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The use of the pesticide dimethoate and cyberkill in combating the fruit fly (*Ceratitis capitata*) on oranges (*Citrus* fruits)

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Abstract
The Study was conducted on 600 Trees of Three Types of Orange, in the Juddaim area, in the City of Zawiya. Chemical Control is the Common Method for Controlling Fruit Flies. The Chemical Pesticide Dimethoate was used as the primary pesticide, along with another pesticide, Cyperkill. The first Spraying process took place with the Chemical Pesticide Dimethoate on August 1, 2023, Coinciding With the achievement of an Orange Fruit size equal to 0.333 of the actual size at maturity, until November 15, 2023, with a spraying frequency every 15 days. It was also fumigated with another pesticide, Cyperkill, and there were two fumigations, the first fumigation was on 11/10/2023 and the Second on 12/1/2023. The ripening period of the Navel Oranges Was in December, while that of the Sweet and Tarocco Oranges was In January. In the last Stage, which is the Fruit harvesting stage, we see Minor infections by this parasite, especially in the Fruits of the Bush Orange, and to a lesser extent in the Tarocco, and the least in the Fruits of the Sweet Orange. The flowering period is early March. The ripening period of the Navel Oranges was in mid-December, while that of the Tarocco and Sweet Oranges was in January.

Keywords: Orange, fruit fly, control, dimethoate, cyperkill

Introduction
Citrus plants (*Citrus* spp. L.; family: Rutaceae) are large shrubs or small Trees 5 to 15 m high, whose thorny shoots and evergreen leaves are arranged alternately and have an entire border. The flowers are solitary or in small clusters, they often have a very strong smell. The fruit is a hesperidia, a specialized, spherical to oblong berry 4 to 30 cm long and 4 to 20 cm in diameter with a leathery husk or "shell" called the pericarp. The pericarp is the endocarp. The segments are also called "stones" and the space within each stone is a chamber filled with juice Sacs or "pulp". The genus is commercially important as many species are grown for their fruits, which are eaten fresh, pressed into juice, or preserved in jam. And cucumbers (Korlapati *et al*. 2014) [15].

Orange is one of the most important fruits in horticulture, providing both financial and nutritional benefits to farmers. Currently, the plant is grown in tropical and subtropical environments, with the United States, Brazil, Spain, Italy, India, South Africa and Egypt being the main producers. Common varieties include Valencia oranges, blood oranges and Washington navel oranges (Otieno, 2020) [22].

It is considered a fruit crop that is important in terms of area coverage, production potential and distribution. A family of *Citrus* fruits including important crops like lemon, orange, tangerine, grapefruit, grapefruit, lime, etc. The *Citrus* fruits represent about 37% of the total fruit production (Gautam, 2020) [9].

Sweet oranges [*Citrus* × sinensis (L.) Osbeck] are the most cultivated and consumed *Citrus* fruit in the world, both for juice processing and fresh fruit. Brazil, China, India, the United States, Mexico and Spain are the largest producers, representing 63.5% of global production of 78.7 million tons in 2019 (Girardi *et al*. 2021) [11].

Rich in vitamin C and other antioxidant ingredients, *Citrus* fruits have enormous potential and are distributed throughout the world. Because these are such large potential ranges, the emergence of various diseases and physiological defects has certainly affected their likely impact and potential. Aastha (Gautam, 2020) [10].

Citrus fruits are widely cultivated in tropical and subtropical African countries. While fresh fruit for the market is preferably grown in subtropical climates (e.g., South Africa) and Mediterranean climates (e.g., Tunisia, Egypt, Morocco, Libya), *Citrus* fruits for juice predominate in tropical climates due to their possible higher content of sugar. The main types of *Citrus* are the sweet oranges (*Citrus sinensis*), the limes (*C. aurantifolia*), the grapefruits (*C. paradisi*), the limes (*C. limon*) and the mandarins (*C. reticulata*), often of mandarins (Ssebunya and Kilcher, 2011) [29].

In Egypt, oranges are one of the most important crops for production, consumption and export. Orange production was about 4 million tons and consumption was about 2 million tons in 2021, while exports were about 1.8 million tons, representing about 82% of the total fruit exports of about 2.2 million tons in the same year (Yones *et al*. 2023) [31].

Spanish *Citrus* cultivation occupies an important place in the world, not only because of its production, but also because it occupies the first place among exporting countries of fruit for fresh consumption, maintaining this world leadership for oranges, tangerines and lemons, with an average of 33%, 55%. Or 28% in the period 1994-2013 (Alcon *et al*., 2019) [2].

In Pakistan, *Citrus* fruits rank first in terms of area and production. It is a high-value crop valued at US$10 billion in Florida and has economic importance in several other regions of the world. Tangerines, oranges, grapefruit, lemons and limes are grown and exported from Pakistan (Arshad *et al*. 2020) [4].

Numerous types of insect pests have a negative impact on fruit and vegetable production in Africa, and fruit flies are among the most economically-important. Females puncture and lay eggs in fruit and vegetables, and inflict direct damage due to feeding of the larvae. The economic impact includes direct yield losses, increased production costs due to suppression actions, and the use of insecticides which can negatively impact on the environment. Fruit flies are also a limiting factor in international trade of fresh agricultural commodities (Grove *et al*. 2019) [12].

Worldwide, control of fruit flies is a challenging problem. They are serious pests of many fruit crops around the world and are commonly considered the cause of significant production losses. They directly harm the fruits, as their larvae feed on them. Due to quarantine requirements, implemented by importing nations, they can occasionally also hinder access to lucrative international markets (Yones *et al*. 2023) [31].

The Mediterranean fruit fly is a harmful fruit pest because it has a broader host range and is better able to withstand colder climates than most other fruit fly species. -Tropical fruits. It has a short life cycle and a large population. The most dangerous Tephritidae species is *Bactrocera zonata* (Saunders), the peach fly. It is a polyphagous species that attacks host plants and more than 40 types of fruit in the wild (Slim *et al*. 2023) [28].

Fruit flies are indisputable as the most destructive insect pests of fruits and vegetables worldwide. A family of Diptera Tephritidae includes more than 4,000 species and about 700 species capable of feeding on the moss of the fruit Dacinae, which is a moss of the fruit of the peach (PFF), *B. zonata* (Tephritidae: Dacini), originated- if in South and Southeast Asia (El-Gendy and Nassar. 2014) [14].

Fruit flies from the family Tephritidae represent one of the most economically important groups of insect pests, threatening a multimillion-dollar fruit production industry in Mediterranean countries. In addition, there are important invasive species such as the (African) peach fruit fly, *Bactrocera zonata* and others, which have spread in recent years both in some countries in the region and in neighboring countries, expanding the list of Tephritid pests alongside the "native" ones. Mediterranean fruit fly also the European cherry fly and the olive fly.

Tephritid fruit flies cause devastating direct losses to many fresh fruits and vegetables. In addition, few insects have a greater impact on international marketing and world trade in agricultural produce than Tephritid fruit flies. With expanding international trade, fruit flies as major quarantine pests of fruits and vegetables have taken on added importance, triggering the implementation of area-wide national or regional (transboundary) control programmes (Malavasi *et al*. 2003) [18].

The Mediterranean fly is considered one of the most devastating insect pests in the world. They lay their eggs in fruits and vegetables and, after hatching, the larvae feed on the pulp. Keeping orchards and gardens free is a prerequisite for exports to many countries. If there is a Mediterranean fly outbreak, this could lead to strict quarantine restrictions on the fruit and vegetable trade, with huge socio-economic consequences for the exporting country. Conventional alternatives, such as some post-harvest treatments of crops, are expensive and often harm their quality, damaging the competitiveness of export products (Food and Agriculture Organization. 2022) [8]. (Although it can also be externally in the seed coat or even in the soil) for three to 43 days. Under optimal conditions, one or two days after emergence, the adult reaches sexual maturity (Mateus *et al*. 2016) [21].

The pest spreads over long distances essentially through the transport of infested fruits. Infestations by fruit flies have caused damage to many fruit crops and imposed limits on the export market. Quarantine regulations imposed by an importing country may deny a producing country a potential export market or force the producer to carry out expensive fruit fly disinfestation treatment (Raga and Sato. 2006) [24].

Controlling fruit flies is a challenging problem worldwide. They are serious pests of many fruit crops around the world and are widely considered to be the cause of significant production losses. They damage the fruits directly because their larvae feed on them. Quarantine requirements imposed by importing countries can also occasionally hinder access to lucrative international markets. It can infect around 300 plant species. Therefore, it was strongly recommended to be classified as one of the world's most destructive pests. It can result in losses of around two billion US dollars (USD) annually (Yones *et al*. 2023) [31].

Fruit flies have become an increasingly prevalent insect in most African countries causing major losses on both domestic and export fruit consumptions. *Bactrocera invadens* was first reported in 2003 in east Africa in Kenya. Since 2003, the species has been rapidly spreading across tropical Africa and is now reported in Benin, Democratic Republic of Congo, Ghana, Uganda, Mail, Nigeria, Sudan, Tunisia, Togo, Guinea, and Equatorial Guinea and Comoros Island and is causing severe damage in Kenya (Asmare and Hassen. 2018) [6].

The Mediterranean fruit fly, *Ceratitis capitata*, is a well-known fruit pest. It can infect around 300 types of plant species. Thus, it was strongly recommended to be classified as one of the global destructive pests. It can cause losses of around two billion US dollars (USD) annually (Yones *et al*. 2023) [31].

There are about 4,000 species (including subspecies) in 483 known genera worldwide. There are several types of fruit flies found around the world. Phytalmine fruit flies, belonging to the subfamily Phytalminae; Dacine fruit flies (Subfamily Dacinae) including Bactrocera and Dacus; Ceratidina Fruit Flies (Subfamily Ceratitidinae); Tripetine fruit flies (Subfamily Typetinae) and Tephritina fruit flies (Subfamily Tephritinae), also known by the largest number of species.

The Mediterranean fruit fly (medfly), *Ceratitis capitata* is one of the most destructive pests of fresh fruit and vegetables worldwide. Females lay eggs in ripe or maturing fruits and the larvae feed by destroying the fruit's mesocarp (pulp, pulp). Saprophytic bacteria and fungi intensify the direct damage caused by larval activity. Fruit and vegetable losses at local level can reach high proportions, resulting in devastating economic damage for farmers. However, the economic importance of the Mediterranean fly is magnified at a regional and global level, as it is considered an important quarantine pest for many tropical and temperate countries, and specific and strict regulations restrict the trade of fresh fruits and vegetables between regions and continents, as well as between countries and counties.

The direct damage caused by *D. suzukii* is caused by the laying of eggs by females that pierce the surface of the fruit and by the larvae that feed on the inside. The fruits may collapse a few days after lying. In addition, there is indirect damage caused by the opportunistic attack of microorganisms such as fungi (e.g. Botrytis cinerea) and bacteria that penetrate the fruit through the laying holes, are spread there by the larvae and cause rot. The economic impact on production can vary between 30% and 100% depending on the crop and region. When taking losses into account, it is also necessary to take into account the intensive use of insecticides, which increases production costs, affects compliance with the waiting period and increases the risk of fruit rejection due to the presence of residues (Mateus *et al*. 2016) [21].

The life cycle of *D. suzukii* includes several stages: egg, three larval stages, pupa and adult. Each female produces an average of 200 to 500 eggs over her lifetime, depending on several factors, mainly the host and temperature. Each female can lay more than one egg per fruit, accommodating eggs from different females. One to three days after being laid, the egg hatches and the larva remains inside, feeding and developing for three to 13 days. The pupa generally remains inside the fruit (although it can also be located outside in the seed coat or even in the soil) for three to 43 days. Under optimal conditions, the adult reaches sexual maturity one to two days after hatching. This shows that the time between lying and emergence of the adult can be very short: 8 to 10 days at 25 °C and 21 to 25 days at 15 °C (Mateus *et al*. 2016) [21].

Drosophila are typical holometabolous insects: They begin their life as worm-like larvae, go through three larval stages before undergoing complete metamorphosis as a pupa and finally hatching into their adult form. Adult flies, like all arthropods, are rigid Exoskeleton and therefore cannot grow. Consequently, adult body size is entirely regulated by growth during the premetamorphic larval stages (Shingleton. 2010) [27].

The life cycle of *D. suzukii* comprises several stages: egg, three larval instars, pupa and adult. Each female produces, on average, 200 to 500 eggs over the course of her life, depending on several factors, mainly the host and temperature. Each female can lay more than one egg per fruit, which can accommodate eggs from different females. One to three days after laying, the egg hatches and the larva remains inside, feeds and develops for three to 13 days. The pupa generally remains inside the fruits (Mateus *et al*. 2016) [21].

Factors that have contributed to the pest status of this species include: high fecundity and rapid life cycle (high number of generations per year) which promote explosive population growth; the wide range of hosts, cultivated and spontaneous, which promote re-infestation; the high thermal tolerance, which expands its geographic distribution; the insertion of eggs inside the fruits, which hides the first phase of the infestation, facilitating the passive dispersal of the species (Mateus *et al*. 2016) [21].

The life cycle of this pest is between 21 and 30 days and can be described in four consecutive stages that consist of (1) penetration of the female fly bite into the fruit and laying of eggs inside, (2) conversion of eggs into larvae that hatch feed on the fruit, resulting in gradual deterioration due to the penetration of fungi and bacteria through the tunnel created in the fruit, (3) exit of the larvae from the fruit to pupa and its fall to the ground and (4) passage of the maturation stage in the soil and exit from the soil; beginning to mate after five days. Successive generations of flies are born after several months due to host availability. Common methods to control this pest around the world are the use of insecticides, spraying protein baits, capture in a contaminated environment and sterilization of male insects.

Detecting and predicting Mediterranean fruit fly infestation in oranges requires an expert, especially in the early stages of infection. Otherwise, the fruits must be transferred to a laboratory for investigation, which is time-consuming. During the period of investigation, fruit damage will increase, today remote sensing technology solves this problem by introducing fast, simple, on-site and non-destructive methods to determine and predict infected oranges in the field (Yones *et al*. 2023) [31].

Organophosphate pesticides and pyrethroid insecticides are widely used in agriculture and public health. Diazinon (DZN) and dimethoate (DIM) are the two representatives of organophosphate pesticides, two commonly used organophosphate pesticides, exhibit neurotoxic effects by inhibiting cholinesterase. The acute toxicity of these pesticides is well documented. The liver and kidneys, organs responsible for metabolism, are common targets of pesticide toxicity (Liang *et al*. 2024) [16].

Dimethoate is a systemic organophosphate insecticide that is used on a wide variety of agricultural, tree and ornamental crops. It was first registered in the United States in 1962. Dimethoate is classified as a general-purpose pesticide and is applied using ground and aerial equipment. About 1.8 million pounds of active ingredient are used annually, with the largest use occurring in alfalfa. Use in four major crops (alfalfa, wheat, cotton and corn) accounts for more than 64% of total Dimethoate use (Mallampalli *et al*. 2008) [19].

Dimethoate (Rogor) is one of the earliest insecticides widely used against vegetables and fruit sucking aphids, mites, saw flies and boring insects on cereals, cotton, chilli, and tobacco and oil seeds (Bharti *et al*. 2023) [7].

The main mechanism of dimethoate toxicity in animals and humans is the inhibition of acetylcholinestrase (ChE), an enzyme that hydrolyzes the neurotransmitter acetylcholine. Inhibition of ChE leads to the accumulation of acetylcholine and the over activation of its receptors at the neuromuscular

junction and in the autonomic and central nervous systems. Hypotension is a common complication of acute organophosphate poisoning that can result in shock and death within 12 to 48 hours of ingestion (Arubi and Oloche, 2023) [5].

Pyrethroids these are non-systemic insecticides that act by altering the nervous system and causing hyperactivity, paralysis and death. Pyrethroids are among the most widely used pesticides worldwide. Cyberkill 25 EC contains 250 g/l of cybermethrin. Cypermethrin is used to control pests, including moths, in cotton, fruit and vegetable crops.

Dimethoate is a broad-spectrum organophosphate insecticide and acaridae, with contact and systemic effects; available as emulsifiable concentrate, wettable powders, granules and ultra-low volume concentrated formulations. It is quickly absorbed through the intestine and skin and quickly excreted without accumulating in adipose tissue. Its dissipation and total residue in celery in the oven corresponded to a first-order kinetic equation with a half-life of 2.42 days. Dimethoate is very stable in acidic solution, but decomposes rapidly in alkaline Ph. (Arubi and Oloche, 2023) [5].

Like other organophosphates, Dimethoate is an acetyl cholinesterase inhibitor which disables cholinesterase, an enzyme essential for central nervous system function. Dimethoate insecticide can be used for both indoor and outdoor purposes to eliminate a number of insect pests under different condition (Bharti, *et al*. 2023) [26].

Cyperkill 25 EC contains 250 g/l cypermethrin. It is a pyrethroid Classified as type II, which is also like type I. Cypermethrin blocks nerve Channels in addition to the depolarization phase and gamma amino acid Receptors also influence chloride and calcium channels in the filaments Of the nerves. Cypermethrin is used to control pests, including moths, in Cotton, fruit and vegetable crops (Lidova *et al*. 2019) [17].

The FAO and IAEA helped the country design a new mass breeding facility capable of producing one billion sterile flies per week. Opened in 2021, this facility is the second largest in the world. To date, 1.2 billion sterile male flies produced at the facility have been released into Colima outbreak areas. The FAO/IAEA-led panel recommended continuing the release of sterile flies until June 2022 to eradicate any remaining pest nest populations (Food and Agriculture Organization. 2022) [8].

One species of *Drosophila* in particular *D. melanogaster*, has been heavily used in research in genetics and is a common model organism in developmental biology. The entire genus, however, contains about 1,500 species and is very diverse in appearance, behavior, and breeding habitat (Parvathi *et al*. 2009) [23].

Libya enjoys a geographical location that is predominantly moderate in the northern and mountainous regions. Therefore, these areas are suitable and suitable for growing many types of *Citrus* fruits (Oranges, Tangerines, and Lemons). Accordingly, the cultivated areas of *Citrus* fruits in Libya developed during the period (1970-2007) from about 3 thousand hectares in 1970 to about more than three times in 2007. As for the quantities produced of oranges alone, they increased from about 17 thousand tons in 1970 to about 88 thousand tons in 2007.

Al-Zawiya area is located to the west of Tripoli, at a distance of 45 km. This region is considered one of the important agricultural areas, as it has a variety of fruit crops, including olives (433,232), palms (118,035), almonds (6,754), *Citrus* fruits (23,670), grapes (23,670), figs (12,743), and the rest (2,392) trees.

Importance

Citrus is a universal fruit, as many citizens depend on cultivating various types in order to obtain the fruits, which are delicious fruits rich in important elements. Its fallen flowers are used to make natural orange blossom water. Dry branches and twigs are used in the production of charcoal, which is considered one of the best types of charcoal and the highest price than other types (olive charcoal, Sarwal charcoal). *Citrus* trees, like all other trees, are exposed to many diseases and pests, including insect pests, most notably the fruit fly. The female lays her eggs on the fruits, hatches the eggs, and the larvae emerge to feed on the inside of the orange. Places where eggs are laid cause many microbial diseases. Infestation by fruit fly larvae renders the fruit inedible and renders the fruit unusable for export. Many orange-producing countries depend very heavily on the export of oranges. The worldwide fruit fly causes millions of dollars in losses annually. The cost of controlling it is very high, and preventing the infection requires follow-up and periodic examination by specialists, and this increases the cost.

Research Aims

This research aims to achieve several goals, including

1. The extent of the fruit fly and its danger to *Citrus* fruits.
2. Knowledge of the mechanisms and methods used to combat this pest.
3. Methods of using the chemical pesticide Dimethoate to combat this pest on *Citrus* fruits.
4. The role and effect of the chemical pesticide Dimethoate in pest control.
5. Knowledge of modern, scientific methods that are safe for the environment and humans in combating this scourge.

Materials and research methods

The study area is located in the Judadam area in the city of Zawiya. The city of Zawiya is located west of Tripoli, about 45 kilometers away from it. The number of orange trees studied is 600 (200 Navel Oranges, 200 Sweet Oranges, and 200 Tarocco Oranges). The distance between trees is5 meters. The chemical pesticide Dimetoate (Spanish production) has a volume of 1 liter. During use, shake the container well, pour it into 800 milliliters of water, and then mix well. Cyperkill Chemical pesticide, size 1000 ml (Spanish production). Pour 500 ml of Cyperkill chemical pesticide into 500 liters of water and mix well. Agricultural tractor with spray machine. This research was conducted in collaboration with the owner of this farm.

Results and discussion

To combat this pest, chemical control was used. Using the chemical pesticide Demetoate (Spanish industry) and Cyperkill (Spanish industry). The results and discussion were recorded in several points, namely.

1. The first spraying process was with the chemical pesticide dimetoate on August 1, 2023, coinciding with the arrival of the orange fruit, to a size of 0.333 of the actual size of maturity, with a dark green color. At this size, the orange is vulnerable to fruit fly infestation. During periodic inspection, we find that the oranges are free from infection with this pest.

2. The second spraying process was with the chemical pesticide Dimetoate on August 15, 2023. After the spraying process, we inspect the oranges to confirm the presence of infection with this pest. We find that oranges are free from infection with this pest.
3. The third spraying process was with the chemical pesticide Dimetoate, which was on September 1, 2023. After the spraying process, we inspect the oranges to confirm the infection with this pest. We find that oranges are free from infection with this pest.
4. The fourth spraying process was with the chemical pesticide Dimetoate, which was on September 15, 2023. After the spraying process, we inspect the oranges to confirm the infection with this pest. We find that oranges are free from infection with this pest.
5. The fifth spraying operation with the chemical pesticide Dimetoate was on October 1, 2023. After the spraying operation, we inspect the oranges to confirm the infection with this pest. We find that oranges are free from infection with this pest.
6. The sixth spraying with the chemical pesticide Dimetoate was on October 15, 2023. After the spraying, we inspect the oranges to confirm infection with this pest. We find that oranges are free from infection with this pest.
7. The seventh spraying operation with the chemical pesticide Dimetoate was on 1/11/2023. After the spraying operation, we inspect the oranges to confirm the infection with this pest. We find that oranges are free from infection with this pest.
8. The eighth and final spraying operation with the chemical pesticide Dimetoate was on 15/11/2023. After the spraying operation, we inspect the oranges to confirm infection with this pest. The oranges were examined and found to be free of infection with this pest. For the success of the control process, this pesticide was used every 15 days until the orange ripening period, in order to eliminate any new infestation of this pest.
9. The first spraying with the chemical pesticide Cyperkill was on 10/11/2023, meaning that the spraying was between the seventh and eighth spraying of the chemical pesticide dimettoate, and the second and last spraying of this pesticide was on 12/1/2023. Then this pesticide was used as another pesticide and an aid. The first pesticide helps eliminate any pest that may have gained resistance to the first pesticide (dimetoate.)
10. Navel oranges ripened in December, and Sweet and Tarocco oranges ripened in January. During the harvesting and harvesting process and after stopping spraying for a period of time, we see some minor infections with this pest, and we find that the most of them were in Navel oranges, followed by Tarocco oranges, and the least of them were in Sweet oranges. The majority of the infestations were in Navel oranges, and the reason could be due to the ripening period, as the ripening period of Navel oranges fruits is before the ripening period of other types, or it could be due to the preference of this pest over Navel oranges. Despite periodic control, we find some infections, and this may also be due to several biological factors of the pest, including the overlapping of generations, the short life cycle, especially in good conditions, and also to its high ability to spread from one area to another because they are flying insects, and the female also lays hundreds of insects. Eggs during their lifespan.
11. 600 orange trees consumed 12 cans of Demetoate, 1 liter in size, the price of which is 20 US dollars, and one can of Cyperkill, 1 liter in size, which costs 20 US dollars. The cost of the pesticide alone for the entire period of combating this pest is estimated at approximately 260 US dollars.
12. The use of chemical pesticides has harmful effects on the environment as well as on human health. There are several other successful and safe methods in combating pests, including biological control used to combat fruit flies. These methods were used in several countries and were effective and safe for the environment, such as the method of raising and producing sterile males resulting from radiation treatment, and releasing them in numbers greater than the number of natural males to ensure that the females are fertilized with those sterile males to produce unfertilized eggs that do not produce larvae, which are the source of infection, and in this way we guarantee the production and obtaining of Oranges free of this pest.
13. Biological control is expensive and requires great capabilities, whether in establishing an integrated factory in fly rearing and producing sterile males or purchasing sterile males directly from manufacturers. Therefore, this type of control requires state intervention. There are also other methods of biological control using pheromones or toxic baits, which are successful in combating this pest, but they require specialized experts as well as intensive efforts.
14. The price of a kilogram of Navel oranges from the farm (wholesale price) is within the range of 0.33 US dollars, and the price of a kilogram of Sweet or Tarocco oranges is within the range of 0.25 US dollars (production of the year 2024 season). Dry orange tree branches can be used to produce high-quality charcoal. Fallen flowers are used to produce natural rose water.

Conclusion

1. The flowering period was at the beginning of March.
2. The fruit set formation period is in mid-March.
3. The orange reaches one-third of its normal size (maturity) at the beginning of August.
4. The ripening period of Navel oranges was in mid-December.
5. The ripening period for both Tarocco and Sweet orange was in January.
6. Chemical control is the method used to control fruit flies.

Recommendations

1. Holding seminars and workshops to introduce this dangerous pest and the modern and scientific methods used to combat it.
2. Support and encourage the farmer by providing good varieties of oranges.
3. Supporting locally produced oranges through marketing, storage, and stopping the import of imported oranges, especially during harvest seasons.
4. Apply agricultural quarantine to infested areas, whether infested with this pest or other pests that cause significant damage.
5. Conducting studies and research in orange growing areas and documenting pests and diseases that affect oranges.
6. The competent authorities must educate farmers about preventing the indiscriminate use of pesticides.

7. Urging farmers to prevent the use of pesticides of unknown origin and origin in order to preserve the environment and public health.
8. Beekeepers must be informed of the timing of the spraying, and to move their hives to places far from the spraying area so that the bees are not poisoned.
9. Keep animals away from spraying areas.

Table 1: Shows the date and Number of Times Spraying with the chemical pesticide Dimethoate

S. N.	Date of spraying	Number of spraying times
1.	First	1.8.2023
2.	Second	15.8.2023
3.	Third	1.9.2023
4.	Fourth	15.9.2023
5.	Fifth	1.10.2023
6.	Six	15.10.2023
7.	Seven	1.11.2023
8.	Nine	15.11.2023

Table 2: Shows the date and times of spraying with the chemical pesticide Cyperkill

S. N.	Date of spraying	Number of spraying times
1.	First	1.12.2023
2.	Second	15.12.2023

Fig 1: Fruit fly (*Ceratitis capitata*) (Allen. 2024)

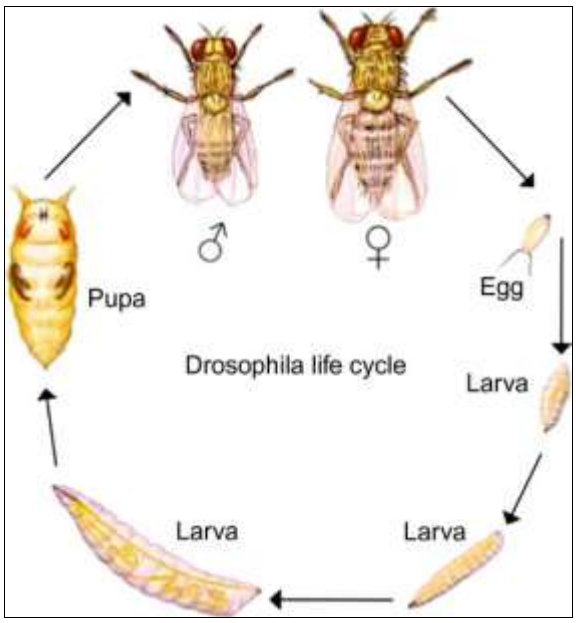

Fig 2: The life cycle of the fruit fly (*Ceratitis capitata*) Adapted from Wangler, Michael & Bellen, Hugo. (2017)

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