

EFFECT OF ORGANIC AND SYNTHETIC MULCHES OF SOME FRESH STRAWBERRY CULTIVARS

ALI, R. A. M., AND RADWAN, E.A.
Veget., research Dept., Hort. Inst. ARC

ABSTRACT

Two successive summer seasons of 2005/2006 and 2006/2007, studies were carried out on sandy soils under a drip irrigation system, at the Experimental Station Farm, South Tahrir, Horticultural Research Station, situated at Behiera Governorate. The objectives of these experiments were to investigate the responses of strawberry plants cv. 'sweet charli' and 'camarosa' to mulch types (straw, black polyethylene, silver polyethylene and non mulch) as well as their interactions on vegetative growth, flowering traits, fruit yield, fruit quality, and chemical constituents of strawberry plants at the two Cultivars were mulched with straw, black, silver polyethylene mulch exhibited significant increases plant height, number of leaves, number of crowns, leaf area, foliage fresh mass, dry mass/ plant, number of flower trusses/ plant and flowered more than non-mulched strawberry plants. Plants were mulched with straw, black and silver polyethylene, mulch produced significant increases for yield potentials, i.e. marketable yield/ fed., culls yield/ fed., total yield/ fed., yield/ plant and early yield than those of non-mulched plants Also, these results showed that, significantly improved strawberry fruit quality; i.e. fruit chronological age, TSS, TAA, average mulch treatment irrespective of type fruit weight, V.C., juice volume fruit, fruit diameter, fruit length, and chemical contents, i.e. fruits sugar content and leaf; N content., type of mulches however did not significantly affect leaf; K content, in both seasons. Both cultivars responded similarly to the treatments.

INTRODUCTION

Strawberry (*Fragaria x ananassa* Duch) is one of the most popular vegetable crops in Egypt, it occupies an important position among the untraditional vegetable crops due to its multifarious use as local fresh consumption, food processing, and exportation. The crop is commonly grown in sandy soils for getting early yields and good fruit quality.

Many researches under both field and laboratory conditions proved that use of a surface organic (straw) mulch resulted in strong more precipitation water in soil by reducing storm runoff, increasing infiltration, and decreasing evaporation (Bond and Willis, 1969; Unger, 1983; Smika and Unger, 1986; Rao *et al.*, 1998; Schertz and Kemper, 1998). Organic mulches such as straw-vetch have provided environmental benefits. These include; increased nitrogen; recycling of nutrients; reduced soil erosion, weed emergence, and water loss; addition of organic matter to the soil; lower soil temperature during the hot summer months; and action as slow- release fertilizer (Abdul-Baki and Teasdale, 1993).

Significant effects of organic and synthetic mulches on vegetative growth, flowering traits and yield and its components of strawberry plants have been reported by several investigators (Blatt, 1984; Nestby, 1985; Haynes, 1987; Lareau and Lamarre, 1990; Lieten and Baets, 1991).

Using a killed sod mulch cover for strawberries reduced erosion and compaction, improved soil structure, and reduced water loss in comparison with non-mulched raised beds (Takeda and Glenn, 1988). Himelrick (1982) showed that plants grown on black plastic mulch produced more runners and fruit than plants grown on clear or white plastic mulches and that total fruit mass was greater with black and clear plastic mulches than with bare soil, on the other hand Baumann *et al.*, (1995) reported that no differences on yields between green and black plastic mulch, but plants grown on black mulch produced larger berries than those grown on green or no plastic mulch.

Black polyethylene provides higher soil temperature in spring than hairy vetch mulch (Teasdale and Abdul-Baki, 1995 , Teasdale and Abdul.Baki,1997).

Plants mulched with straw or white -on- black polyethylene flowered and yielded more than plants mulched with clear or white polyethylene. Conversely, more crowns per plant, runners per plot, and greater leaf, crown, and root dry weight (DW) were associated with plants mulched with clear polyethylene than with those mulched with straw or white -on- black polyethylene, (Fear and Nonnecke, 1989).

The objective of the present study was to compare the effects of several mulch types (black polyethylene, silver polyethylene, straw, and none mulch) on the vegetative growth, flowering traits, fruit yield and quality, and chemical composition of two new strawberry cultivars, 'sweet charli' and 'camarosa'.

MATERIAL AND METHODS

The field experiments were conducted during the summer seasons of 2005/2006 and 2006/2007 at South Tahrir district, newly reclaimed sandy soils, in the Experimental Station Farm, Horticultural Research station, situated at Behiera Governorate, under a drip irrigation system. Precede in the initiation of each experiment, soil samples at 25 cm. depth were collected and analyzed according to Black (1965). The results of these analyses are presented in table (1).

Each experiment included 8 treatments representing the combination of four mulches types (straw, black polyethylene, silver polyethylene, and non-mulched control) and two cultivars i.e.; sweet charli and camarosa.

The experimental layout was split-plot system in a randomized complete blocks design with four replications. Two cultivars were arranged as the main plots, while the type of mulches treatments were arranged as sub-plots. Each sub-plot was 10 m long and 1.2 m width. Thus, the area of the smallest experimental unit was 12 square meters.

Table (1): Physical and chemical analyses of the two experimental sites in 2005/2006 and 2006/2007

Seasons	Physical Properties				Chemical properties								
	Sand %	Silt %	Clay %	Texture	E.C (ds/ms)	pH	Soluble cations (mg/l)			Soluble anions (mg/l)			Total N %
							Ca ⁺⁺	Mg ⁺⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	
2005/2006	95	3	2	Sandy	0.22	8.90	0.88	0.56	0.24	0.59	0.43	0.60	0.009
2006/2007	93	5	2	Sandy	0.24	8.80	0.72	0.57	0.22	0.56	0.42	0.58	0.008

Fresh transplants of the two cultivars were obtained from local nurseries under supervision of Agricultural Research Center and Strawberry Improvement Center of Ain Shams University. They were treated with fungicide (Topsin M-70 at the rate of 2 g liter⁻¹) for 20 minutes.

The transplants took place on the four rows of the line on September 1, 2005 and September 25, 2006 with interred spacing of 15 cm. after four weeks from transplanting, mulches treatments were executed up the line.

All experimental plots received a basal soil dressing, during soil preparation, at the rates of 41 kg N and 46.5 kg P₂O₅ and 72 kg K₂O as Ammonium sulphate (20.5% N) and Calcium super phosphate (15.5% P₂O₅) and Potassium sulphate (48% K₂O), orderly. While, during the entire growing seasons, the rest of Nitrogen, Phosphorus and Potassium fertilizers were added through the drip irrigation system five times per week, at the rates of 200 kg N fed⁻¹ in the form of Ammonium nitrate (20.5% N) and 80 kg P₂O₅ fed⁻¹ in the form of Phosphoric acid (80% P₂O₅) and 120 kg K₂O as Potassium sulphate (48% K₂O).

A mixture of micro-element, including (Fe, Zn, and Mn), were foliar sprayed at four weeks intervals starting from one month after transplanting and was continued throughout the growing seasons. All of the horticultural producers were applied as recommended for strawberry commercial production.

The developed old leaves and runners were removed at the first month to enhance the vegetative growth and flowering. Fruits were harvested after 55 days from transplanting at the full ripe stage in the early morning. Picking started on November and extend to May, in the two summer seasons.

Data recorded

- Vegetative growth characters

Five randomly selected plants were taken from each of the smallest experimental unit at blooming stage, and measurements of plant height/plant, number of leaves/plant, number of crowns/plant, leaf area/plant, foliage weight/plant (g), and foliage dry weight (g), were recorded.

Ten randomly chosen plants from each sub-plot, were labeled to record the earliness of flowering as the number of days from transplanting till flowering 25% of the plants, and to count the number of flower trusses/plant till the end of the experiment.

- Fruit yield and its components

- a. Early fruit yield (ton/fed.) was calculated as the fresh weight of harvested fruits from the first four pickings.
- b. Total yield (ton/fed.) was calculated as the fresh weight of all harvested fruits all over the growing the season. It included marketable and non marketable yield (culls yield).
- c. Marketable yield (ton/fed.).
- d. Non marketable yield (ton/fed.) was included splitted, malformed, green shouldered, water damaged and rotted fruits.
- e. Average fruit yield/plant (in gm.) was estimated as weight of all fruits harvested all over the season/plant (in gm.). Average fruit yield/plant included marketable and non-marketable fruits.

- Fruit quality characteristics:

Random samples of ten fruits were taken from each sub-plot, at the peak of harvesting period (the first week of March) to determine average fruit weight (g), total soluble solids (T.S.S. %) using hand refractometer, total titratable acidity (T.A.A.) as g of citric acid/100 g fruit juice according to A.O.A.C. (1990), Ascorbic Acid Content (Vitamin C) was determined as mg/100 g fresh weight using 2,6-dicholrophenolindophenol an indicator by titration as outlined in A.O.A.C. (1990), juice volume (ml/100 gm. fresh fruits); hundred grams of fruit samples, randomly taken, were blended and measured in a graduate glass; fruit length and diameter (cm), it was measured as an average of the previous ten fruits in centimeters and chronological age of fruits (days), it was expressed as the number of days from anthesis to ripening.

- Chemical constituents of leaves and fruits:

Total sugars (%) were determined in dry matter of a random fruit sample according to Nelson (1974). Nitrogen and Potassium were determined basis in the youngest expanded mature leaves from five

selected plants from each sub-plot. Nitrogen was determined according to Evenhuis and Dewaard (1980); while, Potassium was estimated, using flame photometer as outlined by Jackson, (1967).

All obtained data were statistically analyzed according to Costat software (1985) and the Revised L.S.D test was used to compare the differences among the treatments as outlined by Smith (1978).

RESULTS AND DISCUSSION

-Vegetative growth characters:

The results presented in Table (2), generally, clarified the presence of some significant increments on all studied vegetative characters of strawberry plant as a result of mulches type compared with the non-mulches control, in both seasons. the silver mulch recorded the highest mean values for all studied growth characters, in both seasons. The detected pronounced positive effect of mulches type on the vegetative parameters might be due to the reduced soil erosion; weed emergence; water loss; increased nitrogen; recycling of nutrients and addition of organic matter to the soil.

These results, generally, are matched with those reported by Himelrick, (1982); Blatt, (1984); Nestby, (1985) and Fear and Nonnecke, (1989).

Camarosa cultivar tended to increase most vegetative growth. Characters compared with those of sweet charli, in both seasons. The obtained results seemed to complement with those reported by Shiow *et al.*, (1998).

Camarosa had significantly more. vegetative growth characters than sweet charli. The obtained results seemed to complement with those reported by Shiow *et al.*,(1998).

The results in Table (3) illustrate the interaction effects between (cultivars x mulch types) on vegetative growth characters of strawberry plants. In both seasons, significant differences were detected on plant height, number of crowns and foliage fresh mass/plant as a result of the combinations between the different mulches and cultivars. The best treatment combination for most vegetative growth characters was obtained when the strawberry plants cv. camarosa were mulched by silver polyethylene, in both seasons.

Table (2): The main effect of cultivars and mulches on vegetative growth characters of strawberry plant, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 – 2006						2006 – 2007					
	Plant height (cm)	Number of leaves /plant	Number of crowns/ plant	Leaf area (cm ²) /plant	Foliage fresh mass (gm/plant)	Dry mass (gm/plant)	Plant height (cm)	Number of leaves /plant	Number of crowns/p lant	Leaf area cm ² /plant	Foliage fresh mass (gm/plant)	Dry mass (gm/plan)
Cultivars												
Sweet charli	11.43 B**	15.14 B	3.39 B	348.86 B	41.29 B	11.86 B	12.43 B	15.51 B	2.73 B	317.11 B	44.06 B	13.54 A
Camarosa	12.46 A	17.09 A	4.36 A	373.70 A	43.60 A	15.00 A	13.36 A	17.89 A	3.37 A	415.03 A	45.77 A	13.85 A
Mulches												
Control*	8.89 D	14.27 C	2.33 C	303.45 B	38.03 C	11.14 C	9.92 D	13.61 C	1.60 C	316.67 C	40.68 C	10.91 A
Straw	11.91 C	16.53 B	4.13 B	382.67 A	43.49 B	13.87 B	12.85 C	17.24 B	3.36 B	361.47 B	45.78 B	14.12 A
Black	12.89 B	16.34 B	4.12 B	375.09 A	43.34 B	13.78 B	13.78 B	17.18 B	3.07 B	372.99 B	46.08 B	14.90 A
Silver	14.08 A	17.31 A	4.92 B	383.91 A	44.92 A	14.94 A	15.04 A	18.75 A	4.18 A	413.15 A	47.12 A	14.85 A

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (3): The interaction effects of cultivars and mulches on the vegetative growth characters of strawberry plants, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 – 2006						2006 – 2007					
		Plant height (cm)	Number of Leaves /plant	Number of crowns/plant	Leaf area (cm ²) /plant	Foliage fresh mass (gm) /plant	Dry mass (gm) /plant	Plant height (cm)	Number of Leaves /plant	Number of crowns/plant	Leaf area cm ² /plant	Foliage fresh mass (gm) /plant	Dry mass (gm) /plant
Cultivar x mulches													
Sweet charti	Control*	8.28 f**	13.27	2.29 c	285.45	35.68 c	9.72 f	9.34 f	12.62 f	1.50 d	262.67	38.79 f	11.27
	Straw	11.24 d	15.59	3.48 c	373.42	42.43 c	12.13 c	12.29 d	16.17 d	2.80 c	312.45	45.22 d	13.52
	Black	12.24 c	15.36	3.62 c	365.68	42.58 c	12.25 dc	13.23 c	16.04 d	2.56 c	317.74	45.49 dc	15.08
	Silver	13.96 ab	16.34	4.17 bc	370.91	44.46 b	13.34 c	14.86 ab	17.20 c	4.07 ab	375.58	46.72 ab	14.29
Camarosa	Control	9.51 e	15.26	2.38 d	321.46	40.37 d	12.55 d	10.49 c	14.61 e	1.70 d	370.66	42.58 e	10.54
	Straw	12.58 c	17.48	4.78 b	391.93	44.54 b	15.61 b	13.41 c	18.32 b	3.92 ab	410.48	46.33 bc	14.71
	Black	13.54 b	17.33	4.62 b	384.49	44.10 b	15.30 b	14.32 b	18.33 b	3.57 b	428.25	46.67 ab	14.72
	Silver	14.20 a	18.28	5.67 a	396.92	45.37 a	15.56 a	15.23 a	20.30 a	4.29 a	450.72	47.51 a	15.42

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (4): The main effect of mulches and cultivars on the flowering traits of strawberry plants, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 – 2006		2006 - 2007	
	Number of flower trusses/plant	Earliness of flowering (days)	Number of flower trusses/plant	Earliness of flowering (days)
Cultivars				
Sweet charli	13.06 A**	50.97 B	14.04 A	52.03 B
Camarosa	11.31 B	67.91 A	12.36 B	67.05 A
Mulches				
Control*	7.93 B	65.35 A	9.23 B	65.53 A
Straw	13.53 A	57.47 B	14.44 A	57.60 B
Black	13.49 A	57.57 B	14.56 A	57.43 B
Silver	13.79 A	57.37 B	14.57 A	57.61 B

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

However, the results indicated that leaf area/plant didn't affect by the interaction between cultivar on mulch type .

Number of leaves and dry mass per plant, however appeared not significant, in the first and second season, orderly in general, similar conclusions were previously recorded by Shioh *et al.*, (1998) and Vander Meulen *et al.*, (2006).

- Flowering Traits

The effects of various mulch types on flowering time (earliness) and number of flower trusses/plant were found significant in both seasons (Table 4). The strawberry plants which were mulched, flowered earlier than of non mulched control. It was noticed that there were no significant differences among the three types of mulch on flowering traits, in both growing seasons. The observed enhancement on flowering parameters with type of mulches might be attributed to the benefits of organic and synthetic mulches which led to increased organic matter to the soil; water loss; lower soil temperature during the hot summer months; reduced soil erosion; and action as a slow-release fertilizer (Abdul-Baki and Teasdale, 1993), leading to promote vegetative growth, which positively reflect on flowering traits. These results seemed to be in general agreements with those reported by (Fear and Nonnecke, 1989), who reported that plants mulched with straw or white- on- black polyethylene flowered and yielded earlier than plants mulched with clear or white polyethylene.

The obtained results tabulated in Table (4) reported that, strawberry cv. sweet charli was more earlier and produced more number of flowers plant than those of camarosa.

The interaction effect between type of mulches and cultivars on flowering traits; i.e. earliness of flowering and number of trusses/plant; are presented in Table (5). Application at the strawberry plants cv. sweet charli with sliver mulch was responsible for earliness the flowering and had significant effect on number of flower trusses/plant, in both seasons. Similar results were reported by Shioh *et al.*, (1998).

-Fruit yield and its components:

The results presented in Table (6), clearly, indicated that there were significant increases in all studied yield parameters, i.e.; marketable, culls yield, total yield, yield/plant, and early yield due to

Table (5): The interaction effects of cultivars and mulches on the flowering traits of strawberry plants, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 – 2006		2006 – 2007	
		Number of flower trusses/plant	Earliness of flowering (days)	Number of flower trusses/plant	Earliness of flowering (days)
Cultivar x mulches					
Sweet charti	Control*	8.44 C**	55.29 D	9.34 D	56.56 C
	Straw	14.67 A	49.62 E	15.65 A	50.48 D
	Black	14.47 A	49.60 E	15.39 A	50.51 D
	Silver	14.67 A	49.39 F	15.76 A	50.56 CD
Camarusa	Control	7.42 D	75.41 A	9.19 D	74.49 A
	Straw	12.40 B	65.32 C	13.22 C	64.71 B
	Black	12.50 B	65.55 B	13.73 B	64.35 B
	Silver	12.91 B	65.36 BC	13.38 B	64.66 B

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (6): The main effect of mulches and cultivars on strawberry fruit yield and its components, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 – 2006					2006 – 2007				
	Marketable yield (Ton/fed.)	Culls yield (Ton/fed.)	Total yield (Ton/fed.)	Yield / plant (gm)	Early yield (Ton/fed.)	Marketable yield (Ton/fed.)	Culls yield (Ton/fed.)	Total yield (Ton/fed.)	Yield / plant (gm)	Early yield (Ton/fed.)
Cultivars										
Sweet chari	20.12 A**	0.60 A	20.72 A	0.522 A	1.91 A	20.09 A	0.68 A	20.74 A	0.544 A	2.38 A
Camarosa	18.47 B	0.54 B	19.00 A	0.477 B	1.68 A	19.85 B	0.52 B	20.38 B	0.511 B	1.36 B
Mulches										
Control*	18.06 C	1.01 A	19.07 A	0.488 B	1.39 B	18.07 C	1.01 A	19.08 C	0.477 C	1.28 D
Straw	19.24 B	0.9 B	20.14 A	0.520 A	2.06 B	20.28 B	0.88 B	21.10 A	0.544 A	2.01 C
Black	19.94 A	0.19 C	20.14 A	0.522 A	2.05 A	20.75 A	0.26 C	21.01 B	0.533 B	2.07 B
Silver	19.94 A	0.17 C	20.11 A	0.533 A	1.68 B	20.79 A	0.24 C	21.04 AB	0.533 B	2.11 A

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

the application of three types compared to the non mulched control, in both seasons. These results, also, exhibited significant differences between the two studied strawberry cultivars on all yield parameters, in both seasons. Sweet charli cultivars was superior than camarosa with respect to all yield potential characters. Such responses of strawberry yield to mulch types appeared to be in general accordance with those reported by several investigators (Blatt, 1984; Nestby, 1985; Haynes, 1987; Lareau and Lamarre, 1990; Lieten and Baets, 1991; Shioh *et al.*, 1998; Vander Meulen *et al.*, 2006).

Results in Table (7) illustrated the interaction effects between the various type of mulches and the two strawberry cultivars on the yield and its components which were found significant, in both seasons. The strawberry plants cv. sweet charli which mulched with sliver polyethylene, generally, produced the highest significant mean value for fruit yield and its components, However, strawberry plants cv. camarosa mulched with sliver polyethylene mulch appeared to highest significant mean value for culls yield of strawberry fruits, in both seasons. It was noticed that the treatment combinations didn't differ significantly on early yield in first season, and yield/plant in the second season. The obtained results are in general accordance with those reported by (Albregts et al, 1993, Shioh *et al.*, 1998 and Vander Meulen *et al.*, 2006).

-Fruit Quality Characteristics:

The results in Table (8), generally, showed the presence of some significant differences on fruit chronological age, TSS, total titratable acidity, and average fruit weight, as a result of mulch types, in both growing seasons. Mulching strawberry plants with the three studied types significantly increase TSS and average fruit weight relative to the non mulched control, in both seasons. On the other hand, the use of straw, black and silver mulch resulted in some reduction on both fruit chronological age and total titratable acidity, in both seasons. The obtained results, generally, showed significant differences between strawberry plants cv. sweet sharl and strawberry plants cv. camarosa, in both seasons. It was observed that sweet charli cultivar ripened earlier and contained more total soluble solids than that of camarosa. However, camarosa fruits was higher weight and contained more total titratable acidity than those if sweet charli ones. Generally, the obtained results compatible with those reported by

Table (7): The interaction effects of cultivars and mulches on strawberry yield and its components, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 – 2006					2006 – 2007				
		Marketable yield (Ton/fed.)	Culls yield (Ton/fed.)	Total yield (Ton/fed.)	Yield / plant (gm)	Early yield (Ton/fed)	Marketable yield (Ton/fed.)	Culls yield (Ton/fed.)	Total yield (Ton/fed.)	Yield / plant (gm)	Early yield (Ton/fed.)
Cultivars X Mulches											
Sweet charli	Control*	18.49 d**	1.05 a	19.53 b	0.489 b	1.40	18.10 e	1.13 a	19.23 d	0.488	1.60 c
	Straw	20.14 b	0.95 b	20.10 a	0.533 a	2.31	20.40 c	0.97 b	21.25 a	0.533	2.52 b
	Black	20.93 a	0.20 d	21.15 a	0.533 a	2.29	20.92 a	0.32 c	21.25 a	0.533	2.67 a
	Silver	20.94 a	0.18 d	21.12 a	0.533 a	1.64	20.93 a	0.29 c	21.22 a	0.533	2.71 a
Camarosa	control	17.63 f	0.97 b	18.60 d	0.486 b	1.38	18.04 e	0.89 c	18.93 e	0.477	0.96 e
	Straw	18.34 e	0.85 c	19.18 c	0.488 b	1.82	20.15 d	0.80 d	20.95 b	0.522	1.50 d
	Black	18.96 c	0.17 d	19.13 c	0.488 b	1.81	20.58 bc	0.20 f	20.78 c	0.523	1.47 d
	Silver	18.44 c	0.16 d	19.10 c	0.488 b	1.71	20.65 b	0.18 f	20.86 c	0.522	1.50 d

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (8): The main effect of cultivars and mulches on the chronological age, total soluble solids, total titratable acidity, and average fruit weight of strawberry fruits, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 - 2006				2006 - 2007			
	Fruit chronological age (days)	TSS (%)	Total Titratable acidity (gm) citric acid (100 gm juice)	Average fruit weight (gm)	Fruit chronological age (days)	TSS (%)	Titratable acidity (gm) citric acid (100 gm juice)	Average fruit weight (gm)
Cultivars								
Sweet charli	30.52 A**	11.15 A	0.30 B	23.19 B	30.95 B	11.52 A	0.29 B	23.37 B
Camrosa	31.28 A	9.34 B	0.35 A	24.85 A	31.69 A	9.55 B	0.33 A	25.82 A
Mulches								
Control*	34.68 A	9.57 B	0.52 A	19.93 C	35.15 A	9.91 D	0.51 A	20.09 B
Straw	29.29 B	10.43 A	0.24 C	25.35 B	29.84 C	10.75 B	0.24 D	26.15 A
Black	30.46 B	10.47 A	0.26 B	25.39 AB	30.09 B	10.65 C	0.26 B	26.06 A
Silver	29.36 B	10.51 A	0.26 B	25.43 A	30.21 B	10.82 A	0.25 C	26.08 A

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Lareau and Lamarre, 1990; Lieten and Baets, 1991, and Shio *et al.*, 1998.

The interaction effects among the cultivar and mulch types on the fruit chronological age, total soluble solids, total titratable acidity and average fruit weight are shown in Table (9). The comparisons among the means of the various treatment combinations showed the presence of some significant interaction effects on the total soluble solids and titratable acidity, in the first season, and on average fruit weight, in both seasons, as chronological age, in the second season. The highest mean value of these characters was obtained from strawberry plants cv. sweet charli which mulched with sliver polyethylene. However, fruit chronological age, in the first season, TSS, and T.A.A, in the second season, did not reflect any significant differences due to the interaction effects between mulch types and strawberry cultivars. The obtained results are in general accordance with those reported by Shio *et al.*, 1998.

The results presented in Table (10), clearly, indicated that were progressive and significant increases on all studied fruit quality parameters, i.e.; vitamin C, juice volume, and fruit diameter due to mulch types, in both seasons. Also, the results indicated that significant differences in fruit length, in the first season only, Generally, the results showed, significant differences between strawberry cv. sweet charli and strawberry cv. camarosa, fruit of camarosa cultivar contained more vitamin c than sweet charli, However sweet charli fruits contained higher amount of juice and had more diameter than those of camarosa. in both seasons.

In relation to vitamin c, juice volume and fruit diameter such responses of strawberry quality to type of mulches appear to be in general accordance with those reported by several investigators (Haynes, 1987; Lareau and Lamarre, 1990; Lieten and Baets, 1991; Shio *et al.*, 1998; and Vander Meulen *et al.*, 2006).

Table (9): The interaction effects of cultivars and mulches on the chronological age, total soluble solids, total titratable acidity, and average fruit weight of strawberry fruits, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 - 2006				2006 - 2007			
		Fruit chronological age (days)	TSS (%)	Titratable acidity (gm) citric acid (100 gm juice)	Average fruit weight (gm)	Fruit chronological age (days)	TSS (%)	Titratable acidity (gm) citric acid (100 gm juice)	Average fruit weight (gm)
Cultivar x mulches									
Sweet Charli	Control*	33.87**	10.69 b	0.46 b	19.47 d	34.37 b	10.89	0.49	18.70 d
	Straw	28.35	11.29 a	0.23 d	24.39 b	29.57 e	11.76	0.22	25.02 b
	Black	31.04	11.29 a	0.25 cd	24.49 b	29.87 d	11.63	0.24	24.85 b
	Silver	28.83	11.33 a	0.25 cd	24.42 b	30.00 d	11.80	0.24	24.91 b
Camarosa	control	35.50	8.45 d	0.58 a	20.39 c	35.94 a	8.94	0.52	21.48 c
	Straw	30.24	9.57 c	0.25 cd	26.30 a	30.10 cd	9.74	0.26	27.28 a
	Black	29.88	9.66 c	0.27 c	26.29 a	30.30 c	9.68	0.27	27.26 a
	Silver	29.90	9.68 c	0.28 c	26.43 a	30.41 c	9.84	0.26	27.25 a

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

The results in Table (11) illustrated the interaction effects between the various mulch types and cultivars of strawberry plants on the vitamin C, juice volume fruit, fruit diameter, and fruit length, which were found to be significant, in both seasons. The best results for these characters were obtained from strawberry plants cv. sweet charli which mulched with sliver polyethylene, in both seasons. Similar results were recorded by Shiow *et al.*, 1998.

Chemical constituents of leaves and fruits:

The results of Table (12), clearly, showed that mulching strawberry plants with straw gave significantly higher mean values for leaf's N content, However, strawberry plants which mulched with black polyethylene gave significantly higher mean values for total sugar than control (none mulched). Also, the results indicated significant increase on fruit's leaf K content as a result of mulch types, in both seasons.

The results showed that there were some significant differences between the two studied cultivars concerning the chemical contents of leaves and fruits, in both seasons. However, the results exhibited significant differences between the two studied cultivar; sweet charli and camarosa, in both seasons. Data revealed that sweet charli fruits significantly, contained more total sugar than camarosa cultivar, in both seasons. Similar results were reported by Shiow *et al.*, 1998 and Vander Meulen *et al.*, 2006.

The interaction effects between strawberry cultivars and type of mulches on chemical contents; i.e. total sugars, leaf's N content, and leaf's K content are presented in Table (13). In the first season, strawberry plants cv. sweet charli which mulched with sliver polyethylene gave the highest mean value for total sugars. However, leaf's N content and leaf's K contents were not significantly, affected by this interaction. In the second season, strawberry plants cv. sweet charli mulched with straw gave the highest mean value for leaf's N content. total sugars and leaf's K content were not significantly due to the interaction between cultivar and mulch types.

Table (10): The main effect of cultivars and mulches on the vitamin C, juice volume contents, diameter and length of strawberry fruits, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 - 2006				2006 - 2007			
	Vitamin C (mg/100 gm f. wt.)	Juice volume fruit (ml /100 gm fruit)	Fruit diameter (cm)	Fruit length (cm)	Vitamin C (mg/100 gm f. wt.)	Juice volume fruit (ml /100 gm fruit)	Fruit diameter (cm)	Fruit length (cm)
Cultivars								
Sweet charli	35.08 B**	8.99 A	2.14 A	2.32 B	34.15 B	9.18 A	2.34 A	2.55 A
Camarosa	35.89 A	8.16 B	1.89 B	2.76 A	35.01 A	7.62 B	1.78 B	2.26 B
Mulches								
Control*	30.69 D	7.03 D	1.32 B	2.55 A	30.05 D	6.53 C	1.23 C	2.40 A
Straw	36.95 C	8.99 C	2.22 A	2.55 A	36.14 A	9.11 A	2.37 A	2.38 A
Black	37.07 B	9.09 B	2.22 A	2.55 A	36.09 B	8.99 B	2.35 A	2.41 A
Silver	37.22 A	9.25 A	2.30 A	2.50 B	36.06 C	8.97 B	2.29 B	2.44 A

* control : non mulched

** Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (11): The interaction effects of cultivars and mulches on the vitamin C, juice volume contents, diameter and length of strawberry fruits, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 - 2006				2006 - 2007			
		Vitamin C (mg/100 gm f. wt.)	Juice volume fruit (ml/100 gm fruit)	Fruit diameter (cm)	Fruit length (cm)	Vitamin C (mg/100 gm f. wt.)	Juice volume fruit (ml/100 gm fruit)	Fruit diameter (cm)	Fruit length (cm)
Cultivar x mulches									
Sweet Charl	Control*	30.17 f**	7.62 f	1.43	2.32 c	29.36 f	7.19 g	1.44 d	2.56
	Straw	36.57 d	9.37 d	2.35	2.32 c	35.75 a	9.97 a	2.70 a	2.52
	Black	36.70 d	9.45 ab	2.32	2.32 c	35.86 c	9.88 b	2.66 ab	2.56
	Silver	36.90 c	9.53 a	2.46	2.32 c	35.66 d	9.68 c	2.57 b	2.56
Camarosa	Control	31.21 e	6.45 g	1.21	2.79 a	30.73 e	5.88 h	1.03 e	2.24
	Straw	37.34 b	8.50 e	2.09	2.78 a	36.53 a	8.24 e	2.04 c	2.24
	Black	37.45 ab	8.73 c	2.12	2.69 b	36.33 b	8.09 f	2.04 c	2.25
	Silver	37.54 a	8.97 c	2.15	2.79 a	36.46 a	8.26 d	2.01 c	2.32

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (12): The main effect of cultivars and mulches on the mineral contents of leaves and fruits of strawberry plants and total sugar, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments	2005 – 2006			2006 – 2007		
	Total sugar (%)	Leaf's N content (%)	Leaf's K content (%)	Total sugar (%)	Leaf's N content (%)	Leaf's K content (%)
Cultivars						
Sweet Charli	21.08 A	2.17 A	2.17 A	22.33 A	2.33 A	1.34 B
Camarosa	20.15 B	2.27 A	2.27 A	21.21 B	2.19 B	1.52 A
Mulches						
Control*	28.97 C**	2.18 B	1.28 A	19.86 B	2.11 B	1.43 A
Straw	21.14 B	2.58 A	1.27 A	22.41 A	2.71 A	1.43 A
Black	21.14 B	2.06 B	1.27 A	22.43 A	2.12 B	1.43 A
Silver	21.19 A	2.06 B	2.06 B	22.37 A	2.11 B	1.43 A

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

Table (13): The interaction effects of cultivars and mulches on the mineral contents of leaves and fruits of strawberry fruits, during the seasons of 2005/2006 and 2006/2007.

Seasons Treatments		2005 - 2006			2006 - 2007		
		Total sugar (%)	Leaf's N content (%)	Leaf's K content (%)	Total sugar (%)	Leaf's N content (%)	Leaf's K content (%)
Cultivars X Mulches							
Sweet charli	Control*	19.60 e**	2.06	1.32	20.47	2.20 c	1.35
	Straw	21.53 b	2.54	1.32	22.93	2.74 a	1.34
	Black	21.59 a	2.04	1.32	22.96	2.19 c	1.34
	Silver	21.59 a	2.03	1.32	22.94	2.19 c	1.34
Camarosa	Control	18.35 f	2.30	1.23	19.24	2.01 d	1.52
	Straw	20.75 c	2.62	1.22	21.89	2.68 b	1.52
	Black	20.69 d	2.09	1.22	21.89	2.05 d	1.52
	Silver	20.79 c	2.09	1.22	21.80	2.02 d	1.52

* control : non mulched

**Values followed by the same letter (s), within a comparable group of means, do not significantly differ, using revised L.S.D test at 0.05 level.

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الملخص العربي

تأثير كل من الملش العضوي و الصناعي على بعض أصناف الفراولة الطازجة

رمضان عبد العاطي محمد و البسيوني أحمد رضوان

قسم بحوث الخضرا - معهد بحوث البساتين - مركز البحوث الزراعية

لجريت دراسة حقلية خلال الموسم الصيفي لعامي 2005-2006 ، 2006-2007 بأرض رملية بمحطة التجارب الزراعية بجنوب التحرير ، التابعة لمعهد بحوث البساتين بمحافظة البحيرة ، بهدف دراسة استجابة نباتات الفراولة صنفى (سويت شارلى) و (كماروزا) لأربعة معاملات من الملش هي الملش العضوي (القش) والبولي إيثيلين الأسود و البولي إيثيلين الفضي بالإضافة إلى الكنترول (بدون ملش) وتأثير التدخل بينهم على النمو الخضري و الزهري و المحصول و الجودة و التحليل الكيماوى لثمار الفراولة.

- أوضحت النتائج أن معاملة صنفى الفراولة بأنواع الملش المختلفة (القش - الأسود - الفضى) قد أدت إلى حدوث زيادة معنوية فى صفات النمو الخضري و الزهري معبراً عنها بمتوسط طول النبات و عدد الأوراق و عدد التجان و المساحة الورقية و الوزن الطازج و الوزن الجاف للنبات و عدد النورات الزهرية للنبات و التبركير فى الأزهار مقارنة بالكنترول (بدون ملش).

- أدت معاملة نباتات الفراولة بواسطة الملش العضوي و الأسود و الفضى إلى حدوث زيادة معنوية فى القدرة المحصولية معبراً عنها بالمحصول الصالح للتسويق و المحصول للتالف و المحصول الكلى و متوسط محصول النبات الواحد و المحصول المبكر مقارنة بالكنترول (بدون الملش) ، كما أشارت النتائج إلى حدوث تحسن معنوي فى صفات الجودة معبراً عنها بطول الفترة ما بين تفتح الزهار إلى نضج الثمرة و نسبة المواد الصلبة الذائبة و الحموضة و متوسط وزن الثمرة و فيتامين ج و حجم العصير للثمرة و طول و قطر الثمرة إضافة إلى تحسن الصفات الكيماوية معبراً عنها بالسكريات الكلية و نسبة النيتروجين فى الأوراق. ولقد لوحظ أن معاملات الملش لم تؤثر معنوياً على نسبة البوتاسيوم فى الأوراق. فى حين أن استجابة كلا الصنفين لمعاملات الملش كانت متشابهة.