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ECONOMIC INDICATORS OF NAVEL ORANGE AND KEITT MANGO: COMPARISON OF NET GREENHOUSES *VS.* OPEN FIELD

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ABSTRACT

Through the use of the structures of greenhouses which used to grow vegetables, in addition to the design of simple models of the structures with local materials to cultivate some fruit crops are very important in terms of economic consideration, which can be exported in large quantities to foreign markets such as navel orange and some pygmy mango varieties. The study was carried out at the Bossaily Protected Agriculture unit in Egypt to measure the performance, efficiency of production and the revenue during the cultivation period 2007- 2013. Two different systems of cultivation of Keitt mango (*Mangifera indica*, L.) and navel orange (*Citrus sinensis*, L. Osbeck) were compared: the traditional system of protected cultivation and a new system of performance and management of production processes under screen net. Results showed that the navel orange average yield under screen net was 18.9 tons/ feddan (4200 m^2), comparing with 12.3 tons/ feddan in the open field during 2007- 2013. Meanwhile, the annual net return in screen net was L.E 9940 per feddan, while net return in the open field was L.E 6451 per feddan. The result showed that for Keitt mango, the average of annual yield under screen net was 4.725 tons/ feddan and 2.3 tons/ feddan for the open field during 2007- 2013. Furthermore, the annual net return in screen net was L.E 27467 per feddan, while the net return for the open field was L.E 10843 per feddan.

INTRODUCTION

Citrus is a major export product of Egypt. In 2013, the total cultivated orchard area in Egypt was 1.62 million feddan (4200m^2). About 541.7 thousand feddan are currently under citrus, of which 439 thousand feddan are in production (Fruitful). Citrus total production is estimated at 4.1 million ton/ year (MALR, 2013). The volume of citrus exported to various countries during 2013 was 1.1 million tons (FAO, 2013). According citrus ranking the most important citrus cultivars are navel orange (about 34%) followed by summer Valencia (26%), mandarin (23%) and lime (8%), (MALR, 2012). Citrus is produced mainly in two regions; the Nile Delta (old lands), representing nearly 70% of the total citrus area, and the newly reclaimed lands, which represents nearly the remaining 30% of total citrus area. The cultivation practices applied in these two regions differ due to site specific conditions, soil types and to the different age of the trees (Sheta, *et al.*, 2002). Concerning Mango crop the total area of mango in Egypt was 241.1 thousand feddan in 2013, frutiful area was 200.88 thousand feddan, while, the total production was 712.5 thousand tons (MALR, 2013). Protected cultivation is considered one of the new elements of agricultural intensification. Over the past few years several problems were recognized in Egypt, such as the increase of prices of all production inputs, with a stabilized commodity prices. Another pressing issue is related to the misuse of Egyptian natural resources, such as over application of chemicals that led to environmental degradation (Medany, *et al.,* 2007). Covering ventilation openings with insect-proof screens that physically block (Bethke, 1994) or optically prevent (Antignus *et al*., 1998) the entry of insects into and their distribution within the greenhouse is a common practice nowadays. However, these screens reduce air exchange rates depending on the size of the pore openings (Harmanto *et al*., 2006) and also influence the light quantity transmitted into the greenhouse (Klose and Tantau, 2004). Net houses and its variants have been used in some European, South American and Southeast Asian countries for producing egg plants (Kaur

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et al., 2004), leafy greens (Talekar *et al*., 2003) and cabbage (Martin *et al*., 2006). In Africa, mobile net houses made of mosquito nets (25-mesh) were effective as physical barrier against the diamondback moth, cutworms, and loopers providing 66 to 97% control of moths and caterpillars (Martin *et al*., 2006). The present study aimed to determine the performance and efficiency of production and net return of navel orange and Keitt mango cultivated in open field and inside net greenhouse; in addition to design a simple of greenhouse models with local materials.

MATERIALS AND METHODS

The present study was carried out during seven successive seasons from 2007 to 2013 on navel orange plant (*Citrus sinensis L. Osbek*) cv. New hole and mango plant (*Mangifera indica L.*) cv. Keitt. The orchad site was chosen at El- Bossaily farm at the north west of Nile Delta, Behairah Governorate, Egypt.

of each navel orange and Keitt mango per feddan under each of screen net and open field along the study period (2007-2013) were estimated. Moreover, the annual production (ton/ fed.) of navel orange and Keitt mango during the 7 years under the two cultivation methods was recorded and their total production (ton/ fed.) and total revenue (L.E) along the 7 years were calculated. The study relied on the use of descriptive analysis to characterize the problem in addition to the quantitative analysis method using some important economical indicators. Published and unpublished data were collected utilized to achieve the study objectives.

RESULTS AND DISCUSSION

Navel orange cultivation

During the recent years, the increasing demand for food, make countries using intensification of agricultural.

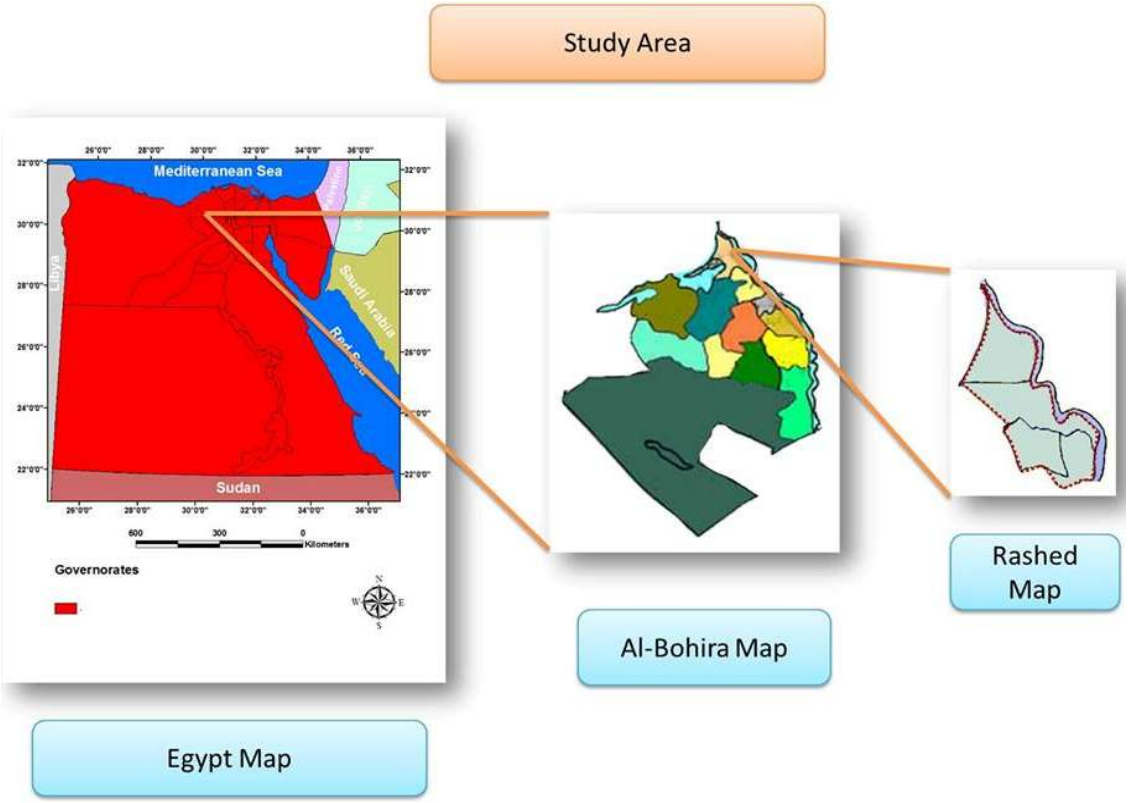

Figure 1. Location of the study area in Egypt

Tress of navel orange was planted at 4X4 m. spacing (262 trees/ feddan); the distance between plants of Keitt mango was two meters and distance between rows three meters (700 trees/ feddan). The rows were oriented from north to south. The greenhouse area of navel orange and Keitt mango was 4200 m^2. Each greenhouse was covered by white screen net. The cell diameter of white screen net was 0.28 mm, and cell size was 3X 7.4 mm. All agricultural operations (irrigation, fertilization, pest and diseases and weed management) were carried out similar whether the cultivated land sustained under the screen net or open field. Costs of ultra structure establishment, required materials, land preparation, cultivation, agricultural practices and other production inputs

One of the modern techniques to achieve this goal is cultivation of orchard (navel orange and Keitt mango) under screen net. This technique used to protect the trees from insects and fruit from the hot sun and wind. The continuous field observations showed that a large prances in the rate of growth of trees and increases in the rate of fruit set (compared with the growth and set of the trees in open field at the same age). Therefore, it is worthy to indicate that this technique useful for production of the grafting buds without viruses. In addition, this technic contributes to organic farming through the protection of trees from pests, besides maximizing unit output of the unit area.

Navel orange had problems in production and the specifications of the required quality for export when cultivated in open field, as follows:-

- Weather fluctuations from the beginning (March) and even the stability of the set (July).
- Infection with leaf borers "from first May to end of October"
- Infection with peach fly and fruit fly (after completion of fruit growth).
- Quality of fruits low.

Mango production also facing several problems as:

- Weather fluctuations from flowering period until the stability of the set, which lead to the decrease of the quantity and quality of their harvested yield.

Comparison between navel orange trees grown under screen net with those grown under open field shows the following results as shown in table 1.

Table 1. Production trend of navel orange under open field and screen net of greenhouse

Items	Open field	Screen nets
Vegetative growth	Small	Three times bigger (open field)
Yield 2007	No yield	10 kg/ tree
Yield 2008	5 kg/ tree	25 kg/ tree
Yield 2009	35 kg/ tree	65 kg/ tree
Yield 2010	50 kg/ tree	90 kg/ tree
Yield 2011	65 kg/ tree	100 kg/ tree
Yield 2012	85 kg/ tree	105 kg/ tree
Yield 2013	90 kg/ tree	110 kg/ tree
Exportable fruits	50%	> 90%

Cost accounting for navel orange \

Table 2 and 3 shows the cost accounting for navel orange under screen net.

Table 2. The constructing costs of a greenhouse on 4200 m^2 by local materials

Item	Value (L.E)	Spam life	Depreciation (L.E)
Wood (gazwarina trunk)	4000		
Iron and galvanization wire	7500		
Building materials	1000		
Construction cost	2500		
Total structure cost	15000	15	933
screen net	11000	5	2200
Total cost	**26000**		

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data

From the data in table 2 results that the constructing cost of the greenhouse on an area of one feddan (4200 m^2) by local materials in the domestic market, with a total cost reached L.E 26000. Likewise, table 3 reveals that the total costs of the cultivation for feddans of navel oranges under screen net during the first seven years of agriculture is about L.E 62731. Agricultural operations e.g. "irrigation, fertilization and hoeing, etc.", came in the first place with L.E 30000, which representing about 47.8% of the total production costs, while the value of screen net came in the second place being on average 24.55% of the total costs. Concerning open field, data presented in table 4 show that the costs of the cultivation of one feddan of navel orange in open field during the seven years considered, was estimated by L.E 41300. The production practices e.g. "fertilization and hoeing, etc.", value ranked first in terms of costs with L.E 31500, representing about 76.27% of the total costs. The value of drip irrigation system depreciation ranked second representing 13.56% of the total costs. And the value of maintenance followed in the third rank representing 4.84% of the total costs.

Table 3. Production costs of the cultivation navel orange per feddan under screen net in the period of 2007- 2013

Cost items	Value (L.E.)	%	Notes
Structure cost depreciation	6531	10.41	
screen net	15400	24.55	
Seedling transplanting	1700	2.71	262 seedling per feddan
land preparation	500	0.80	
Drip irrigation system depreciation	5600	8.93	
Production practices inputs	30000	47.82	Value of fertilizers, irrigation, manure, insecticides, and labor wages
Maintenance	3000	4.78	
Total costs	62731	100.00	

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data

Table 4. Costs of the cultivation of navel orange per feddan in open field in the period of 2007- 2013

Cost items	Value (L.E.)	%	Notes
Seedling Transplanting	1700	4.12	262 per feddan
Land preparation	500	1.21	
Drip irrigation system depreciation	5600	13.56	
Production practices inputs	31500	76.27	Value of fertilizers, irrigation, manure, insecticides, and labor wages
Maintenance	2000	4.84	
Total costs	41300	100.00	

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data.

Table 5 shows the comparison between navel orange total production, cost, total revenue and net return per feddan under the open field and under screen net during the first seven years of agriculture. The total production of screen net reached 132 tons/ feddan, compared to 86 tons/ feddan in the open field, during the years 2007- 2013.

Table 5. Comparison between navel orange total production, total cost, total revenue and net return per feddan under the open field and under screen net during the years 2007- 2013

Items	Open field	screen net
Total production (ton/fed.)	86460	132310
Total cost (L.E.)	41300	62731
Average farm gate price (L.E.)	1.00	1.00
Total revenue (L.E.)	86460	132310
Net return (L.E.) within 7 years	45160	69579

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data

Result also showed that the total cost reached L.E 41300 in open field compared to L.E 62731 under the screen net. Moreover, total revenue reached L.E 86460 for the open field and L.E 132310 for the cultivation under screen net during the years 2007- 2013. Accordingly, the net return per feddan for the first seven years in screen net cultivation reached L.E 69579, while the net return per feddan in the open field reached L.E 45160 (Table 5).

Keitt Mango cultivation

Comparison between mango Keitt trees grown under screen net with those under open field showed the following characteristic differences presented in table 6.

Table 6. Production trend of keitt mango under open field and screen nets

Items	Open field	screen net
Vegetative growth	Small	Three times (open field)
Yield 2007	No yield	0.25 kg/ tree
Yield 2008	No yield	2 kg/ tree
Yield 2009	0.5 kg/ tree	5 kg/ tree
Yield 2010	2.5 kg/ tree	7 kg/ tree
Yield 2011	5 kg/ tree	11 kg/ tree
Yield 2012	7 kg/ tree	10 kg/ tree
Yield 2013	8 kg/ tree	12 kg/ tree

Cost accounting for Keitt Mango

The costs of the constructing of a new greenhouse on 4200m^2 area with local material were previously illustrated in Table 4. Such greenhouse model was used to planting both navel orange and Keitt mango. Thereat, the previous costs used for establishing a greenhouse (Table 3) are reused to estimate the same feature for Keitt mango.

Table 7. Total production costs of the cultivation of Keitt mango per feddan under screen net in the period of 2007- 2013

Cost items	Value (L.E.)	%	Notes
Structure cost depreciation	6531	9.03	
screen net	15400	21.29	
Seedling transplanting	9800	13.55	700 seedling per feddan
land preparation	500	0.69	
Drip irrigation system depreciation	5600	7.74	
Production practices inputs	31500	43.55	Value of fertilizers, irrigation, manure, insecticides, and labor wages
Maintenance	3000	4.15	
Total costs	72331	100	

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data.

Table 7 reveals that the total costs of the cultivation for feddan of Keitt mango under protected cultivation during the first seven years of cultivation was L.E 72331. The agricultural operations such as "irrigation, fertilization and hoeing, etc.", ranked first with L.E 31500, which represent about 43.55% of the total production costs, while the value of screen net came in the ranked second being on average 21.29% of the total costs. As for the costs of the cultivations of Keitt mango in open field, Table 8 shows that the costs of cultivation one feddans of Keitt mango in open field during the first seven years of agriculture, was L.E 52900.

The agricultural operations values such as "fertilization, hoeing etc." came in ranked first with L.E 35000, which represent about 66.16% of the total costs. On the other hand, the value of seedlings transplant ranked second representing about 18.53% of the total costs, whereas the value of drip irrigation system depreciation came in the third rank representing 10.59% of the total costs.

Table 8. Costs of the cultivation of Keitt mango per feddan in open field in the period of 2007- 2013

Cost items	Value (L.E.)	%	Notes
Seedlings Transplant	9800	18.53	700 seedling per feddan
Land preparation	500	0.95	
Drip irrigation system depreciation	5600	10.59	
Production Practices inputs	35000	66.16	Value of fertilizers, irrigation, manure, insecticides, and labor wages
Maintenance	2000	3.78	
Total costs	52900	100	

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data.

Table 9. Comparison between Keitt mango total production, total cost, total revenue and net return per feddan under the open field and screen net during the period of 2007- 2013

Items	Open field	screen nets
Total production (ton/fed.)	16100	33075
Total cost (L.E.)	52900	72331
Average farm gate price (L.E.)	8.00	8.00
Total revenue (L.E.)	128800	264600
Net return (L.E.) within 7 years	75900	192269

Source: Calculated using the data taken from Bossaily unit, CLAC, ARC, MALR, unpublished data.

Results in Table 9 show the comparison between Keitt mango total production, total cost, total revenue and net return per feddan in the open field and protected cultivation during the first seven years of cultivation. The total production during 2007- 2013 under screen net reached 33.075 tons/ feddan, while that in the open field was 16.100 tons/ feddan. The results also show that the total cost was L.E 52900 in open field compared to L.E 72331 in screen net. Moreover, during the same period, the total revenue reached L.E 128800 for the open field, and L.E 264600 in screen net. Consequently, the net return per feedan within first seven years in screen net cultivation within 7 years reached L.E 192269, while the net return per feddan in the open field reached L.E 75900.

Table 10. Profitability of Keitt mango and navel orange for one year

No.	Particulars	Keitt mango		Navel orange	
		Open field	Screen net	Open field	Screen net
1	Area (fed.)	1	1	1	1
2	Yield (t. / fed.)	2.3	4.725	12,351	18,901
3	Yield (kg/ m^2)	0.54	1.125	2.94	4.5
4	Annual production cost (LE. / fed.)	7557	10333	5900	8962
5	Net income (LE.)	10843	27467	6451	9940
6	B/C ratio	1.43	2.66	1.09	1.11

Results in Table 10 show the comparison between Keitt mango and navel orange profitability for one year under open field and screen net. Total yield per feddan for Keitt mango under screen net reached 4.72 tons/ feddan and 2.3 tons/ feddan in the open field, while the total yield per feddan for navel orange in screen net reached 18,9 tons/ feddan and 12,35 tons/ feddan in the open field. Table 10 also shows that the net income is higher for cultivation under screen net than in open field, in both Keitt mango and navel orange despite, the total production costs of screen net is higher than in open field for both fruit crops.

Conclusion

This study was undertaken with the primary purpose of assessing the welfare gain to local residents resulting from fruit crops inside net greenhouse. Valuation could be particularly helpful for policymakers, especially as concerns decisions on agricultural policy reform. Valuation can be used for pricing non-commodity agricultural outputs. The findings give evidence to the fact that fruit crops inside net greenhouse produces externalities that create higher benefits for residents. This seems to be a positive result encouraging investments in fruit crops inside net greenhouse Management operation and production of fruits under greenhouses should be applied at new reclaimed lands.

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