



## Development Growth and Productivity of Orange Orchards (*Citrus Sinensis L*) in Egypt (Delta Region)

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**Received Date:** June 11, 2018; **Published Date:** June 28, 2018

### Abstract

This work presents the current situation for the orange orchards (*Citrus sinensis L*) in Delta region, and the main challenge which effects on growth and productivity, over the next few years also, focusing on increasing total yield and enhancement fruit quality by following crop management practices and increasing awareness between growers to increase total yield and enhancement fruit characters to contest in the worldwide trade through proper management practices contain use proper fertilizers, different irrigation technique, pest and disease management and harvest technique to improve orange orchards productivity in Delta region. Consequently, this review evaluates the orange production current situation in Delta region under surface irrigation and how could transfer new irrigation technique and new management system to assesses orange grower to improving productivity and fruit quality. This paper deals with the current situation and different challenge expressions of orange growers in Delta region, as well as with exotic pathogens and pests potentially harmful to citrus industry in Egypt. The aim of this work is to development productivity of orange orchards, through a serious applied of good crop management practices to implement sustainability of orange production as well as for sustaining soil fertility.

**Keywords:** Citrus sinensis; Orange orchards; Productivity; Fruit quality; Delta region

### Introduction

Citrus is considered as one of the premier fruit crops all over the world, both in terms of planting area and production. Egypt ranking as the sixth largest producer of orange all over the world, and also, considered the largest exporter of orange in the world [1].

In Egypt, citrus fruits are economically important with a large scale production estimated around 4.5 million ton/year; it occupies a place of considerable importance in the

fruit economy of the country. It ranks first place in cultivated area and productivity, as well as considered the most economic exporting crop and most favorite popular fruit, furthermore, Oranges (sweet and sour) are the main citrus species in Egypt and considered the most abundant as fresh fruit and they contribute to roughly (80 percent) of the Citrus fruit production [2], where the area of cultivated about (162650 hectares) representing about 69% of the total citrus area(9224300 hectares), producing about 3.35 million tons orange fruit, representing about 71% of the total citrus production (4.65 million tons), exports orange about

1.1 million tons, representing about 92% of the total amount of total citrus exports (1.27 million tons). Improving citrus groves productivity in Egypt depended on the use of appropriate management practice including balanced nutrition, proper irrigation technique for each region and integrated pest management [3]. This paper deals with the current situation and different challenge expressions of orange growers, as well as with exotic pathogens and pests potentially harmful to citrus industry in Delta region, the main target for this work evaluates current situation of the orange orchards in Delta region under surface irrigation and how could transfer new irrigation technique and new management practice to assess orange grower to increasing productivity and enhancement fruit quality.

### Current Situation of Citrus in Egypt

There are several citrus species and varieties are spread all-over Egyptian Agricultural areas, caused prolong the harvesting season and accommodate local consumption and exportation.

The mostly spread citrus varieties could be arranged to descend as follows

- a. Navel orange (*Citrus sinensis*),
- b. Balady orange (*C. sinensis*),
- c. Valencia orange (*C. sinensis*),
- d. grapefruit (*C. paradisi*),
- e. Mandarin (*C. reticulata*),
- f. lime (*C. aurantifolia*),
- g. Lemon (*C. limon*),
- h. Sour orange (*C. aurantium*),
- i. And Kumquat (*Fortunella spp.*).

Delta is an important region of orange productivity, where Washington Navel orange and Balady orange is grown widely; however, these orange orchards are weakening in productivity due to poor management and for various reasons like decrease soil fertility, surface and groundwater pollution from agricultural chemicals, little farm income due to increase production costs.

### Citrus Production

Egypt's production is estimated at a record 4.9 million tons in 2016, up 6 percent from last year (4.6 million tons) on higher area (Figure 1).

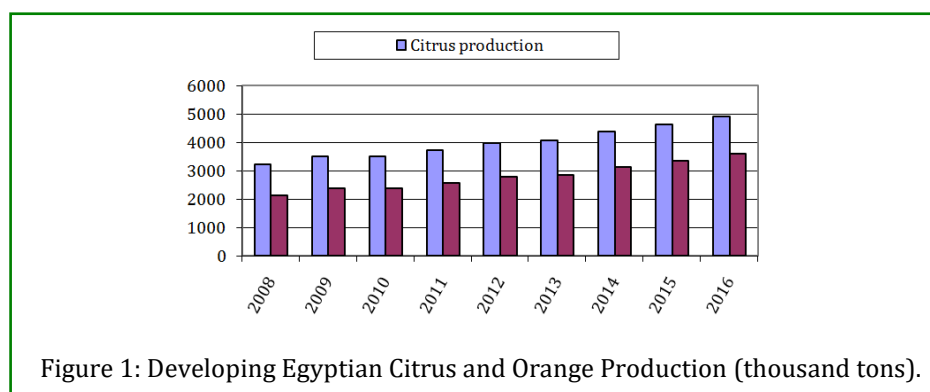


Figure 1: Developing Egyptian Citrus and Orange Production (thousand tons).

Citrus exports are growing up 5 percent to a record 1.6 million tons on greater exportable supplies. In addition, the forecast assumes that the devaluation of the Egyptian pound which took place in November 2016 will positively

impact exports for a second year (Figure 2). Egypt accounts for one-third of global orange exports [4].

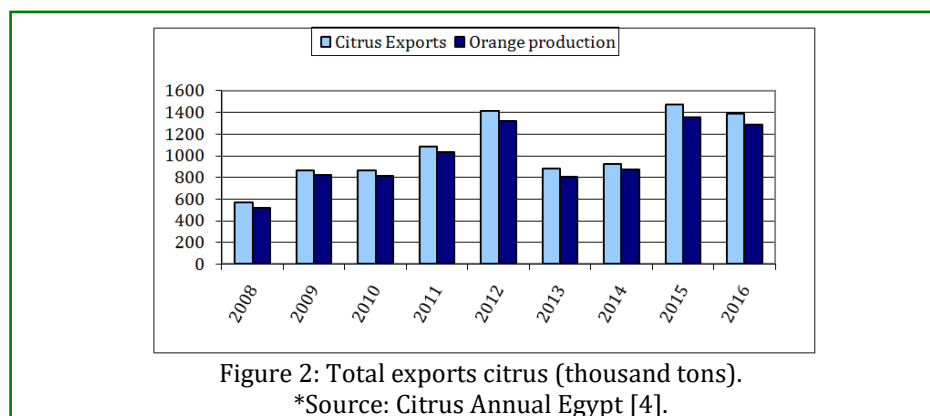


Figure 2: Total exports citrus (thousand tons).

\*Source: Citrus Annual Egypt [4].

## Sweet Orange

*Citrus sinensis*, the sweet orange is a medium-sized tree with a rounded top and consistent branches; twigs are angled when young, usually with slender, slightly blunt spines in the axils of the leaves; leaves medium-sized, pointed at the apex, rounded at the base; petioles intently winged, articulated both with the twig at the base and with the leaf blade at the tip; flowers middle-sized with 5 petals and 20-25 stamens, single in the axils of the leaves, or in small racemes, fruits are oval or flattened globose; peel thin, tight. In view of these, there is an increasing need of progress orchards management system which contains soil fertility enhancement and providing plant nutrition from all probable sources of plant nutrients, integrated pest management to achieve the optimum level for sustaining crop efficiency.

### Permitted varieties of orange in delta region-Egypt include

- a. Washington Navel: considered the best variety grown in delta region, it is a seedless fruit which is direct eating as a table fruit; it matures early in November as the first orange variety in the season.
- b. Seeded Baladi orange.
- c. Sweet orange.
- d. Valencia orange: considered a processing cultivar for juice due to the quantity of juice in the fruits, this cultivar is the latest maturity (from mid of March till May) in the season; the fruit has a rough rind [5].

**Soil:** Oranges grow in a wide range of soils but deep well-drained loamy soils are most ideal for the cultivation of orange, also, soil pH preferred to be 6.5 to 7.5.

**Irrigation:** For maximum orange productivity enough irrigation require throughout the year, water requirements vary according to irrigation system and climate conditions, but as a whole the ideal range is between 7620- 10700m<sup>3</sup>/Hectare/ year, and EC of water preferred to be less than 1.0, in Delta region all orange orchards have been irrigating through Nile river water which is not as saline, also, good drainage system is essential in orange farming [6].

**Harvesting season:** Start at November to January, while Valencia orange extended to May.

**Root Stock:** Sour orange is best under Delta region conditions, now Cleopatra mandarin is also preferred.

## Common Challenges for Orange Production in Delta Region

### Inferior varieties

Most orchards in delta region rely on many varieties that are sometimes very susceptible to infections and had different maturity time.

**Management:** Hence varietal diversification of a different variety is necessary to meet market demands and for sustainable citrus industry in Egypt, old trees which unproductive, diseased and inferior cultivars could successfully be replaced in short time to the main variety through top grafting, the good, well-established root system of the standing tree helps to produce fast re-growth of the new scion, a rapid return to complete production with good crops is reachable in 3 to 5 years.

### Poor yields for small category farms

Orange production in delta region is done on small farms as a result of division of soil holdings, also due to much water quantity and nutrient deficiency, poor crops often result, the trees are not irrigated probably and in most cases suffer from sinking stress, delayed flowering, affecting potential yields.

### Excessive irrigation

Water is a critical factor for commercial citrus groves, the citrus tree is greatly sensitive to water both of deficiency and overdose quantity of soil moisture during all critical stages i.e. flower initiation, fruit cell division, and cell development of fruit growth [7]. Irrigation is a subject to several citrus growers, usually, citrus orchards in delta irrigated by surface irrigation system with excessive water (about 16000 to 19000 m<sup>3</sup>/Hectare per year) [6] therefore, trees suffer from sinking stress in different cases, drop flowering, affecting potential yields and fruit quality (Figure 3). Unbalanced nutrient uptake [8], poor rooting [9] and suboptimum plant growth [10], either alone or in combination contributes with the suboptimum productivity and decline of citrus in waterlogged soils. Physiologically, fruit drop (June drop) is severe in citrus orchards in Delta areas especially when high heat waves occur. The growers were imparted with the training on the necessity of proper irrigation in tree physiological stages and their critical condition during certain phonological phases.



Figure 3: Field image for excessive irrigation in Delta region.

**Management:** The main purpose of irrigation is delivering the probable water quantity at the optimal time to the rhizosphere of the trees, furrow, basin and rings method are the most applied techniques of irrigation in citrus orchards under Delta region soil conditions [11]. Therefore, it needs to regulate since the establishment and adopts drip system of irrigation or another modern system to avoid sinking the trees and reduce nutrients leaching. The proper amount of irrigation water for citrus orchards in Delta region ranges from 9,000 to 11,000 m<sup>3</sup> per hectare yearly divided to 14-17 times through the year, irrigation intervals depend on the type of soil and climate conditions [6]. Due to critical situation for water in Egypt. Nowadays, some orange growers start adapt to drip irrigation or pop up irrigation system indifferent sites in Delta region to reduce quantity of irrigation water, decrease fertilizer loss, reduce infection by various soil pathogens, and minimize amount of fertilizers used to producing worthy yield with better fruit quality [12]. Furthermore, good drainage has an effective role in increasing the productivity of orange groves in clay soil under Delta region conditions.

### Bad pruning

In different areas in Delta region orange tree grow up to different heights and maybe fruit picked by ladders due to high canopy (Figure 4), from another side, in high-density orchards many farmers left tree to grow up without trimming especially the old farms which cause a severe problem due to the internal area of canopy become shaded and poor or little fruit grown there, which reduce tree yield.



Figure 4: Field image for huge tree.

**Management:** Pruning should be done before new growth cycle start, preferable after harvesting time directly or before the flowering of the trees to avoid improper effects on new yield. Regular pruning conserves sunlight and air penetration through the canopy of the orange trees and reduce the humidity around and inside the tree canopy contributing to pathogen and pest prevention, the distance between the trees should be enough for different processing during the year and tree height should be kept at less than twice the planting distance in the row. There are different types of pruning followed to control tree size include:

- Thinning out to improve aeration and remove inner parts of the canopy which have poor or no fruit set at all.
  - Cut off infested parts of the tree, especially after *Phytophthora* infections (Selective pruning).
  - Heading back to regulate canopy size of the tree.
- Also, during pruning processing, any extra side branches should be removed including those growing inwards, and regularly remove any diseased or dead branches.

**Canopy management:** All rootstock sprouts must regularly remove and low lying branches near to soil surface to facilitate the easy cultural process. All diseased, dried, intercrossing, and weak branches in old trees need to remove to get good aeration and enough sunlight. Meanwhile, in the old orchards preferable careful pruning of the internal branches during summer season (July to August), one time every three years. Also, trimming away the weak shoots among the crowded terminal shoots during July and August.

**Rejuvenation of old orchards:** In different areas in Delta, there are old orchards and need urgently rejuvenation, through top working by use scions of good



varieties. All head of the trees cut off during December and January, leaving the main trunk at an appropriate height and allow new shoots to grown, use the cleft method of grafting during February and March, or grafting the developing shoots on the main stem.

## Weeds

There are various weed species are grown in citrus orchards in delta region like *Sorghum halepense* (L.), *Cynodon dactylon* (L.), *Convolvulus arvensis* L., *Cyperus rotundus* L., *Mercurialis annua* L., but there are some dangerous kinds of weeds need urgently removed from orchards to avoid harmful damage like *Arundo donax*, *Convolvulus arvensis* and *Imperata cylindrical* [13]. In delta region due to using flooding irrigation system weeds growing quickly in orchards; weed density caused a decrease in the tree growth by about 15 to 96 % while reducing total yield up to 35% as a result of the adverse influence on fruit quality (Figure 5), the loss in fruit yield could reach to 35%, also, reduce the total yield and decline fruit quality [14].



Figure 5: Field image for widespread of weeds in some citrus orchards in Delta region 2018

**Weed Management:** Weed control is an important component in citrus crop production, the aim of weed control in citrus groves is to inhibit the weed growth or prevent weed competition during the critical period of fruit growth to maximization the productivity of orange trees [15]. Conventional practices for weed management in orange orchards in delta region usually include tillage, ploughing, hoeing, mulching and application of herbicides.

In Delta region most of farmers start deeply manual hoeing of the soil to remove all weeds and in the same time turn over the soil to improve aeration, also, regularly

hoeing within rows of orange orchards considered more environmentally friendly than the use of herbicides to decrease the weed density to the level that does not make any adverse effect on orange trees to produce the highest yield and best fruit quality.

**The Importance of weed control in fruit crops:** Weed control achieved in orchards several benefits including

- Increase the total yield quantity and quality.
- Enhancement the efficiency of different agricultural practices, like fertilization, irrigating and harvesting.
- Decrease losses from plant-pathogen and pests.
- Reduce the risk of fire.
- Reduce the hazard effects of frost on crops.

Regarding herbicides use as a chemical control for weeds, there are potential problems associated with herbicides use like crop injury, residues in soil and water and toxicity to other non target organisms, therefore, that chemical herbicides must use care to avoid increase chemical residual in orange fruits [16].

## Orange Orchards Nutrition

Conventional fertilization practice in citrus orchards in Delta region includes the application of phosphorus with organic fertilizer after harvesting during December or January, part of potassium and nitrogen requirements during February before spring growth cycle start and the application of one or two doses of N fertilizer during growing season. However, there are different annual fertilizer requirements for citrus trees, appropriate fertilization is one of the most important agricultural practices for achieving healthy trees and good yield, it includes appropriate form of nutrients for different growth stage, optimum rates of various nutrients, proper timing, also, fertilizers placement are essential for efficient fertilizer management. Nowadays, Nano fertilizers may have more safety than their bulk materials, there has been main attention in using Nano fertilizers applications in plant nutrition to improve plant growth and enhance productivity through implementing nutrient efficiency, and allowing better management of nutrient inputs of plant and reduce pollution of soil [17].

## Nitrogen

Several studies have been conducted to determine the optimal N rates and application frequencies for mature fruitful citrus trees, also, rootstocks can affect the success and profitability of virtually any commercial citrus industry [18]. Under Delta region conditions, nitrogen is considered to be the most main factor in crop productivity, therefore, preferably apply 30% of nitrogen

requirements approximately during February before spring growth cycle start, and the application of the second dose about 30% in May or June, while the last nitrogen dose added during August.

However, some horticulture growers in Delta region used high rates of nitrogen yearly may be overdose than tree requirements and as a result of this excessive application there are a substantial financial loss and pollution of the environment with nitrate [19], also increasing soil and plant N availabilities increase tree growth and vigour and maybe had adverse effects on fruit set or even total yield [20]. Currently, there are different nano fertilizers available like Nano nitrogen, Nano phosphorus, Nano potassium and Nano microelements use for various crop nutrition; therefore, currently there are some growers in Delta region orange start use Nano Nitrogen to replace part of bulk nitrogen fertilizers [17].

### Regarding potassium

The total potassium content in citrus leaves was found to be unsatisfactory in orchards in Delta region; this due to potassium fixation on clay surface by wetting and drying cycles [21] and antagonized by other soil cations. Therefore, the annual application of potassium fertilizer is very important, combined with a balanced nutrition for other nutrients for producing high yield and good fruit quality in orange orchards [22]. Horticulture growers in Delta add potassium twice time yearly, the first one in March represent about 50% from annual requirements, the other dose may be divided for two sections one in May and the other in August combined with the last dose of Nitrogen fertilizer.

### Concerning phosphorus

Usually, in Delta region, orange growers add phosphorus [23] nutrient one time after harvesting during December or January as mono superphosphate form (P<sub>2</sub>O<sub>5</sub> 15.5%) 200 kg/ feddan and is mixed in soil with other fertilizers like sulphur at a rate of 100 kg and organic fertilizer 15 m<sup>3</sup>/ feddan.

### Regarding micronutrients

Foliar application of micronutrients in chelated forms was more effective than soil application, therefore, in Delta region orange orchards fertilizing with chelating form of zinc, iron, and manganese at rate 250g from each nutrient /600 L of water three times during growth season, first one in March, repeated spraying in May and August to provide the trees requirement from micronutrients, also, preferable adding 3 kg urea/600 L of water to enhance nutrients absorption.

### Some Special Treatments for Improvement of Flowering and Fruit Set

- After fruit harvesting and before mid of January, preferable spray 1.0- 1.5% Urea (10- 15 g/liter) to induce flowering, in case stored fruit on the trees after mid of January, harvesting must delay about a month after spray urea.
- At flowering stage, GA3 20 ppm may be sprayed to increase the fruit set.
- During fruit set directly preferable use copper oxychloride or any other fungicide as a foliar application for the trees and once again 15 days later to reduce Alternaria fruit rot disease spreading effectively (Table 1).

Element	Symbol	Unit of measure	Low conc.	Optimum conc.
Nitrogen	N	%	2.2- 2.4	2.5- 2.7
Phosphorus	P	%	0.09- 0.11	0.12- 0.16
Potassium	K	%	0.7- 1.1	1.02- 1.7
Calcium	Ca	%	1.5- 2.9	3.0- 4.9
Magnesium	Mg	%	0.2- 0.29	0.3-0.49
Manganese	Mn	ppm	18- 24	25- 100
Zinc	Z	ppm	18- 24	25- 100
Copper	Cu	ppm	3-4	6- 16
Iron	Fe	ppm	35- 59	60- 120
Boron	B	ppm	20- 35	36- 100

Table 1: Guidelines for optimal and low concentration of some nutrients in orange tree leaf Modified from [24].

## Important Diseases and Pests in Delta region

Citrus trees are attacked by different kinds of pathogens from flowering to harvesting phase pathogens that affect total yield and significantly depreciate the fruit quality. The diseases are caused by fungi, bacteria, virus, virus-like pathogens, etc. they cause severe damage to the orange cultivation. Citrus orchards are also attacked by different pests like scales, Citrus Thrips, leaf miner, whiteflies, and nematodes, also, some of which are vectors of the citrus tristeza virus. All these aspects together cause a great loss to citrus orchards.

### The major diseases affecting orange crop in Delta regions are as follows

**Gummosis disease (*Phytophthora gummosis*):** The characteristic symptom of the disease is exudation of gum from the bark of the tree trunk (Figure 6). The bark shows conspicuous brown staining along with hardened masses of gum on the surface. The bark cracks open and in the later stages dry up and fall off, with severe infection the tree usually flowering heavily and dies before the fruits mature. Disease occurrence is particularly spreading in orchards established with the graft union at or below the soil surface and subjected to flood irrigation; also, severe losses also can occur if trees are planted on susceptible rootstocks like Volkameriana lemon.



Figure 6: Field image for Gummosis disease symptoms on orange tree in Delta region 2018.

**Controlling:** Preventive measures like Keeping the budding area at least higher up to 35-40 cm above the soil surface, avoiding direct contact of water with the trunk during irrigation by adopting double ring irrigation method; or change irrigation technique to another system like drip irrigation. Under clay soil conditions good

drainage is effective against the disease, also, usage of resistant rootstock, avoiding plant injured during hoeing and other practice, and soil drenching application with fungicides after harvesting is also effective in control the disease.

**Alternaria fruit rot (*Alternaria citri*):** Also called Black rot, it is a fungal disease caused by *Alternaria citri*, it could increase premature fruit drop, and also, infected fruits had masses of black fungal mycelium in the interior bulb. It is a very important disease in Delta region and causes a severe reduction in total yield for Navel orange orchards, also, Alternaria fruit rot is very affected in areas where citrus is processed for juice, because of juice contamination by fungal mycelium. Usually, the disease appears in oranges orchard especially in Navel orange orchards in Delta region (Figure 7), the fungus infection takes place throughout the citrus groves all over the world.



Figure 7: Field image for Alternaria Citri symptoms on orange in delta region 2018.

**Management:** control of this disease by using copper fungicide as a foliar application for the trees during fruit set and at once again 15 days interval reduces disease spread effectively, also, in infected orchards repeated treatment of copper fungicide twice time during May, all dropped fruit must be collected and remove out of the orchards regularly.

**Stubborn disease:** Stubborn is one of the mycoplasma diseases and considered a main disease of citrus in Mediterranean areas, the disease spread under the hot and dry climate conditions, the disease was caused by a unique mycoplasma-like organism *Spiroplasma citri*. The disease infected Washington Navel trees more than other



citrus variety (Figure 8), but infection may occur in Valencia, Sweet orange, and Grapefruit.



Figure 8: Field image for stubborn disease.

**Symptoms:** The disease may appear at any time during the life of the tree; however severity and symptoms differ from year to other, hot weather increase accentuated disease symptoms. Symptoms appear on vegetative growth and the new shoot growth display as witches'-brooms, later twig dieback, and new foliage had the symptoms like Zn or Mn deficiency. However fruit had "acorn-shaped" as a symptom of disease with peel thick at the stem end and thin at the stylar end; in seedy varieties, most of the seed aborted in the infected tree.

## Citrus Pests

There are various pests attacked citrus tree in Egypt, some of these pests cause serious damage and cause economic loss in the crop.

## Citrus Mites in Delta Region

Citrus trees are affected by a number of different types of mites, which are different in timing of the infection, as well as the symptoms of infection, but they caused different damage for the trees, these mites harm new flush, leaves, buds, and fruits through absorb the plant juice and causes yellow spots turn brown and dried spots.

There are three main kinds of citrus mite in Delta as follow

- Brown citrus rust mite (*Eutetranychus orientalis Kliem*)
- Citrus rust mite (*Phyllocoptruta oleivora*)
- Broad mite (*Polyphagotarsonemus latus*)

Also, there are other kinds of mites affected citrus tree but with little injury for the orange trees, like Citrus red mite

(*Panonychus citri*), and citrus bud mite (*Eriophyes sheldoni*).

## The main different mites infected citrus trees in Delta region including

### Brown citrus mite (*Eutetranychus orientalis Kliem*):

The infection on leaves Injury starts from March, April and the infection peak during July.

**Symptoms:** Start as yellow spots on the lower surface and extend on the upper surface, turn brown and dried and dropped later; the infected small fruits had yellow spots, in case of infected mature fruit symptoms are brown spots and reduce fruits marketability.

### Citrus rust mites (*Phyllocoptruta oleivora*)

Also, known as (Silver mite) live on both leaf surfaces and on fruit skin, it has been described as a serious citrus pest in Egypt and most of the humid tropical regions of the world, and has long been recognized as affecting citrus quality and yield, especially when conditions are optimum and populations explode. It is found in all the citrus-planting areas of the world approximately [25]. Under Delta region conditions infection start at May till August and decreasing till October, sometimes, due to heat weaves infection could start at January, it is infections are generally heavier on the outside shoots of the tree, and fruits infested fruit skin turns silvery and the rind of fruit becomes thicker than on healthy fruit.

**Control:** Dust or spray applications of sulphur could use as a preventive treatment. If infestations are heavy, a treatment with wet table sulfur can be used as a dust or foliar application, also, horticultural oil could use periodically every 15 days. Biological control could use predatory mite like ladybird beetles to keep the population of the mite in check.

### Broad mite (*Polyphagotarsonemus latus*)

This mite usually harms newest leaves and small fruit on the shaded side of the tree, the infection starts at May till September and damage terminal leaves and flower buds, to become malformed, leaves turn downward and turn coppery or purplish. Infested fruit is discolored by feeding and in severe cases, premature fruit drop may occur.

**Management:** Preferable use insecticidal oils or agricultural soaps it is usually effective and less toxic to the environment, also, biological control agents are available, including several species of predatory mites [26].



## Scale Insects

Many of scale insects are reported in the main citrus-producing region like red scale (*Aonidiella aurantii* Mask), Brown Soft Scale (*Coccus hesperidum*), Black parlatoria scale (*Parlatoria ziziphi*), yellow scale (*Aonidiella citrina* Coq.), black scale (*Saissetia oleae* Oliv.), and purple scale (*Lepidosaphesbeckii* Newm), which attack the leaves, new branches and fruits, causing the yellowing of the leaves and their fall, leading to drying of small branches and deforming the appearance of fruits, wherever, in Egypt, there is three main kind of scale spreading in citrus groves due to various reasons as follow

- Scale infecting new areas where there are no natural enemies.
- Use of nonselective pesticides to control other pests like fruit flies.
- Disturbance of biological control by climate change.
- Citrus trees are infected with several types of crustaceans.

### Brown soft scale (*Coccus hesperidum*)

Brown soft scale or circular scale is a common problem on citrus orchards in the main citrus produced region; it often infected leaves and new shoots in shady parts of the tree, after infection, there is some secretion from the scale feeding often acts as a growing source for sooty mold, infected leaves turn yellow and drop later. It could damage untreated orchards through complete defoliation of single trees [27], however, severe infestation of fruits discarding fruit marketability.

**Control:** Horticultural oil could be used as foliar application for effectively control; treatment should be start at early summer and must avoiding application during hot weather to reduce oil hazards on the tree.

### Red Scale (*Aonidiella aurantii*)

Red scale is one of the most dangerous insects on citrus around the Mediterranean basin; it causes damage to all organs of the tree including leaves, new shoots, and fruits. The beak of infection starts from June till August, therefore effectively control start from June till August.

**Control:** Horticultural oil could be used as a foliar application for effective control; treatment should start at early summer and must avoiding application during hot weather to reduce oil hazards on the tree.

**Biological control:** By nature enemies like *Aphytis melinus* deBach could be used as an alternative control in orchards, this method is now regularly used in citrus orchards as a part of integrated pest management system in numerous countries.

### Black parlatoria scale (*Parlatoria ziziphi*)

The species has been reported causing serious damage to citrus orchards in eastern Mediterranean region, black scale attacked leaves, new shoots, and fruits, in Egypt, *Parlatoria ziziphi* has become the most dangerous pest of citrus orchards, there is two peaks of insect activity per year in April and October, the seasonal variation in the population of *P. ziziphi* due to weathering conditions [28].

**Symptoms:** *P. ziziphi* infected the shoots, foliage, and fruit, the reduction of plant sap leads to decreased tree vigour, the new growth and fruit may be had yellow streaking and spotting. In severe infections cases, black scale covers all leaves and shoots as clearly visible and may result in the premature dropping of the leaves and fruit.

**Chemical Control:** Scale control is mainly based on mineral oil and pesticide sprays in the field as a foliar application, during spray solution must entire tree until it is dripping wet.

## Conclusion

Developing orange orchards in Delta region could be achieved through modified farm management processing, such as improving irrigation technique to delivering the probable water requirement at the optimal time to the trees, enhancing drainage system efficiency to increase the productivity of orange orchards under clay soil conditions, also, canopy management is very effective in increasing total yield and improving fruit quality; therefore, preferable tree pruning after harvesting directly and before new growth cycle to avoid improper effects on new yield, also, prevent weed competition during the critical period of fruit growth is very important to expand the productivity of orange trees. Therefore, improving tree vigor and performance lead to produce a high crop and better fruit quality.

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