INFLUENCE OF SOIL MULCHING AND PLANT SHADING ON GROWTH, YIELD, FRUIT QUALITY AND STORAGEABILITY OF SWEET PEPPER

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ABSTRACT

A series of experiments were carried out at Kaha vegetable Experimental station and postharvest laboratory during 2001 and 2002 seasons on pepper cv. Gedeon F_1 hybrid to study the effect of soil mulching and plant shading on growth, yield and fruit characteristics at harvest and during cold storage. Different types of packaging were examined to find out their effects on fruit quality during storage and retail display conditions. The results were summerized as follows:

1- Effect of soil mulching and shading on vegetative growth, fruit quality and yield of sweet pepper.

The application of shading and bare soil in addition to the interaction between them were the best treatments for plant growth (Plant height, number of leaves and leaf area). On the other hand, neither soil mulch nor its combination with shading had an effect on plant dry matter, flesh thickness and fruit length. Fruit weight and diameter were increased using soil mulching compare to bare soil but produced lower total yield (Kg/ plant). Moreover, shading treatment increased significantly fruit diameter, weight and total yield. Respecting interaction affect (Shading treatment and bare soil) was the best treatment for fruit diameter, weight and total yield.

2- Effect of soil mulching and shading on physical and chemical characteristics of pepper fruit during cold storage.

As the storage period was prolonged, the weight loss was increased and when pepper fruits stored for 14 days at 8ºC no further loss of quality was observed. However losses were occurred when the storage period was extended to 28 days. Significant decrease in T.S.S., ascorbic acid and total chlorophyll content with the elapse of the storage period.

T_2 (shading, plus bare soil) and T_4 (un-shaded plastic plus bare soil) (control) had the lowest value of weight loss percentage in the second season during the storage period and these two treatments had higher visual quality than did the other treatment in both seasons.

(T_2) and (T_4) gained slightly higher T.S.S. content in the first season, as compared to (T_1) shading, soil mulching or (T_3) without shading, soil mulching but there were no significant differences between treatments in the second season. No significant differences were found between treatments as for their effect on the ascorbic acid content in both seasons.

(T_2) and (T_4) retained higher total chlorophyll content over the other two used treatments.

3- Packaging materials and their effect on sweet pepper fruit during storage and retail display condition.

Storing pepper fruit for 28 days at 8ºC plus additional 3 days at 20ºC for fruit retail display and the results indicated that as the storage period was prolonged, weight loss, decay percentage were increased. No significant differences were noticed in dry matter content. There were continuous loss of T.S.S., ascorbic acid and total chlorophyll content as the storage period was prolonged.

As for the packaging types. Packing pepper fruits in carton box (Control) had higher percentage of weight loss compared with fruit packed in P.E lining or P.E bags. Nonperforated P.E. bag and control treatment had higher percentage of decay than

those of P.E lining or per forated P.E bags. The packages types did not have any significant effect on dry matter, T.S.S. and ascorbic acid content.

Non perforated polyethylene bag retained higher chlorophyll content compared to the other packaging types.

It can be concluded that spraying the upper surface of the plastic sheet of the greenhouse with sepidag without mulching to produce high yield and quality of green pepper grown under greenhouse during August. Packaging pepper fruits in film wrapping (P.E. lining and perforated or nonperforated P.E. bags) maintained quality, retain green color and extended the shelf life if held at 8ºC and 85% R.H. for a period of 28 days.

INTRODUCTION

Sweet pepper is an important vegetable crop grown under protected cultivation in Egypt. More than 30% of the greenhouses in Egypt are cultivated with sweet pepper for export and local consumption. To produce yield of sweet pepper grown under greenhouses, seeds must be sown from 15th of June till 15th of July and seedlings of sweet pepper must be transplanted in the greenhouses during August. The weather in this month is usually very hot and the seedlings are under stress. The high temperature in July and August increases transpiration and respiration rates, thus the growth of the seedlings is limited. Root and shoot growth of pepper seedlings were inhibited when seedlings kept in higher temperature regime compared with control plants which kept at 25ºC /18ºC (Aloni *et al.,* 1992). Transpiration rate and stomata conductance increased with the high-temperature treatments while the yields were considerably reduced. There was a clear negative relationship between vegetative and reproductive growth under high temperature conditions, flower absission at a high temperature was considered to be a strategy to maintain a minimum level of plant growth (Tahgaki *et al.* 1993). In Egypt, any treatment reduces the temperature during this time of the year may improve the growth and hence yield and fruit of sweet pepper grown under greenhouses.

Sweet pepper is stored for relatively long periods at temperature 7-13ºC (Paull, 1990), depending on the variety and the stage of maturity. However these low temperatures did not completely inhibit decay development during storage (Barkai Golan, 1981). In the main time, temperature above 13ºC encouraged ripening and spread of bacterial soft rot (Handenburg *et al*., 1986). Because of their large surface to weight ratio, pepper are also prone to water loss and shrivelling. The most effective method of maintaining quality and controlling decay of pepper is a rapid cooling soon after harvest followed by storage at low temperature with a high relative humidity (hardenburg *et al*., 1986).

Modified atmosphere packaging of green pepper, has been reported to inhibit respiration, delay ripening, decrease ethylene production, slow down compositional changes associated with ripening, maintain color and extend shelf life (Ben-Yehoshua *et al.,* (1983). Miller *et al.,* (1986) Gonzalez and Tiznado (1993). The benefial effect could be due to the modification of the concentrations of Co_2,O_2 and created ethylene inside the package. Zagory and Kader (1988).

Although packaging also reduce water loss (Ben yehoshua *et al.,* 1983; Lurie *et al.,* 1986; Meir *et al.,* 1995; Wall and Berghage 1996), post harvest diseases could be enhanced by high humidity created in the bags (Ben Yehoshu, 1985; Rodov *et al.*, 1995).

The purpose of the present work was to test the use of plastic mulch and greenhouse shading on the growth, yield and quality of fruit. Besides, storage of sweet pepper fruits at 8ºC for 28 days will be examined. Additionally the influence of different packaging material on the fruit quality during storage and simulated marketing will be studied.

MATERIALS AND METHODS

An experiment was conducted at Kaha experimental farm, Qalubia governorate in the two successive seasons i.e., years 2001 and 2002. Seeds of sweet pepper cv. Gedeon F_1 hybrid were sown in the nursery on 15th of June in both seasons and the seedlings were transplanted on 7th of August in the greenhouses. Four greenhouses were used in this experiment, plastic mulch of double face was used (The upper face is silver and the bottom is black).

The treatments were as follow:

1- Spraying the upper surface of the clear plastic sheet covering the greenhouse with sepidag plus spreading sliver plastic mulch on the soil surface.
2- Spraying the upper surface of the plastic sheet of the greenhouse with sepidag without mulching.
3- Covering the soil of the greenhouse with silver plastic mulch without spraying the plastic sheet with sepidag.
4- Greenhouse without Mulching and without sepidag (Control).

A split plot design with four replicates was adopted. The plastic mulch was arranged in the main plot, while the sepidag was plotted at random in the subplot. Maximum and Minimum temperature were meseaured daily for 60 days after transplanting. Determination of the studied characters was carried as follows:-

1- Plant height after 60 days from transplanting (before cleaning the plastic sheets from sepidag).
2- Number of leaves and stem diameter after 60 days from transplanting.
3- Leaf area: the sixth leaf from the apex was determined using Li-cor (Li - 3000) portable area meter and expressed as cm^2/leaf.
4- Dry matter control of the whole plant: randomly plants were taken after 60 days from transplanting and dried at 105ºC and dry matter percentage was calculated.
5- Average fruit weight, diameter, length, flesh thickness and number of locules were determined.
6- Total yield kg/plant.

Sweet pepper fruits were harvested at mature green stage and transported to the laboratory at Giza and uniform sized pepper free of blemishes or defects were selected.

The samples were arranged in a complete randomized block design, twelve fruit were placed in a canton box as one replicate. Twelve replicates for each treatment were stored for 28 days at 8ºC, 85% relative humidity (R.H.). In all stored fruits, samples were taken at random from 3 replicates for each treatment and examined every 7 days intervals for fruit quality, weight loss, visual quality appearance, dry matter, total soluble solids, ascorbic acid and total chlorophyll.

Packaging materials and their effect on sweet pepper fruit during storage and retail display condition.

Pepper fruits were obtained from the same green house, which was used as control to study the effect of shipment and retail display condition on fruit quality.

Fruits were picked at mature green stage, Medium size (5-7cm) fruit diameter were used, sound and healthy fruits were chosen and packed using different packaging materials:

1- Packing in corrugated carton previously lined with polyethylene 60 micron thickness.
2- packing in perforated polyethylene bags 30 micron thickness, (38 x 25 cm in size) with 6 holes (each 5 mm in diameter) for a total 0.0082% perforation, then placed inside corrugated carton box.
3- Packing in non-perforated polyethylene bags 30 micron thickness (38 x 25 cm) in size, and placed inside corrygated carton box.
4- Un bagged fruits packed in carton box served as control.

A complete Randomized block design was adopted. Twelve fruits were put in a carton box as one replicate. Nine replicates for each treatment. The packaged fruits were stored at 8ºC and 85% R.H. for 2.3,4 weeks, with an additional 3 days at 20ºC, 55% R.H. to simulate marketing conditions.

At each interval, samples were taken at random from 3 replicates for each treatment, and examined for percentage of weight loss, decay, dry matter, total soluble solids, ascorbic acid and total chlorophyll.

The data were recorded at each interval and the following criteria were measured:

1- Percentage of weight loss:

$$\frac{\text{Weight of sample at the beginning of storage-its weight after storage}}{\text{Weight of sample at the beginning of storage}} \times 100$$

2- Visual quality was evaluted using a 1 -5 scale with 5 excellent, 4 good, 3 fair, 2 poor and 1 unusable fruits. Fruit evaluated at less than 2.8 were considered unmarkatable.
3- Percentage of decay:

$$\frac{\text{Weight of decayed fruits}}{\text{Original weight of the sample}} \times 100$$

4- T.S.S. content was determined using Able refractometer (A.O. A.O., 1990).
5- Dry Mater content: 100gm. of fresh fruits were weighted and dried at 70ºC until a constant weight and percentage of dry matter was calculated .
6- Ascorbic acid content was determined using the dye 2-6 dichloro -phenol indo phenol method A.O.A.O., (1990).
7- Total chlorophyll (Chlorophyll a & b) was measured by extracting the chlorophyll from a 2 grams sample of fruits with a cetone (85%) as described by Singh (1982).

All data were subjected to the statistical analysis according to the method described be Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Data in Table (1) show clearly that maximum air temperature was higher under mulching treatment without spidage, this may be due to the reflection of

sun light from the silver mulch to the air around the plants, meanwhile the lower maximum air temperature was under spidag treatment without mulching, this due to the reflection of the sun light from the upper surface of the plastic sheets by spidag. Brown 1982, EL-Aidy, 1986 and Hissely 1986 indicated that shading had clearly great effect on reducing air temperature.

Vegetative growth

Data in Table (2) show clearly that mulching with double layer (Silver on top and black in the bottom) decreased plant height, number of leaves, leaf area and stem diameter of pepper plant significantly in both seasons.

The comparison between the spidag and without spidag means, in both growing season, showed that spidag treatment increased plant height, number of leaves and leaf area significantly, on the other side spidag treatments reduced stem diameter significantly in both seasons this may be due to the plastic shading with spidag which make on elongation in stem cells.

The interaction between mulch and spidag treatments indicated that there was a significant effect on plant height, number of leaves and leaf area of pepper plants and the best treatment was spraying the plastic with spidag without mulching in both seasons. Meanwhile there was no significant difference between treatments on stem diameter in both seasons. The improvement in the vegetative growth under spidag treatment may be due to the reduction in maximum temperature under spidag that reduced transpiration rate from plants (Schoch 1972).

Dry matter content

Data in Table (2) illustrated that there were no significant differences between the treatments on plant dry matter content after 60 days from transplanting.

Yield behaviour

Data in Table (3) illustrated that mulching treatments increased pepper fruit weight and fruit diameter significantly in both seasons. The same results were found with spidag treatment. The interaction between treatment indicated that there were significant differences between them. The best treatment was spidag without mulching. As for pepper fruit length and flesh thickness, data in Table (3) showed that there was no significant difference between treatments or interactions.

As for number of locules data in Table (3) showed that mulching treatment decreased number of locules significantly in both seasons. The same results were found with spidag treatment. The interaction between treatments illustrated that there were significant differences between treatments and the best treatment was spidag without mulching.

Concerning total yield per plant, data in Table (3) indicated that mulch treatment reduced total yield per plant significantly in both seasons. However, spidag treatment increased total yield per plant significantly in both seasons.

The interaction between treatments indicated that there were significant differences between them. The best treatment was spidag without mulching. It is clear that shading with spidag decreased maximum air temperature which in turn improved vegetative growth. High temperature increased flower shading (Abd- Alla and Verkerk 1968) reduced fruit set (Sheby *et al*. 1988). These effects subsequently lead to increased total yield under spidag treatment.

Effect of soil mulching and shading on physical and chemical characteristics of pepper fruit during cold storage.

Percentage of weight loss

Results reported in Table (4) indicated a progressive increase in the percentage of loss in fruit weight of different treatments during storage. Storing pepper fruit for 14 days at 8ºC resulted in 5.96% weight loss in the first season. Moreover, holding pepper in storage for additional 14 days resulted in a significant higher loss (11.56%) when compared to the first period of storage. The same trend was also noticed in the second season. These results are similar to those obtained by Abd EL-Rahman and EL-Sheikh (1994).

Regarding cultural treatments, no significant differences were detected in the first season (Table 4). On the other hand, significant differences between treatments were evident in the second season, where (T_1) suffered higher weight loss (4.90%) than (T_4) - control (3.97)% (Table 4).

As for interaction (treatment x storage period) data showed that the interaction was insignificant in the first season, while was significant in the second season. (T_2) and (T_4) showed the lowest weight loss percentage after 28 days of cold storage

Visual quality

Table (4) showed that pepper fruits could be stored for 14 days without serious loss of quality and the visual quality score reached 4.58 after 14 days in first season. Significant loss of quality was observed when the period of storage was extended up to 28 days as the visual appearance quality reached 3.42. The same trend was noticed in the second season. These results are matched well with those obtained by Hardenburg *et al.* (1986) and Paull, (1990).

As for the treatments, (T_1) resulted in the lowest score of visual quality (4.26) in the first season compared with either (T_2) 4.73 or (T_4) control 4.46. The same trend was found in the second season.

No. significant interaction between treatments vs storage period was noticed in both seasons.

Dry Matter

Table (4) showed that the dry matter content of pepper was not significantly affected by the treatments, the period of storage and the interaction between them in the first season. In the second season, results in Table (4) showed that there were significant differences in dry matter content of pepper fruit for different storage period. These data showed that dry matter content increased up to 14 days of storage after that decreased till the end of storage period. The increase in dry matter in the first period might be due to the higher rate of moisture loss through transpiration than that of dry matter loss through respiration, while the reduction during the last periods of storage might be related to the higher rate of sugar loss through respiration than water loss through transpiration. Similar results were obtained by Abed EL-Rahmin (1990). As for treatment, control treatment (T_4) had higher dry matter content (7.30%) as compared to T_1 (6.30%). The interaction (treatment x storage period) was not significant.

Total soluble solids (T.S.S.)

Total soluble solids of pepper fruit was significantly affected by the period of storage. Data in Table (5) demonstrated that there was a gradual and continuous decrease in total soluble solids till the end of storage period. These

results are true in the two seasons. Where losses in T.S.S. of pepper fruit accounted for (8.24%) and (9.69%) in the first and second season respectively after 28 days of cold storage when compared to these content at harvest time. Although treatments were not significantly effective on T.S.S. content in the second season, T_2 and (T_4) gained slightly higher percentage (4.7), (4.4)% than did the other treatment (T_3 and T_1) (4.17), (4.08)% in the first season.

Regarding interaction (treatment x storage period) data showed that this parameter was insignificant in the two seasons.

Ascorbic acid

Ascorbic acid content in pepper fruits showed significant decrease as the period of storage prolonged in both seasons (Table 5). Losses in ascorbic acid content reached 13.74% and 6.08% in the first and second seasons respectively. The decline in L- ascorbic acid content can be attributed to the oxidation by enzymic catalysis which involves an election electron transfer to produce an unstable semiquin one like free radical, mono-dehydroscorbic acid (MDHA) then with the transfer of further electron dehydro - L- ascorbic acid (DHA) is formed which in turn acid by the opening of the lacton ring (Hulme 1970). On the other hand, no significant differences were found between treatments and the interaction (Treatment x storage period) on ascorbic acid content in both season.

Total chlorophyll

Total chlorophyll content of pepper fruit was significantly affected by the period of storage in both seasons (Table 5). Holding pepper at 8ºC for 28 days resulted in significant loss in chlorophyll content (94.3 mg) compared tothat found at harvest time (124.2 mg) which accounted for (24.57%). Similar trend was found in the second season.

The reduction in chlorophyll content with the elapse of the storage period may be due to the destruction of chlorophyll and transformation of chloroplasts to chromoplasts. This might be attributed to the activity of enzymes.

These results are in harmony with those obtained by Abed EL-Rohman and EL-Sheikh (1994).

The treatments were significantly differed in their effect on chlorophyll content. T_2 (treatments 2) retained the highest chlorophyll content (115.7mg) followed by T_4 (control treatment) (111.02) in the first season. The same trend was found in the second season. No significant interactions were noticed in both seasons.

Packaging materials and their effect on sweet pepper fruit during storage and retail display condition.

Percentage of weight loss

Data in Table (6) showed that the period of storage had a significant effect on the percentage of weight loss. Storing pepper fruit for 28 days at 8ºC and additional 3 days at 20ºC (storage and marketing simulation) resulted in a significantly higher weight loss (6.73%) when compared to the first period of storage 14 days at 8ºC plus additional 3 days at 20ºC (3.67%). The same trend was also noticed in the second season. These results were similar to those obtained by Abed EL-Rahman and EL-Sheikh (1994).

The type of packages was significantly effective on such criteria in both seasons. Table (6) revealed that, unbagged fruits suffered significant weight loss (11.89%) when compared with fruit packed inside P.E. lining or P.E. bags.

It seemed that the packing types, non-perforated P.E. bags inhanced the accumulation of more humidity inside than in the case of perforated bags, P.E. Lining or unbagged bags, Since weight loss is likely to occur as a result of water loss from the product (Ryall and Lipton 1972).

The perforated bag, P.E. Lining or unbagged control allowed the stored pepper to respire at higher rate than those of non perforated P.E. bags, since more ambient air (O_2) surounding the bags allowed the exchange with the internal atmosphere in perforated bags, lining or unbagged control resulting in higher transpiration rate and concequently to higher weight loss.

These results agree with those reported by Gonzalez and Tiznado 1993; Meir et al. 1995; wall and Berghage (1996) on pepper.

Significant interaction was found between packaging types x storage period in both season.

The various comparisons illustrated that within each storage period, pepper fruits which packed in non-perforated P.E. bags recorded the lowest percentage of weight loss.

Percentage of Decay

Stored pepper fruits showed high incidence of decay percent during storage. The period of storage had a pronounced effect, as the decay percentage was increased as the storage period was prolonged (Table, 6).

The incidence of decay was higher in non-perforated P.E. bags and unbagged control than of P.E. Lining or perofrated P.E. bags. Moreover, non-perforated P.E. bags had the highest values, while P.E. lining gave the lowest.

Similar results were detected in both seasons. The water saturated atmosphere inside the P.E. bags often increases disease incidence, as it did for pepper in the present study which confirmed that of Poldendijk *et al.,* 1993 this effect is usually attributed to the presence of condensed water on the fruit surface forming the favorable conditions for pathogen development (Ben-yahoshua 1985 and Rodov *et al.,* 1995). Generally, it was noticed that, non-perforated P.E. bags gave the highest percentage of decay at the end of 28 days storage, in both seasons.

Dry Matter

Results obtained in Table (6) showed that the period of storage, the packages types and the interaction between them were not significantly effective on dry matter content in both seasons.

Total soluble solids (T.S.S.)

The storage period affected significantly total soluble solids content in both seasons. Storing pepper fruits for 14 days at 8ºC plus 3 days at 20ºC resulted in a slight decrease in T.S.S. compared to that of freshly harvested fruits. In the mean time at harvest time the difference was significant when storage period was extended to 28 days in the first season. A similar trend took place in the second season. Table (7).

The packaging types had no significant effect on the total soluble solids content in the two seasons as shown in Table (7).

The interaction effect (Packaging types x storage period) was not significant on T.S.S. content in the first season, while interaction was significant in the second season. After 28 days of storage at 8ºC plus 3 days at 20ºC, non-perforated P.E. bags had slightly higher T.S.S. content (3.53%) than the other packaging type.

Ascorbic acid

The storage period had significant effects on the ascorbic acid content in both seasons. (Table 7). In the first season, storing pepper fruits for 14 days at 8ºC plus 3 days at 20ºC resulted in a decreasing trend of ascorbic acid compared to that of freshly picked fruits. A continuos loss in ascorbic acid content were evident where storage period was extended to 28 days. A similar trend took place in the second season.

The packages types did not have any significant differences in their effects on the ascorbic acid content, in both seasons.

As for the interaction (Packaging types x storage period) no significant effects were noticed in both seasons.

Fruits stored in non perforated bags through the storage period at 8ºC for 28 days was the best treatment as it contained the highest ascorbic acid content.

Total chlorophyll

Storage period affected significantly total chlorophyll content in the two seasons. Total chlorophyll in pepper fruits showed noticeable decrease as the period of storage was prolonged in both seasons. (Table 7). Storing pepper fruits for 14 days plus 3 days at 20ºC resulted in significant loss in chlorophyll content (111.8 mg/100g) compared to that of freshly picked fruits (125.3 mg/ 100g). Moreover, keeping the fruits in cold store for 28 days results in further losses in chlorophyll content (95.6 mg/100g), which accounted 23.67% of their intial chlorophyll content in the first season. Similar trend was noticed in the second season.

The reduction in chloropyll concentration with the elapase of the storage period may be due to the destruction of chlorophyll and transformation of chloroplasts to chromoplasts. This might be attributed to the activity of enzymes. These results are in harmony with those obtained by Abed EL-Rahman and EL-Sheikh (1994).

As for packages, packing pepper fruits in non-perforated bags resulted in retaining a significant higher chlorophyll content, compared to the other packaging types in the two seasons. These results seemed to match with those obtained by leberman *et al.* (1968**)** who found that chlorophyll retention in broccoli was increased by progressive increase in Co_2 and decrease in O_2.

The interactions (packaging types x storage period) did not appear to have any significant effect on this character in the first season. However significant difference was noticed in the second season. The data showed that pepper fruits stored at 8ºC for 28 days plus 3 days at 20ºC in non-perforated P.E. bags maintained high chlorophyll content.

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تأثير تغطية سطح التربة بالبلاستيك الأسود والتظليل
على النمو والمحصول وجودة الثمار والقدرة التخزينية لمحصول الفلفل الحلو

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*** قسم بحوث الزراعات المحمية ** قسم بحوث تداول الخضر**
معهد بحوث البساتين - مركز البحوث الزراعية - جيزة

أجريت دراسة خلال مواسم ٢٠٠١، ٢٠٠٢ بمزرعة بحوث الخضر بقها محافظة القليوبية ومعمل قسم بحوث تداول الخضر لتقييم التأثيرات المختلفة لكل من تغطية سطح التربة بالبلاستيك والتظليل باستخدام (السبيداج) على النمو الخضرى لنبات الفلفل - هجين جديون وكذلك المحصول وصفات الثمار الناتجة عند الحصاد وأيضاً أثناء التخزين المبرد.

وكذا تأثير استخدام عبوات مختلفة على جودة ثمار الفلفل أثناء التخزين المبرد والعرض بالأسواق.

وقد أوضحت النتائج ما يلى:-

١- تأثير تغطية سطح التربة بالبلاستيك الأسود والتظليل على النمو الخضرى وصفات الثمار والمحصول للفلفل الحلو.

استخدام التظليل وعدم تغطية سطح التربة بالبلاستيك بالإضافة إلى التفاعل بينهم كانت أحسن المعاملات على النمو الخضرى (ارتفاع النبات - عدد الأوراق - ومساحة الورقة) ولم يكن لتغطية سطح التربة بالبلاستيك أو التظليل أو التفاعل بينهم اى تأثير معنوى على محتوى النبات من المادة الجافة - سمك اللحم وطول الثمرة. بينما أدى تغطية سطح التربة بالبلاستيك إلى زيادة قطر ووزن الثمرة عند مقارنتها بعدم تغطية سطح التربة بالبلاستيك لكنة قد أعطى محصول أقل (كجم/ نبات).

٢- تأثير تغطية سطح التربة بالبلاستيك والتظليل على الصفات الطبيعية والكيماوية لثمار الفلفل أثناء التخزين المبرد.

بينما أدى التظليل إلى زيادة قطر ووزن الثمرة وأيضاً زيادة المحصول الكلى (كجم/ نبات).

التفاعل (التظليل مع عدم تغطية سطح التربة بالبلاستيك) كان له تأثير معنوى على قطر ووزن الثمرة وكذا محصول النبات.

- لقد لوحظ زيادة نسبة الفقد فى وزن الثمار أثناء التخزين.
- ولم يحدث فقد كبير فى المظهر العام بعد ١٤ يوماً للثمار المخزنة على ٨°م لكن بإطالة فترة التخزين حتى ٢٨ يوماً يقل المظهر العام.
- هناك تناقص معنوى فى محتوى الثمار من المواد الصلبة الذائبة الكلية وحمض الأسكوربيك وأيضاً الكلورفيل أثناء التخزين.
- المعاملة الثانية (التظليل وبدون تغطية سطح التربة بالبلاستيك) والمعاملة الرابعة (بدون تظليل وبدون ملش) الكنترول كانت أقل فقد فى الوزن خلال فترات التخزين فى الموسم الثانى.
- وأيضاً فان تلك المعاملتين قد حصلت على أعلى نسبة من المظهر العام فى كلا الموسمين.

- احتوت ثمار المعاملة الثانية والرابعة على نسبة أعلى من المواد الصلبة الذائبة الكلية فى الموسم الأول عندما قورنت بثمار المعاملة الثالثة (بدون تظليل وتغطية سطح التربة بالبلاستيك ملش) أو المعاملة الأولى (التظليل وتغطية سطح التربة بالبلاستيك ملش)، ولم يلاحظ فروق معنوية بين محتوى الثمار من المواد الصلبة الذائبة الكلية فى الموسم الثانى.
- لا يوجد فروق معنوية فى محتوى الثمار من حمض الأسكوربيك بين المعاملات المختلفة فى كلا الموسمين.
- أظهرت المعاملة الثانية والرابعة نسبة أعلى من محتوى الثمار من الكلوروفيل مقارنة بباقى المعاملات.

٣- تأثير استخدام التغليف والتعبئة على صفات ثمار الفلفل أثناء التخزين المبرد والعرض بالأسواق.

أجريت التجربة كمحاكاة للنقل المبرد وفترة العرض بالأسواق حيث أخذت ثمار الفلفل الكنترول وعبئت فى عبوات مختلفة وخزنت على درجة حرارة ٨°م (النقل المبرد) لفترات مختلفة ثم نقلت على درجة حرارة ٢٠°م لمدة ٣ يوم) (العرض بالأسواق) ودرست صفات الجودة لثمار وكانت النتائج كالأتى:-

- زادت نسبة الفقد فى الوزن ونسبة الثمار التالفة بإطالة فترة التخزين ولم يلاحظ فروق معنوية فى محتوى الثمار المادة الجافة مع فترات التخزين المختلفة.
- هناك تناقص مستمر طوال فترات التخزين فى محتوى الثمار من المواد الصلبة الذائبة الكلية وحمض الأسكوربيك والكلوروفيل.
- أظهرت الثمار الغير مغلفة (الكنترول) أعلى نسبة فى الفقد فى الوزن مقارنة بالثمار التى عبئت فى كرتونات مبطنة بالبولى إيثيلين أو فى اكياس بولى إيثيلين بينما كانت أعلى نسبة للثمار التالفة فى الثمار التى عُبئت فى أكياس غير مثقبة وثمار الكنترول عند مقانتها بالثمار التى عبئت فى كرتونات مبطنة أو أكياس بولى إيثيلين مثقبة .
- لم تظهر الأنواع المختلفة من التغليف فروق معنوية على محتوى الثمار من المادة الجافة ونسبة المواد الصلبة الذائبة الكلية والمحتوى من حمض الأسكوربيك.
- بينما الثمار التى وضعت فى أكياس بولى أيثلين غير مثقبة فقد احتفظت بمحتوى أعلى من الكلوروفيل عند مقارنتها بالأنواع المختلفة من العبوات.

وتوصى هذه الدراسة :-

بأن يتم طلاء السطح العلوى للصوبة بالسبيداج إذا أريد إنتاج الفلفل الحلو فى الصوب البلاستيكية خلال أشهر يوليو وأغسطس للحصول على محصول عالى ذو صفات جودة جيدة. كما أن تعبئة الثمار فى عبوات كرتون مبطنه من الداخل بالبولى ايثلين بسمك ٦٠ ميكرون - أو فى أكياس بولى ايثلين مثقبة أو غير مثقبة والتخزين المبرد (٨°م - ٨٥% رطوبة نسبية) تحافظ على صفات الجودة واللون الأخضر للثمار وتزيد من فترة العرض بالأسواق.

Table (1) Average Maximum and Minimum air Temperature under different treatments from transplanting until 60 days later.

First season								Second season							
S + M		M		S		Control		S + M		M		S		Control	
Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
43	23	48	24.5	38	24.0	44	24.0	44	23.5	49	25.0	39	24.0	44	24.0
42	23	47	25.0	39	24.0	42	23.5	43	23.5	47	24.5	38	24.5	42	24.0
44	22	48	24.0	39	23.5	43	23.0	44	22.0	48	24.0	38	23.0	44	23.0
41	21	47	22.0	37	22.0	40	22.0	41	21.5	47	23.0	36	22.5	41	22.0
42	20	46	19.5	36	20.5	42	20.5	43	20.0	48	21.5	38	21.0	42	21.0
41	19	46	20.5	36	20.0	41	20.0	42	20.0	48	22.0	37	21.0	43	21.0
40	18	44	20.0	35	19.0	39	19.0	41	19.0	45	21.0	35	20.0	41	20.0
38	17	42	18.0	32	18.5	37	18.0	37	18.5	42	20.0	31	20.0	37	20.5

S = Sipdag M = Soil mulching

Table (2) Effect of soil mulching and shading on vegetative growth characteristics of sweet pepper for the two seasons 2001 and 2002.

ments	The first season					The second season				
	Plant height	No. of leaves	leaf area	D. W. mg/100 g	Stem diameter	Plant height	No. of leaves	Leaves area	D. W. mg/100 g	Stem Diameter
A)										
	63.0	60.5	81.0	18.1	1.2	59.5	70.7	81.5	18.0	0.85
ch)	88.7	62.5	107.5	18.4	1.9	71.5	77.2	104.0	18.4	1.2
t 0.05	7.231	1.58	10.792	N.S	0.462	4.281	4.357	11.231	N.S	0.131
B)										
	90.2	75.2	101.5	18.8	1.15	71.0	74.5	104.5	18.8	0.8
dag)	61.5	73.5	87.0	17.7	1.9	60.0	73.4	81.0	17.6	1.25
t 0.05	15.321	0.458	9.382	N.S	0.48	8.382	0.532	7.78	N.S	0.371
x B)										
lch)	66.3	105.7	78.0	18.7	1.1	67.7	69.7	78.5	17.9	0.9
dag x mulch)	59.7	135.0	84.0	17.3	1.3	51.3	71.7	84.5	17.8	0.8
thout mulch)	114.0	146.0	125.0	18.9	1.2	74.3	79.3	130.5	18.8	0.7
dag x Without lch)	63.3	105.0	90.0	18.0	2.5	68.7	75.0	77.5	18.8	1.7
t 0.05	5.381	11.482	3.046	N.S	N.S	9.382	2.831	3.782	N.S	N.S

Table (3) Effect of soil mulching and shadding on fruit characteristics and total yield of sweet pepper for the two seasons 2001 and 2002.

	The first season						The second season					
	Fruit Weight (g)	Fruit Diameter (cm)	Fruit Length (cm)	Flesh thickness (cm)	No. of locules	Total yield kg/plant	Fruit weight (g)	Fruit diameter (cm)	Fruit Length (cm)	Flesh thickness (cm)	No. of locules	Total yield kg/plant
	90.1 84.8	6.17 5.95	11.2 11.0	0.5 0.74	3.17 4.84	6.11 6.66	98.1 86.2	5.65 5.05	9.22 9.21	0.49 0.69	3.17 5.0	6.42 6.71
	0.006	0.342	N.S	N.S	0.682	0.231	0.432	0.291	N.S	N.S	0.941	0.172
	92.0 87.9	6.78 5.34	10.6 11.6	0.5 0.74	3.67 4.34	6.90 5.86	96.4 87.9	5.88 4.82	9.04 9.38	0.46 0.72	3.5 4.67	6.79 6.33
	0.319	0.782	N.S	N.S	0.418	0.781	0.437	0.613	N.S	N.S	0.529	0.278
ulch) **ulch)** **Without**	86.9 92.6 97.0 83.2	5.7 6.63 6.93 4.93	10.8 11.6 10.4 11.6	0.5 0.5 0.5 0.57	3.67 2.67 3.67 3.0	6.83 5.38 6.97 6.34	89.1 92.6 103.6 83.2	5.62 5.68 5.96 4.13	9.19 9.24 8.89 9.52	0.5 0.47 0.41 0.57	3.33 3.0 3.67 3.33	6.37 6.46 7.21 6.20
	2.831	0.382	N.S	N.S	1.432	0.431	3.956	0.492	N.S	N.S	0.283	0.113

Table (4) Effect of soil mulching, shading and storage period on the percentage of weight loss, visual quality score and dry matter content of pepper fruit during storage at 8ºC.

Weight loss %				Visual quality score						Dry matter %					
Storage periods in days															
	14	21	28	Mean	At harvest	7	14	21	28	Mean	At harvest	7	14	21	28	Mean
First season																
	6.28	9.00	11.23	7.35	5	5	4.33	4.0	3.00	4.27	7.90	8.12	8.28	7.73	7.15	7.84
	5.16	9.39	11.40	7.19	5	5	5.00	4.66	4.00	4.73	8.39	8.59	8.70	8.28	7.81	8.35
	6.45	8.57	11.55	7.49	5	5	4.33	4.00	3.33	4.33	8.05	8.13	8.47	8.75	7.70	8.22
	5.98	10.01	12.07	7.82	5	5	4.66	4.33	3.33	4.46	8.34	8.36	7.89	8.30	8.24	8.23
	5.97	9.24	11.56		5	5	4.58	4.25	3.42		8.17	8.30	8.34	8.27	7.73	
reatment				N.S					0.252					N.S		
Storage period (S)				0.91					0.28					N.S		
T) x (S)				N.S					N.S					N.S		
Second season																
	4.06	6.0	7.46	4.90	5	5	4.33	4.00	3.00	4.27	6.31	6.51	6.62	6.15	5.90	6.30
	3.22	5.66	6.2	4.20	5	5	4.66	4.66	4.33	4.73	7.13	7.31	7.42	7.50	7.01	7.27
	3.8	5.69	7.1	4.59	5	5	4.66	4.33	3.66	4.53	6.99	7.20	7.40	7.14	6.87	7.12
	3.3	4.9	6.11	3.97	5	5	4.66	4.33	4.33	4.66	7.5	7.57	7.76	7.42	7.27	7.50
	3.60	5.56	6.72		5	5	4.58	4.33	3.83		6.98	7.15	7.30	7.05	6.76	
reatment				0.33					0.301					0.244		
rage period (S)				0.33					0.337					0.272		
(T) x (S)				0.66					N.S					N.S		

(T_1) Shading + Soil mulching
(T_3) Without shading + Soil mulching
(T_2) Shading + without soil mulching (T_4)
Without shading + Without soil mulching (control)

Visual quality score 5 = Excellent 4 = good
3 = Fair 2 = poor
1 = Unusable

Table (5) Effect of soil mulching, shading and storage period on the total soluble solids %, ascorbic acid (mg /100g fresh weight)

and total chlorophyll (mg /100g fresh weight) of pepper fruit during storage at 8ºC.

Total Soluble Solids %					Ascorbic acid (mg /100g. fresh weight)					Total chlorophyll (mg /100g fresh weight)					
Storage periods in days															
7	14	21	28	Mean	At harvest	7	14	21	28	Mean	At harvest	7	14	21	28	Mean
First season																
4.13	4.07	4.06	3.90	4.08	118.5	115.7	111.6	107.3	105.3	111.68	120.5	117.3	108.4	100.4	89.9	107.30
5.10	4.80	4.46	4.36	4.72	125.3	121.5	117.6	112.5	108.2	117.02	128.3	125.0	118.4	108.4	98.5	115.72
4.30	4.10	4.16	4.00	4.17	120.5	117.4	111.9	109.2	105.4	112.88	122.7	115.1	106.4	101.6	92.3	107.62
4.46	4.40	4.33	4.20	4.38	123.0	119.4	115.6	112.7	106.1	115.36	125.3	117.5	111.7	104.3	96.3	111.02
4.49	4.34	4.25	4.12		121.83	118.5	114.2	110.43	106.25		124.2	118.73	111.23	103.68	94.3	
reatment		0.16						N.S						4.13		
torage period (S)								4.84						4.62		
T) x (S)		N.S						N.S						N.S		
Second season																
3.66	3.56	3.33	3.33	3.54	113.9	112.70	109.90	106.40	104.40	109.46	115.5	112.3	104.2	95.3	85.1	102.48
3.86	3.80	3.66	3.60	3.76	118.3	117.90	116.40	113.70	110.60	115.38	120.5	118.4	108.4	99.6	92.2	107.82
3.73	3.53	3.40	3.40	3.57	114.8	112.80	110.50	108.30	106.3	110.54	116.4	114.0	105.2	97.9	88.3	104.36
3.80	3.73	3.73	3.47	3.71	115.1	114.03	112.96	110.10	108.10	112.06	118.5	115.5	109.6	101.3	90.5	107.08
3.76	3.66	3.53	3.45		115.53	114.36	112.44	109.63	107.35		117.73	115.05	106.85	98.53	89.03	
reatment			N.S					N.S						4.57		
rage period (S)			0.231					5.214						5.11		
T) x (S)			N.S					N.S						N.S		

(T_1) Shading + Soil mulching
(T_3) Without shading + Soil mulching
(T_2) Shading + Without soil mulching
(T_4) Without shading + Without soil mulching (control)

Table (6) Effect of packaging type and storage period on the percentage of weight loss, decay and dry matter content of pepper fruit during storage at 8ºC and additional 3 days at 20ºC (storage and marketing simulation).

Treatment	Weight loss %				Decay %				Dry Matter %				
	Storage periods in days												
	14d. at 8ºC + 3d at 20ºC	21d. at 8ºC + 3d at 20ºC	28d. at 8ºC + 3d at 20ºC	Mean	14d. at 8ºC + 3d at 20ºC	21d. at 8ºC + 3d at 20ºC	28d. at 8ºC + 3d at 20ºC	Mean	At harvest	14d. at 8ºC + 3d at 20ºC	21d. at 8ºC + 3d at 20ºC	28d. at 8ºC + 3d at 20ºC	Mean
First season													
(A)	3.51	4.7	6.39	4.87	0.0	2.17	6.57	2.91	8.34	8.50	8.17	8.01	8.26
(B)	2.71	3.22	4.82	3.58	0.0	1.54	5.47	2.34	8.34	8.60	8.19	7.96	8.27
(C)	0.22	0.35	0.53	0.37	9.12	14.3	25.5	16.31	8.34	8.36	8.31	8.25	8.32
(D)	8.24	12.26	15.17	11.89	5.99	10.7	20.26	12.32	8.34	8.87	8.10	7.50	8.20
Mean	3.67	5.14	6.73		3.78	7.18	14.45		8.34	8.58	8.19	7.93	
LSD at 5% Treatment (T)				1.15							N.S.		
Storage period (S)				1.00							N.S.		
(T) x (S)				1.99							N.S.		
Second season													
(A)	1.95	2.33	4.53	2.94	1.0	1.53	3.03	1.85	7.5	7.49	7.32	7.25	7.39
(B)	2.41	3.4	5.03	3.61	0.0	1.8	4.2	2.0	7.5	7.45	7.37	7.19	7.37
(C)	0.19	0.32	0.49	0.33	4.5	10.3	15.0	9.93	7.5	7.47	7.39	7.35	7.43
(D)	4.97	6.3	10.63	7.30	6.2	8.33	12.04	8.86	7.5	7.62	7.35	7.10	7.39
Mean	2.38	3.09	5.17		2.93	5.49	8.57		7.5	7.51	7.36	7.22	
LSD at 5% Treatment (T)				0.74							N.S.		
Storage period (S)				0.64							N.S.		
(T) x (S)				1.29							N.S.		

(A) Polyethylene lining 60 Mu thickness. (C) Non perorated Polyethylene bags.

(B) Perforated Polyethylene bags (6 holes, 5 mm indiameter each). (D) Un packaged carton box (Control).

Table (7) Effect of packaging type and storage period on total soluble solids%, ascorbic acid (mg /100g fresh weight) and total chlorophyll (mg /100g fresh weight) of pepper fruit during storage at 8ºC and additional 3 days at 20ºC (storage and marketing simulation).

Total Soluble Solids %				Ascorbic acid (mg /100g. fresh weight)					Total chlorophyll (mg /100g fresh weight)				
Storage periods in days													
14d. at 8ºC 3d at 20ºC	21d. at 8ºC 3d at 20ºC	28d. at 8ºC 3d at 20ºC	Mean	At harvest	14d. at 8ºC 3d at 20ºC	21d. at 8ºC 3d at 20ºC	28d. at 8ºC 3d at 20ºC	Mean	At harvest	14d. at 8ºC 3d at 20ºC	21d. at 8ºC 3d at 20ºC	28d. at 8ºC 3d at 20ºC	Mean
First season													
4.46	4.33	4.3	4.41	123	117.6	110.9	101.6	113.28	125.3	110.7	102.0	95.3	108.33
4.36	4.26	4.17	4.33	123	118.3	112.0	103.2	114.13	125.3	112.5	103.6	92.2	108.4

4.5	4.36	4.36	4.44	123	118.1	114.7	106.3	115.53	125.3	115.3	108.8	104.86	113.49
4.28	4.10	4.0	4.23	123	111.2	106.2	96.5	109.23	125.3	108.5	98.4	90.2	105.6
4.4	4.26	4.21		123	116.3	110.95	101.9		125.3	111.8	103.2	95.64	
ment (T)		N.S				N.S						4.52	
ge period (S)		0.12				5.001						4.52	
x (S)		N.S				N.S						N.S	
					Second season								
3.60	3.53	3.46	3.61	115.1	107.96	101.2	97.4	105.4	118.5	109.2	101.2	93.2	105.53
3.80	3.60	3.40	3.66	115.1	106.50	100.2	96.5	104.6	118.5	108.3	102.3	94.3	105.85
3.73	3.67	3.53	3.69	115.1	110.20	106.3	101.13	108.2	118.5	115.2	111.5	106.7	112.98
3.56	3.40	3.33	3.53	115.1	102.90	97.1	92.6	101.93	118.5	105.5	99.8	86.9	102.43
3.67	3.55	3.43		115.1	106.89	101.2	96.91		118.5	109.55	103.45	95.28	
ment (T)		N.S				N.S.				3.67			
ge period (S)		0.18				4.52				3.67			
x (S)		0.36				N.S.				7.35			

(A) Polyethylene lining 60 Mu thickness. (C) Non perorated Polyethylene bags.

(B) Perforated Polyethylene bags (6 holes, 5 mm indiameter each). (D) Un packaged carton box (Control).