# PHYSIOLOGICAL AND ECOLOGICAL STUDIES ON EARLI GRAND PEACH TREES GROWN UNDER DIFFERENT PROTECTIVE SYSTEMS OF SAND AND WIND A- PHYSIOLOGICAL STUDIES

*Journal*

***J. Biol. Chem. Environ. Sci., 2008, Vol. 3(2): 191-206***
***www.acepsag.org***

**Abou Rawash*, M.; A. El-Gazzar*; M. El-Hadidy** and H. El-Gamal****

**Faculty of Agriculture, Department of Horticulture, Ain Shams University*
*** Desert Research Center, Environment and Arid Land Cultivation, Sand Dune Department*

## ABSTRACT

Growth, flowering, fruit set, fruit characteristics and yield of 7-years old peach trees (*Prunus persica*) cv. Earli Grand grafted on sour almond rootstock under the rainy conditions of El-kharafeen village, El-sheikh Zouid, North Sinai Governorate, Egypt as affected by biological (Napier grass and Tamarix as 1 & 1.5 m. height) and artificial (Theran and Plastic nets as 1 & 1.5 m. height) protective systems were studied in the two seasons of 2004 and 2005. The results obtained revealed that, the protective systems significantly increased fruit set and decreased blooming period/days, flower drop, fruit drop, fruit maturity/days, fruit firmness and total fruit acidity in both seasons. However, fruit weight, fruit volume, fruit diameter and fruit length significantly decreased in the first season only. Meanwhile, Plastic net barriers increased tree height, tree canopy and maximum horizontal extension in both seasons, while fruit number/tree, yield and T.S.S. % did not differ significantly specially in the first season but Napier grass and plastic net 1.5 m. height increased tree yield significantly in the second season compared with the unprotected trees. Moreover, first bloom, full bloom, end of bloom and first fruit set dates in protected trees were earlier than the unprotected ones by 2 to 12 days.

From the obtained results it could be recommend that, the use of Theran fences as an artificial protective system and Napier grass as a biological protective system is very important to improve productivity

and fruit quality of Earli Grand peach cv. under North Sinai conditions.

**Keywords:** Peach (*Prunus persica*) cv. Earli Grand- Protective systems- Biological protection- Artificial protection- Vegetative growth- Flowering- Fruit characteristics and Yield.

# INTRODUCTION

Peach is considered as one of the most favorite fruits for many of the world populations. The cultivated area with peach in Egypt was increased and concentrated in old land (Dakahlia, Behira, Gharbia and Menofeia governorates) and in new land (Noubariya, Salhiya, Ismailia and North Sinai provinces). The production of this crop in Egypt is increasing from year to year according to the 2004 statistics of Egyptian Ministry of Agriculture; peach was grown in 79199 feddans and yielded 360937 tons of fruits.

Moreover, peach is considered as one of the most important crops for farmers in North Sinai. Peach acreage reached about 59001 feddons in North Sinai (in Rafah, El-sheikh Zouid, Bear El-Abd, El-Areesh, El-Hasana, Nekhel and Rommana regions), these area produce about 176442 tons (M.A.L., 2004).

Wind barriers are used all over the world to reduce the harmful effects of wind speed on humans, animals, plants and soils. Wind barriers are important in agriculture and horticulture to safeguard crop yield. They are essential for the protection of orchards. Many types of windbreaks may be used to achieve this goal. They can be divided into natural, vegetative protections and artificial windbreaks. Although the efficiency of windbreaks is of primary importance, the final choice will also depend on various other considerations (Dierickx, 2003)

Many crops have been placed into four categories based on their relative tolerance to damage by wind and/or wind-blown soil. These categories form the basis for general design criteria. The kind of crop and the level of risk that the producer is willing to accept determine the appropriate windbreak design. These basic design principles apply not only to trees and shrubs but also to other plant materials and artificial barriers (Sherman, 1988).

In the case of peach tree, several aspects concerning its capacity to withstand arid environments have been studied but little reports were found about the effect of hazard environmental processes like sand shifting effects on orchard trees and crops.

Thereby, this study was conducted to evaluate vegetative growth, flowering and fruiting of peach trees in El-sheikh Zouid, North Sinai Governorate, Egypt which is located at sand encroachment condition.

Different treatments were applied for the purpose of alleviating the adverse environmental conditions affecting the trees of Earli Grand peach cv. growing under sand drift condition and these treatments comprised of erecting various types and height of fences.

# MATERIALS AND METHODS

This investigation was conducted on 7-years old peach trees (*Prunus persica* L.) cv. Earli Grand grafted on sour almond rootstock during the two successive seasons of 2004 and 2005. Trees were planted 5x5 apart in sandy soil watered with rainfall and fertilized by balady manure (20$m^3$/ feddan every two years ) without any another additions at El-kharafeen village, El-sheikh Zouid, North Sinai Governorate, Egypt. For the aim of investigating the effect of various kinds, types and heights of fences to reduce wind speed and prevent shifting sand from attacking peach trees on vegetative growth, flowering and fruiting of peach trees.

The rain rates in studied region were 108.19 mm. (454.4 $m^3$/feddon/year) in the first season and 299.69 mm. (1258.7 $m^3$/feddon/year) in the second season and concentrated between November and April in each season.

The systems which used for protection were artificial and biological. However, the artificial fences involved two polyethylene fences with different porosity manufactured from Polyethylene and having a shading potential of 73% (Theran) and 48 % (plastic) have been constructed in 1/10/2003 as 1 & 1.5 m heights and the Biological fences involved two plants, Napier grass (*Pennisetum purpureum* Schum) and Tamarix (*Tamarix articulata*) were planted in first week of August 2003 in vertical angle with the prevailing wind direction and kept as 1 and 1.5 m heights with 5 m distance from the first row of peach trees.

Consequently, the experiment included eight treatments in addition to the control (unprotected) in a randomized complete block design. Each treatment was replicated three times on two trees for each replicate.

**Tree growth measurements were taken (in the 1$^{st}$ week of May in each season) including:**

a) Trunk diameter (cm): 5 cm above grafting zone.
b) Tree height (m): from crown zone to the highest point
c) Tree canopy (m): diameter of tree canopy
d) Maximum canopy horizontal extension (m)

**Flowering characteristics were taken in different tree directions including:**

a) Start of blooming: When the first flower was opened.
b) Full blooming: When 80% of flowers were opened.
c) End of blooming: When 25% of flowers petal fall.
d) Blooming period / days: Calculated from start of blooming to end of blooming.
e) Flower drop %: Dropped flowers were counted as a percentage of total flowers.

**Fruit set attributes were taken as follows:**

a) Start of fruit set date: When first flower was set.
b) Fruit set and fruit drop: Set and dropped fruits were counted as a percentage of each one.
c) Age of fruit maturity in days: Calculated from start fruit set to fruit maturity as measured by visual fruit color and fruit firmness.

**At harvesting**, the yield of each individual peach tree was weighed in kg/ tree and counted as a number of fruits for each replicate.

The average of 10 fruits per replicate was taken every year to measure the physical characteristics of fruits i.e. fruit length, fruit diameter, fruit volume, flesh thickness, fruit weight and fruit firmness.

**Chemical composition of fruits was determined as following:**

a) Total soluble solids (T.S.S %) was measured by hand refractometer
b) Total acidity % in fruit juice was estimated as malic acid by titrating 0.1 N NaOH up to an end point pH of 8.1.
c) T.S.S / acidity ratio was obtained by dividing the percentage of T.S.S. for each sample on its acidity percent.

Data obtained in the two seasons were statistically analyzed by using the analysis of variance (Snedecor and Cochran, 1980). Means were differentiated by using Duncan*s multiple rang test at 5% (Duncan, 1955).

# RESULTS AND DISCUSSION

## Tree growth parameters

### Trunk Diameter (cm)

The obtained data in Table (1) clarify that, the protective systems increased trunk diameter of peach trees compared with the unprotected trees in the two seasons. This increment was significant with all fences except Theran net, Napier grass and Tamarix with heights 1 m. in the first season but it was only significant with Theran net and Plastic net with heights 1.5 m. in the second season. However, the highest trunk diameter (19.8 & 20.0 cm) was recorded for peach trees protected with plastic net 1.5 m. compared with the unprotected trees (18.4 & 18.9 cm) in the first and second seasons, respectively.

In this respect, Heiligmann and Schneider (1975) reported that barriers were significantly improved seedling growth of Black Walnut (*Juglans nigra*) in protected plots, with increases in stem height and diameter of 15 %.

### Tree height (m)

Data in Table (1) show that the plastic nets significantly increased tree height of the protected peach trees in the two seasons. Anyhow, Plastic net 1 m. protected peach trees gained the highest tree height (2.43 & 2.58 m.), followed by those protected with Plastic net 1.5 m. (2.35 & 2.40 m) compared with the unprotected trees (1.50 & 1.52 m) in the first and second seasons, respectively.

Increasing tree height as a result of wind and sand protective systems was previously reported by Flemer (1974) on 1-year-old peach trees; Heiligmann and Schneider (1975) on Black Walnut (*Juglans nigra*); Kamal *et. al.,* (1995) on mango (*Mangifera indica* cv. Dashehaari) and Elkarbotly (2000) on grape vines.

### Tree canopy (m)

It is quite evident from Table (1) that the artificial protective systems affected tree canopy of the protective peach trees significantly in the two seasons. However, the peach trees protected with plastic net 1 m. height gained the highest tree canopy (11.85 & 12.23 m.), while those which unprotected gave the lowest tree canopy (7.00 & 7.27 m.) in the first and second seasons, respectively.

**Table (1) Effect of different protective systems on tree growth parameters of Earli Grand peach trees in the two seasons (2004 & 2005)**

| Treatment | Trunk diameter (cm) | | Tree height (m) | | Tree canopy (m) | | Max. canopy horizontal extension (m) | |
|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| Theran net (1m)* | 19.2 abc | 19.4 abc | 1.67 b | 1.88 ab | 10.05 a | 10.18 ab | 3.35 bc | 3.42 abc |
| Theran net (1.5m)* | 19.7 a | 19.8 ab | 2.12 ab | 2.20 ab | 11.00 a | 11.18 a | 3.90 ab | 3.97 abc |
| Plastic net (1m)* | 19.5 ab | 19.7 abc | 2.43 a | 2.58 a | 11.85 a | 12.23 a | 4.85 a | 4.87 a |
| Plastic net (1.5m)* | 19.8 a | 20.0 a | 2.35 a | 2.40 a | 11.10 a | 11.33 a | 4.15 ab | 4.03 ab |
| Napier grass (1m)** | 19.0 abc | 19.2 abc | 1.90 ab | 1.95 ab | 7.60 bc | 7.88 bc | 3.00 bc | 3.00 bc |
| Napier grass (1.5m)** | 19.4 ab | 19.5 abc | 2.05 ab | 2.00 ab | 9.50 ab | 9.63 abc | 3.55 bc | 3.43 abc |
| Tamarix (1m)** | 18.8 bc | 19.1 bc | 1.50 b | 1.56 b | 7.02 c | 7.40 c | 2.53 c | 2.52 c |
| Tamarix (1.5m)** | 19.3 ab | 19.5 abc | 1.65 b | 1.62 b | 7.33 bc | 7.72 bc | 2.58 c | 2.92 bc |
| Control | 18.4 c | 18.9 c | 1.50 b | 1.52 b | 7.00 c | 7.27 c | 2.50 c | 2.53 c |

Means having the same letter(s) in each column are not significantly different at the level of 5 %.
* Artificial protection ** Biological protection

Similar result was obtained with Zaghloul (2006) who studied the effect of single and double rows of palm leaves fences on alfalfa crop and reported that the fences significantly increased green and dry forage yield compared with control (without fences).

**Maximum canopy horizontal extension**

As shown in Table (1) the plastic net significantly increased maximum canopy horizontal extension in the two seasons but Theran net 1.5 m. significantly increased maximum canopy horizontal extension in the first season only. As such, peach trees protected with plastic net 1 m. gave the highest values (4.85 & 4.87 m.), while the unprotected trees gained the lowest values (2.50 & 2.53 m.) in the first and second seasons, respectively.

**Flowering characteristics**

**First bloom**

Data in Table (2) clear the effect of protective systems on first bloom dates of peach trees in both seasons. However, the unprotected trees were late than the protected trees with 4: 6 days and 2: 5 days in the first and second seasons, respectively.

**Full bloom**

The obtained data in Table (2) clarify the effect of the protective systems on full bloom date of peach trees. Napier grass protected peach trees were the earliest in this respect (10 & 9 days) in both seasons, respectively while the early peach trees were those protected with Tamarix and Plastic net 1.5 m. height (7 days) in the first season and Tamarix (6 days) in the second season compared with control.

**End of bloom**

Data in Table (2) demonstrate that the end of bloom date was earlier in all the protected trees than the unprotected ones. The earliest end of bloom date (26 Jan. & 21 Jan.) was recorded for peach trees protected with Napier grass 1.5 m. height compared with the unprotected trees (7 Feb. & 31 Jan.) in the first and second seasons, respectively.

**Blooming period / days**

Data in Table (2) present the significant effect of all protective systems on blooming period / days in the protected peach trees compared with the unprotected ones. However, the lowest blooming period / days (19.67 & 18.67 days) was gained with peach trees protected with Napier grass 1.5 m. height compared with the unprotected trees (26.33 & 24.33 days) in the first and second seasons, respectively.

**Flower drop percentage**

It is quite evident from Table (2) that the protective systems reduced flower drop percentage of peach trees significantly in the two study seasons.

**Table (2) Effect of different protective systems on Flowering Characteristics of Earli Grand peach trees in the two seasons (2004 & 2005)**

| Treatment | First bloom | | Full bloom | | End of bloom | | Blooming period (days) | | Flower drop % | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| Theran net (1m)* | 7 Jan. | 2 Jan. | 24 Jan. | 19 Jan. | 28 Jan. | 22 Jan. | 21.33 cd | 20.33 bc | 14.29 d | 15.76 bc |
| Theran net (1.5m)* | 6 Jan. | 3 Jan. | 24 Jan. | 19 Jan. | 27 Jan. | 23 Jan. | 20.67 de | 19.67 cd | 14.21 d | 15.34 bcd |
| Plastic net (1m)* | 8 Jan. | 4 Jan. | 25 Jan. | 20 Jan. | 30 Jan. | 25 Jan. | 22.33 bc | 21.33 b | 16.58 c | 16.05 bc |
| Plastic net (1.5m)* | 7 Jan. | 3 Jan. | 26 Jan. | 19 Jan. | 30 Jan. | 23 Jan. | 23.00 b | 19.67 cd | 17.95 b | 14.99 cd |
| Napier grass (1m)** | 6 Jan. | 2 Jan. | 23 Jan. | 18 Jan. | 27 Jan. | 22 Jan. | 21.33 cd | 20.33 bc | 15.78 c | 13.97 e |
| Napier grass (1.5m)** | 6 Jan. | 2 Jan. | 23 Jan. | 18 Jan. | 26 Jan. | 21 Jan. | 19.67 e | 18.67 d | 12.47 e | 14.03 e |
| Tamarix (1m)** | 8 Jan. | 5 Jan. | 26 Jan. | 21 Jan. | 31 Jan. | 26 Jan. | 23.33 b | 21.33 b | 18.36 b | 15.00 cd |
| Tamarix (1.5m)** | 7 Jan. | 4 Jan. | 26 Jan. | 21 Jan. | 29 Jan. | 25 Jan. | 21.67 cd | 21.00 b | 16.81 c | 14.52 de |
| Control | 12 Jan. | 7 Jan. | 2 Feb. | 27 Jan. | 7 Feb. | 31 Jan. | 26.33 a | 24.33 a | 22.54 a | 23.84 a |

Means having the same letter(s) in each column are not significantly different at the level of 5 %.

* Artificial protection ** Biological protection

Anyhow, the lowest flower drop percentage (12.47 & 13.97 %) was recorded with Napier grass 1.5 and 1 m. height compared with the unprotected trees (22.54 & 23.84 %) in the first and second seasons, respectively.

These results are in agreement with those found by Norton (1988) on grape and Elkarbotly (2006) on olive. They indicated that mean flowers number increased significantly by the protection of fences comparing with the control due to its effect for reduction in wind speed within the orchard that reduces the amount of mechanical damage caused by the whipping of leaves, branches, buds, flowers and fruits

**Fruit set attributes**

**First fruit set**

The obtained data in Table (3) clarify that the protective systems affected the first fruit set date of peach trees which occurre earlier than the unprotected trees by (9:11 days) and (6:10 days) in the first and second seasons, respectively. Since, peach trees protected with Napier grass 1.5 m. height were the earliest (20 Jan. & 15 Jan.) compared with other peach trees in both seasons, respectively.

**Fruit set percentage**

It appears from Table (3) that the protective systems increased fruit set percentage of peach trees significantly in the two seasons. As a whole, the uppermost fruit set percentage was achieved with Theran net 1.5 m. height and Tamarix 1 m. height protection (93.77 & 97.50 %) in the first and second seasons, respectively.

**Fruit drop percentage**

The data in Table (3) clear that fruit drop percentage decreased with the protective systems significantly in the two seasons. However, the lowermost fruit drop percentage gained with Theran net 1.5 m. height and Tamarix protection (6.23 & 2.50 %) in the first and second seasons, respectively.

**Age of fruit maturity in days**

From the results obtained in Table (3), the age of peach fruit maturity in days decreased significantly in both two seasons as a result of the protective systems. As such, the lowest values (88.67 & 84.67 days) were recorded for protected peach trees with Napier grass 1.5 m. height in the first and second seasons, respectively.

These results are in harmony with those reported by Smith and Lewis (1972) on apple, Neuteboom (1978) on many fruits, Norton

(1988) on grape vines and Elkarbotly (2006) on olive. They indicated that windbreaks improved orchard microclimate, such as, reducing air movement and increase the temperature due to improving conditions for pollination and fruit set that in turn result in greater yields. However, fruit set % increased significantly in trees sheltered by different fence types compared with control.

**Table (3) Effect of different protective systems on fruit Set % and tree yield of Earli Grand peach trees in the two seasons (2004 & 2005)**

| Treatment | First Fruit set | | Initial Fruit set % | | Fruit drop % | | Age of fruit Maturity in days | | Fruits No. / tree | | Yield / tree (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| Theran net (1m)* | 22 Jan | 17 Jan | 91.44 b | 95.95 ab | 8.56 d | 4.05 ef | 92.0 b | 88.3 bc | 171.0 ab | 142.0 bc | 12.1 a | 16.4 bc |
| Theran net (1.5m)* | 22 Jan | 18 Jan | 93.77 a | 92.96 c | 6.23 e | 7.04 d | 90.7 cd | 87.7 cd | 225.7 ab | 198.0 abc | 19.0 a | 22.7 ab |
| Plastic net (1m)* | 23 Jan | 18 Jan | 89.06 d | 86.86 e | 10.94 b | 13.14 b | 92.3 b | 87.7 cd | 195.3 ab | 158.7 abc | 13.4 a | 18.9 abc |
| Plastic net (1.5m)* | 24 Jan | 17 Jan | 89.49 cd | 87.16 e | 10.51 bc | 12.84 b | 91.7 bc | 87.0 d | 237.7 a | 230.7 ab | 16.6 a | 28.3 a |
| Napier grass (1m)** | 21 Jan | 16 Jan | 90.12 bcd | 89.64 d | 9.88 bcd | 10.36 c | 90.0 d | 86.7 d | 173.3 ab | 233.7 ab | 12.4 a | 24.0 ab |
| Napier grass (1.5m)** | 20 Jan | 15 Jan | 90.85 bcd | 93.56 c | 9.15 bcd | 6.44 d | 88.7 e | 84.7 e | 188.7 ab | 276.0 a | 12.9 a | 27.9 a |
| Tamarix (1m)** | 23 Jan | 19 Jan | 90.17 bcd | 97.50 a | 9.83 bcd | 2.50 f | 92.3 b | 89.3 b | 180.7 ab | 140.0 bc | 12.4 a | 13.6 bc |
| Tamarix (1.5m)** | 22 Jan | 18 Jan | 90.94 bc | 95.03 bc | 9.06 cd | 4.97 de | 90.3 d | 88.7 bc | 190.7 ab | 160.3 abc | 13.0 a | 16.3 bc |
| Control | 31 Jan | 25 Jan | 83.55 e | 78.26 f | 16.45 a | 21.74 a | 98.3 a | 93.3 a | 127.0 b | 90.0 c | 12.0 a | 9.4 c |

Means having the same letter(s) in each column are not significantly different at the level of 5 %.

* Artificial protection ** Biological protection

## Yield

### Fruit number / tree

Data in Table (3) show that different protective systems increased peach fruit number / tree insignificantly in both seasons except Plastic net 1.5 m. height in the two seasons and Napier grass 1 and 1.5 m. height in the second season only. The highest numbers of fruit / tree (237.7 & 276.0) were recorded with Plastic net 1.5 m. height and Napier grass 1.5 m. height compared with the unprotected trees (127.0 & 90.0) in the first and second seasons, respectively.

### Yield / tree (kg)

As shown in Table (3), yield /tree of the protected peach tree increased insignificantly in the first season but there was significant increment in the second season with Theran and Plastic nets 1.5 m. heights and Napier grass 1 and 1.5 m. heights protective systems only. However, the highest yield (19.049 & 28.315 kg) was achieved in peach trees protected with Theran and Plastic nets 1.5 m. heights compared with the untreated trees (11.957 & 9.409 kg) in the first and second seasons, respectively.

These results go, generally in line with those reported by Elkarbotly (2000) and Hegazi *et al.* (2001) on Thompson seedless grapevine, McAneney and Judd (1987) on kiwifruit, Waister (1970) on raspberries, Van der Linde (1958), Van Rhee (1959), Van Eimern *et. al.* (1964), Shah (1970), Waister (1972 a & b) and Kartashov (1979) on berry and Elkarbotly (2006) on olive. They reported that the effects of the windbreaks and barriers relative to open-field environments increased yields of various studied fruits. Overall, crop yield increases due to shelterbelts and protective systems.

**Physical fruit characteristics**

The obtained data in Table (4) clarify that all the protective systems decreased fruit weight, fruit volume, fruit diameter and fruit length of peach trees significantly in the first season but did not differ significantly in the second season .

**Table (4) Effect of different protective systems on some fruit physical characteristics of Earli Grand peach trees in the two seasons (2004 & 2005)**

| Treatment | Fruit weight (g) | | Fruit volume (ml) | | Fruit diameter (cm) | | Fruit Length (cm) | | Flesh Thickness (cm) | | Fruit firmness kg/cm$^2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| Theran net (1m)* | 70.13 bc | 117.22 a | 68.45 b | 115.27 a | 5.15 bc | 6.34 a | 5.31 bc | 6.16 a | 1.70 abc | 2.12 a | 1.16 b | 1.10 c |
| Theran net (1.5m)* | 83.71 b | 112.52 a | 89.10 a | 109.06 a | 5.44 ab | 6.10 a | 5.62 ab | 6.04 a | 1.73 abc | 2.15 a | 1.15 c | 1.08 e |
| Plastic net (1m)* | 68.57 c | 117.93 a | 69.70 b | 114.57 a | 5.02 bc | 6.24 a | 5.20 bc | 6.03 a | 1.79 ab | 2.13 a | 1.08 g | 1.11 b |
| Plastic net (1.5m)* | 67.66 c | 117.46 a | 68.05 b | 113.23 a | 5.07 bc | 6.24 a | 5.02 bc | 6.04 a | 1.46 c | 2.15 a | 1.05 i | 1.06 f |
| Napier grass (1m)** | 70.53 bc | 102.04 a | 71.05 b | 99.85 a | 5.12 bc | 6.05 a | 5.24 bc | 6.00 a | 1.70 abc | 2.14 a | 1.11 e | 0.99 g |
| Napier grass (1.5m)** | 68.31 c | 103.05 a | 69.48 b | 100.13 a | 5.18 bc | 6.12 a | 5.42 bc | 6.04 a | 1.72 abc | 2.17 a | 1.07 h | 0.88 h |
| Tamarix (1m)** | 69.47 bc | 101.67 a | 69.29 b | 98.30 a | 4.85 c | 6.05 a | 4.92 c | 6.09 a | 1.54 bc | 2.12 a | 1.14 d | 1.09 d |
| Tamarix (1.5m)** | 69.01 c | 102.51 a | 68.53 b | 98.07 a | 4.88 bc | 5.92 a | 5.04 bc | 6.10 a | 1.65 abc | 2.08 a | 1.10 f | 1.08 e |
| Control | 99.57 a | 106.09 a | 100.28 a | 102.94 a | 5.46 a | 6.04 a | 6.08 a | 6.40 a | 1.92 a | 2.21 a | 1.24 a | 1.21 a |

Means having the same letter(s) in each column are not significantly different at the level of 5 %.
* Artificial protection ** Biological protection

In the first season, the highest and lowest values of fruit weight (99.57 & 67.66 g) and fruit volume (100.28 & 68.05 ml$^3$) were gained by the unprotected and protected trees with plastic net 1.5 m. height, respectively. However, the highest and lowest values of fruit diameter

(5.46 & 4.85 cm) and fruit length (6.08 & 4.92 cm) were achieved by the unprotected and Tamarix 1 m. height protected trees, respectively.

Table (4) also show that, flesh thickness was insignificantly decreased in both seasons except plastic net 1.5 m. height and Tamarix 1 m. height protected trees were significantly decreased in the first season only. So, the highest and lowest fruit thickness were 1.92 cm (the unprotected trees) and 1.46 cm (plastic net 1.5 m. height), respectively.

As shown in Table 4, the peach fruit firmness was decreased significantly by protective systems in both seasons. Anyhow, the highest fruit firmness (1.24 & 1.21 kg/cm$^2$) were gained with the unprotected trees and the lowest fruit firmness (1.05 & 0.88 kg/cm$^2$) were achieved with plastic net and Napier grass 1.5 m. heights protected trees in the first and second seasons, respectively.

These findings are in agreement with those obtained by Freeman (1974) on citrus trees, Preez, (1986) on plum, McAneney *et. al.*, (1984) on kiwifruit, Rodriquez *et. al.* (1986) on Valencia late orange, Elkarbotly (2000) on Thompson seedless grapevine and Elkarbotly (2006) on olive. They stated that the fruit quality significantly increased in the protected fruit trees as a result of windbreaks benefits, such as, fruit length, fruit diameter, fruit weight, fruit volume and flesh thickness.

**Chemical fruit characteristics**

It is quite evident from Table (5) that the fruit total soluble solids percentage T.S.S % was not affected with all the protective systems in both seasons but fruit total acidity percentage was significantly decreased by the protective systems in both seasons. Since, the uppermost percentages (0.525 & 0.514 %) were gained with the unprotected trees and the lowermost percentages (0.462 & 0.468 %) were achieved with Napier grass and Theran net 1.5 m. heights in the first and second seasons, respectively.

The obtained data in Table 5 clarify that total soluble solids/acid ratio was significantly increased in Theran net and Napier grass protected trees in the first season and in Theran net 1.5 m. height protected trees in the second season. However, the highest (28.82 & 22.22) and the lowest (22.69 & 19.37) ratio were gained with Theran net 1.5 m. height and Tamarix 1 m. height protected trees in the first and second seasons, respectively. No available literature was found in such concern.

**Table (5) Effect of different protective systems on some chemical fruit characteristics of Earli Grand peach trees (2004 & 2005 seasons)**

| Treatment | T.S.S. % | | Titratable acidity % | | T.S.S. /acid ratio | |
|---|---|---|---|---|---|---|
| | 2004 | 2005 | 2004 | 2005 | 2004 | 2005 |
| Theran net (1m)* | 13.13 ab | 10.53 a | 0.493 cd | 0.488 d | 26.63 abc | 21.57 ab |
| Theran net (1.5m)* | 13.80 a | 10.40 ab | 0.479 f | 0.468 g | 28.82 a | 22.22 a |
| Plastic net (1m)* | 13.07 ab | 10.27 ab | 0.515 b | 0.513 a | 25.33 bcd | 20.02 cd |
| Plastic net (1.5m)* | 12.57 abc | 10.33 ab | 0.494 c | 0.506 b | 25.46 bcd | 20.44 bcd |
| Napier grass (1m)** | 12.53 abc | 9.77 bc | 0.469 g | 0.488 d | 26.70 abc | 20.02 cd |
| Napier grass (1.5m)** | 13.03 ab | 10.07 abc | 0.462 h | 0.475 e | 28.21 ab | 21.20 abc |
| Tamarix (1m)** | 11.17 c | 9.50 c | 0.492 d | 0.491 c | 22.69 d | 19.37 d |
| Tamarix (1.5m)** | 11.50 bc | 10.13 abc | 0.485 e | 0.470 f | 23.71 cd | 21.54 ab |
| Control | 12.13 abc | 10.47 ab | 0.525 a | 0.514 a | 23.13 d | 20.38 bcd |

Means having the same letter(s) in each column are not significantly different at the level of 5%. * Artificial protection ** Biological protection

## Conclusion

From the results obtained here it could be conclude that, different protective systems studied increased tree growth parameters and some artificial fences had significant effect in the first and second seasons. Moreover, flower drop percentage and blooming period / days were decreased significantly in the protected trees in both seasons and the protected trees were earlier than the unprotected ones in the first bloom, full bloom, end of bloom and first fruit set dates by 2 to 12 days.

Fruit set percentage and fruit maturity in days was increased but fruit drop percentage was decreased significantly in the first and second seasons as a result of protective systems. However, the protective systems did not affect fruit number / tree and yield / tree in the first season, while Napier grass and plastic net (1.5 m. height) fences had a significant effect in the second season.

Fruit physical characteristics were significantly decreased by using the protective systems except Theran net (1.5 m. height) fence in the first season and did not differ significantly in the second season compared with control. However, fruit firmness decreased significantly in the protected trees in both seasons.

All the protective systems had no effect on T.S.S. % but it significantly decreased fruit total acidity in both seasons.

From the obtained results it could be recommend the use of Theran fence as an artificial protective system and Napier grass as a biological protective system to improve productivity and fruit quality of Earli Grand peach cv. under North Sinai conditions.

## REFERENCES

Dierickx W. (2003). Field evaluation of windbreak protection for orchards. Biosystems Engineering 84 (2), 159–170.

Elkarbotly, A. A. (2000). Effect of windbreaks on growth and yield of Thompson seedless grapevine at west Nubaria region. M. Sc Thesis Fac. of Agric. Pomology Dept., Cairo Univ. Egypt.

Elkarbotly, A. A. (2006). Studies on growth and fruiting of olive trees under sand drift conditions at North Sinai. Ph.D. Thesis Fac. of Agric. Pomology Dept., Cairo Univ. Egypt.

Flemer, W. (1974). The role of plants in today's energy conservation. Am. Nurseryman. 139(9): 10, 39-45. (Cited in Sturrock, J. W., 1988. Shelter: its management and promotion. Agric., Ecosystems and Environ., 22/23: 1–13).

Freeman, B. (1974). Skin blemish problems of citrus and control with artificial windbreaks. Aust. Citrus News, Nov., p. 6. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Hegazi, E.S.; T. A. Yehia; M. A. El-Hadidy and A. A. El-Kharbotly (2001). Effect of windbreaks on yield and yield component of Thompson seedless grapevines. Egypt. J.Hort.Sci.,28 (3): 403-412.

Heiligmann, R. and G. Schneider (1975). Black walnut seedling growth in wind protected micro-environments. Forest Science (21): 293-297.

Kamal, S.; I. M. Sharma; N. K. Sharma and K. Sharma (1995). Preliminary studies on the effect of windbreaks on growth and yield of mango (*Mangifera indica* L.). Indian Forester, 121 (2): 122-125.

Kartashov, A. P. (1979). Effect of protective screens on strawberry cropping. Agriculture, Ecosystems and Environment, 22/23: 256-269. (Hort. Abstr., 51 No. 2496).

M.A.L.R., (2004). Ministry of Agriculture and Land Reclamation,Central Administration of Agricultural Economics, Egypt. Economic Affairs Sector(EAS),Agricultural Statistics, vol.2: pp.337- 338.

McAneney, K.J. and M. J. Judd (1987). Comparative shelter strategies for kiwifruit: A mechanistic interpretation of wind damage measurements. Agricultural and Forest Meteorology, 39: 225-240. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

McAneney, K.J.; M. J. Judd and M. C. T. Trought (1984). Wind damage to kiwifruit in relation to windbreak performance. N. Z. J. Agric. Res., 27: 255-263. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Neuteboom, D. I. (1978). Cox production in England. Grower Books, London. pp. 33-34. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Norton, L. R. (1988). Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213.

Preez, N. D. (1986). The economic advantage of artificial windbreaks in plum cultivation on Tatura trellis system in a windy environment. Deciduous Fruit Grower, 36: 59-65. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Rodriquez, R.; N. Del Valle; W. Arango; R. Torres and M. Fernandez (1986). Effect of shelterbelts on yield in Valencia late orange (*Citrus sinensis* (L.) Osbeck) plantations. Cent. Agric., 12: 71-80. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Shah, S. R. H. (1970). The influence of windbreaks on the development and yield of horticultural crop (genus Fragaria). Agric. Pakistan, 21 (2): 137-158.

Sherman, J. F. (1988). Field windbreaks: Design criteria. Agric. Ecosystems and Environ. 22/23, 215-228.

Smith, B. D. and T. Lewis (1972). The effects on the blossom-visiting fauna of apple orchards and on yield. Ann. Appl. Biol., Long

Ashton Res. Stn., Bristol, England, pp. 229-238. (Cited in Norton, L., 1988. Windbreaks: benefits to orchard and vineyard crops. Agriculture, Ecosystems and Environment, 22/23: 205-213).

Van der Linde, R. J. (1958). Het probleem van houtopstanden in het cultuurlandschap. The problem of shelterbelts in cultivated area. Cent. Landbouwkd. Doc. No. 21, pp. 44 (Cited in Baldwin, S. C., 1988. The influence of field windbreaks on vegetable and specially crops. Agric. Ecosystems and Environ. 22/23, 191-203).

Van Eimern, J.; R. Karschon; L. A. Razuinova and G. W. Robertson (1964). Windbreaks and shelterbelts. W. M. O. Tech. Note. No. 59. 188 pp.

Van Rhee, J. A. (1959). Wind protection of agricultural crops, especially studies for fruit. Inst. Biol. Nature (I. T. B. O. N.) Arnhem, Meded. No. 43, 66 pp. (Cited in Baldwin, S. C., 1988. The influence of field windbreaks on vegetable and specially crops. Agric. Ecosystems and Environ. 22/23, 191-203).

Waister, P. D. (1970). Effects of shelter from wind on the growth and yield of raspberries. J. Hort. Sci., 45: 435-445.

Waister, P. D. (1972 a). Wind damage in horticultural crops. Hort. Abstr. 42: 609-615.

Waister, P. D. (1972 b). Wind as a limitation on the growth and yield of strawberries. J. Hort. Sci., 47: 411-418.

Zaghloul, A. K. (2006). Performance of fences on the protection of alfalfa grown at Siwa aeolian sand. Annals of Agric. Sc., Moshtohor. Vol. 44(2): 503-514. Egypt.

# دراسات فسيولوجية وبيئية على أشجار الخوخ أيرلي جراند النامية تحت نظم حماية مختلفة من الرمال والرياح
## أ- الدراسات الفسيولوجية

**محمد أبورواش*، أحمد الجزار*، مصطفي الحديدي**، حسام الجمل****
* جامعة عين شمس – كلية الزراعة – قسم البساتين –مصر
** مركز بحوث الصحراء – شعبة البيئة وزراعات المناطق الجافة – قسم الكثبان الرملية - مصر

خلال موسمي الدراسة 2004 ، 2005 تأثير كل من النمو وعقد الثمار وصفات الثمار والمحصول لأشجار الخوخ صنف أيرلي جراند المطعومة على أصل اللوز المر عمر 7 سنوات تحت الظروف المطرية بقرية الخرافين – الشيخ زويد بشمال سيناء باستخدام نظام حماية بيولوجي (علف الفيل والأتل بارتفاع 1، 1.5م) ونظام حماية صناعي (شبك من الثيران والبلاستك بارتفاع 1 ، 1.5 م). أظهرت النتائج أن نظم الحماية كان لها تأثير معنوي على زيادة عقد الثمار ونقص عدد أيام فترة التزهير وصلابة الثمار والحموضة الكلية خلال موسمي الدراسة، بينما أظهرت أنخفاض معنوى خلال موسم الدراسة الأول على وزن الثمرة وحجم الثمرة وقطر الثمرة وطول الثمرة.

أدى إستخدام شبك البلاستك كنظام حماية للأشجار إلى زيادة ارتفاع الشجرة وأقصي أتساع عرضي للشجرة خلال الموسمين، بينما لم تتأثر صفات عدد الثمار/شجرة والمحصول ومحتوي الثمار من المواد الصلبة الذائبة الكلية معنويا في الموسم الأول ولكن في الموسم الثاني أدت معاملتي علف الفيل وشبك البلاستك بارتفاع 1.5م إلى زيادة المحصول معنويا مقارنة بالأشجار الغير محمية كما لوحظ أن الأشجار المحمية بنظم الحماية المختلفة كانت أكثر تبكيرا في مواعيد بداية التزهير واكتمال التزهير ونهاية التزهير وبداية العقد عن الأشجارغير المحمية بحوالي 2 : 12 يوم بصفة عامة.

وعلي ذلك ينصح باستخدام الثيران كنظام حماية صناعي أو علف الفيل كنظام حماية طبيعي لتحسين أنتاجية وصفات ثمار صنف الخوخ أيرلي جراند للأشجار المنزرعة فى منطقة الشيخ زويد بشمال سيناء.