	5.67d	0.36b-e	8.73c	185b-d	5.59d	0.29c	9.23d
Black	Without	185cd	5.52g	0.35c-e	8.03f	184b-d	5.43g	0.30bc	8.33g
	Barley straw	186bc	5.55f	0.31de	8.33e	187a-c	5.43g	0.25c	8.53f
	Dry veg. resi-dues	187bc	5.56f	0.32de	8.63d	188a-c	5.45f	0.25c	8.53f
Green	Without	184de	5.39j	0.31de	7.43i	195ab	5.23i	0.25c	7.63i
	Barley straw	189b	5.44i	0.31de	7.53h	194ab	5.28h	0.25c	7.83h
	Dry veg. resi-dues	192a	5.46h	0.30e	7.73g	198a	5.28h	0.25c	7.83h

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's multiple range test.

transpiration and improved plant water status and net photosynthesis under shaded conditions (Ilic *et al.,* 2017).

4.1.2 Effect of organic mulch: The same data in Tables 4&5 show that organic mulches had significant effects on most studied traits of marketable, unmarketable, and total yield. In general, the addition of dry veg. res. mulch to soil surface resulted in the highest values for both marketable and unmarketable yield components, *i.e.,* total fruit weight plant^{-1}, average fruit weight, and total fruit fed^{-1} as well as total yield (marketable yield + unmarketable) in the 1st and 2nd seasons followed by barely straw mulch with no apparent differences than without mulching for average fruit weight (unmarketable) and barley straw above the soil surface for total yield (marketable yield + unmarketable). In this concern, Tipu *et al.,* (2014) used five types of mulch viz, sawdust, garden leaves, rice husk, and black polyethylene with control (without mulch), they found that, the highest values for number of fruits, and total yield of tomato plants were recorded with the rice husk application and the lowest values for the same traits recorded with control.

4. 1. 3 Effect of interaction: Results observed from the data in Tables 4&5 showed that the interaction between shade color nets and organic mulches gave significant effects on most marketable and unmarketable yield and its components traits, generally, covered pepper plants by black and green color nets with dry veg. res. mulch recorded the highest values for yield and its components, i.e., total fruit weight plant^{-1} (2216.3 and 2474.2; 2210.7 and 2432.0 g.), average fruit weight (231.2 and 229.2; 228.6 and 221.3g.) and total fruit weight fed^{-1}. (18.61 and 20.78; 18.57 and 20.43 ton.) as well as both unmarketable average fruit weight (131.66 and 95.20 g.) and total yield fed^{-1}. (unmarketable and marketable yield), where the maximum productivity (19.67 and 21.73 ton fed^{-1}.) was obtained using the black cover with dry veg. res. mulch (Table 5), followed by green nets (19.61 ton fed^{-1} and 21.44) with no significant differences between them in the first and second seasons, respectively. As for the number of total fruits plant^{-1} of marketable yield, the data showed that all interaction treatments among shade color nets (green, black, and white) and the organic mulches (without or with barley straw and dry veg. res. mulches) recorded significantly increased compared to open field (without shaded) in both seasons. Generally, the number of

Table 7: Effect of shade color nets, organic mulch and their interaction on fruit physical measurements of yellow pepper plants during 2018-2019 seasons.

Characters Treatments		Pericarp thickness (mm)	Fruit length (L.cm)	Fruit diameter (D. cm)	Fruit shape (L/D)	Pericarp thickness (mm)	Total fruit weight plant -1 (g)	Average fruit weight	Total fruit weight fed-1. (ton)
Shade color nets		2018 season				2019 season			
Control		3.64d	6.11d	3.85d	1.77a	3.55d	5.81d	4.05d	1.58a
white		4.20c	7.47c	5.91c	1.39c	4.23c	6.51c	5.93c	1.22d
Black		4.24b	8.36b	6.41b	1.44b	5.00b	7.68b	6.36b	1.33c
Green		4.68a	8.65a	6.66a	1.43b	5.36a	8.76a	6.76a	1.43b
Organic mulches									
Without		3.92c	7.55c	5.45c	1.57a	4.39c	6.88c	5.61c	1.37b
Barley straw		4.24b	7.59b	5.64b	1.51b	4.52b	7.08b	5.71b	1.41a
Dry vegetable residues		4.41a	7.81a	6.02a	1.43c	4.70a	7.60a	6.01a	1.40a
Interactions									
Control	Without	3.34l	5.94k	3.26l	1.98a	3.35l	5.31l	3.74j	1.56b
	Barley straw	3.65j	6.11j	3.64k	1.83b	3.41k	6.01k	3.78i	1.74a
	Dry veg. residues	3.94i	6.31i	4.65j	1.49c	3.91j	6.11j	4.64h	1.45c
White	Without	4.12h	7.35h	5.75i	1.41f	4.01i	6.26i	5.79g	1.21h
	Barley straw	4.25g	7.44g	5.94h	1.38g	4.34h	6.44h	5.97f	1.21h
	Dry veg. residues	4.36f	7.64f	6.04g	1.41fg	4.36g	6.84g	6.05e	1.26g
Black	Without	3.44k	7.95e	6.11f	1.43e	4.64f	6.94f	5.96f	1.29f
	Barley straw	4.63d	8.49c	6.44e	1.45e	5.11e	7.42e	6.46d	1.28f
	Dry veg. residues	4.65c	8.65b	6.65c	1.43e	5.26c	8.68c	6.67b	1.43cd
Green	Without	4.93a	8.97a	6.68b	1.47d	5.57a	9.04a	6.98a	1.43d
	Barley straw	4.45e	8.34d	6.57d	1.41fg	5.24d	8.45d	6.64c	1.41e
	Dry veg. residues	4.68b	8.64b	6.74a	1.41f	5.28b	8.79b	6.68b	1.45cd

Values having the same alphabetical letter(s) did not significantly differ at 0.05 levels of significance, according to Duncan's m. multiple range test.

fruit plant^{-1} was no record any differ significantly between shade color nets *i.e*., white, black, and green in the first season but, the pepper plants gave the high significance for the number of fruits plants^{-1} when growing under the green color net without mulching in the second season. However, the open field recorded the lowest values for the number of fruits in both seasons. These may be due to improve microclimate under shading and avoid abiotic, and biotic stress there for reflecting on the first: reduced of evaporation, transpiration, infection by the insects, and physiological disorders for fruits, and the second importance the raise of bio, and physio-chemical processes in the soil for that the stimulation of supply nutrients and its improve movement into plant cycle and it helps vigor of leaves and photosynthesis, and therefore, helps to cells division increase, and produce large fruits it›s accordingly occur increased in total marketable fruit yield. On the opposite, without shaded treatment (open field) combined with dry vegetable residues mulch resulted in the highest values (unmarketable), *i.e.,* 4.0 and 4.33 for the number of total fruits plant^{-1}, 156.84 and 180.21 g. for total fruit weight plant^{-1} and 1.31 and 1.51 ton. for total fruit weight fed^{-1} in the 1st and 2nd seasons, respectively.

5.0 Fruit quality

5.1 Effect of shading: Fruit quality attributes of yellow sweet pepper were affected by cultivated under open field conditions, where the highest values were observed for pH (6.02 and 5.86), titratable acidity (0.42 and 0.32 %) and the total soluble solids (8.96 and 9.83%) in the 1st and 2nd seasons, respectively (Table 6). However, vitamin C content recorded the high significance by green color net treatment. Guillén *et al.,* (2007) reported that sugar accumulation in vegetable crops leader to affected by light intensity and temperature, according to that, exposing the fruit for higher temperatures, essentially during ripening, leads to an increase of total soluble solids content, fundamentally due to the increase in carbohydrate biosynthetic enzyme activity and increased transpiration. Also, Ilic *et al.,* (2014) indicated that the values of titratable acidity increase with high air temperatures.

5.2 Effect of organic mulchL: Presented data in the same Table 6 indicated that the fruit quality parameters in both growing seasons were significantly affected by organic mulches, except titratable acidity in both seasons and vitamin C content in the second season, however, the dry vegetable residues recorded the highest values of pH (5.68 and 5.56), TSS (8.53 and 8.83%) respectively in both 1st and 2nd seasons, and vitamin C content in the 1st season,

5.3 Effect of interaction: Results of the interactions between shad color nets and organic mulches on fruit quality traits were presented in Table 6, the data show significant effects of all interaction treatments on all fruit quality traits (vitamin C, pH, titratable acidity and TSS) in both seasons. The interaction between green color net and dry veg. res. mulch gave the high significance of vitamin C content in both seasons. While, quality traits i.e., pH, titratable acidity and TSS recorded the highest values in open field interaction for alike without mulching or with barley straw or dry veg. res. mulches compared by any other treatments. In this respect, Kader *et al.,* (1978) suggest that high-quality fruits should have values of titratable acidity > 0.32% and TSS values > 3%. Fruit quality produced in the open field was highly in content from TSS and titratable acidity than a product in shade color nets as red, black, white, and blue (Ilic and Milenković., 2012).

6.0 Fruit physical measurements

6.1 Effect of shading: The effect of shad color nets on fruit physical measurements is presented in Table 7 results showed that significant effects on all study traits, i.e., pericarp thickness (mm), fruit length (cm), fruit diameter (cm) and its fruit shape (L/D).

The cultivation of yellow fruits sweet pepper plants "Yellow Star F_1"under green shade color nets gave the highest values for pericarp thickness (4.68 and 5.36 mm), fruit length (8.65 and 8.76 cm), fruit diameter (6.66 and 6.76 cm) compared to the open field (unshaded) treatment, pericarp thickness (3.64 and 3.55 mm), fruit length (6.11 and 5.81 cm) and fruit diameter (3.85 and 4.05 cm) in the first and second season respectively, except, fruit shape (L/D) which achieved significantly superior with (unshaded) treatment was 1.77 and 1.58, these resulted were observed in the first and second season respectively. El- Bassiony *et al.,* (2014) found that fruit quality characteristics expressed as fruit length, and diameter enhanced by shading nets and best results were gained by shading net with 50 % intensity in all mentioned fruit characteristics compared to open field conditions, although they didn›t discuss a significant difference between shading net with 50 %, and 25% intensity for fruit length and diameter in the two studied seasons.

6.2 Effect of organic mulch: It is clear from such data in Table 7, that the effectiveness of organic mulches on physical fruit traits which achieved with the addition of dry veg. res. mulch in both seasons, except, fruit shape (L/D) were no significant differences between barley straw and dry veg. res. mulch in the second season compared to without mulching treatment which recorded the lowest significant variances., while the highest value (1.57) reflected without organic mulching in the 1st season.

6.3 Effect of interaction: The interaction between shade color nets and organic mulches resulted in a significant effect on all fruit physical parameters i.e., pericarp thickness (mm), fruit length (cm), fruit diameter (cm), and its fruit shape (L/D) as shown in Table 7. Data recorded the highest values for pericarp thickness (mm), and fruit length (cm) by the interaction between green shade net without mulching in both seasons. While fruit diameter (cm) increase with a combination of green shade net with dry veg. res. mulch in the first season, and without mulching in the second season. Fruit shape character (L/D cm) recorded a significant increase by cultivation of pepper plants in the open field without mulching in the first season, while, significantly increased with adding barley straw mulch to soil in the second season. Generally, the application of shade color nets with organic mulches together barley straw or dry veg. res. mulches recorded the increment values for most physical measurements compared to pepper plant cultivation in the open field.

CONCLUSION

To overcome the problems of high solar radiation and high temperature, it is a recommended using of shade color nets (Black and green) with organic mulch (dry vegetable residues mulch and/or barley straw mulch) under high-temperature regions for modify microclimate conditions of color sweet pepper plants and soil, to improve growth, productivity and fruit quality traits.

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