

First part: Acarology

Workplan

Introduction: what is a mite?

Chapter 1: ~~Dust~~ mites

1. Phytophagous mites: Eriophyidae, Tetranychidae, Tenuipalpidae and Tarsonemidae

1.1. Tetranychidae family

1.1. Morphological characteristics

1.2. Biological characteristics

1.3. Feed

1.2. Family Tarsonemidae

1.2.1. Morphological characteristics

1.2.2. Biological characteristics

1.2.3. Feed

1.3. Family Eriophyidae

1.3.1. Morphological characteristics

1.3.2. Biological characteristics

1.3.3. Feed

1.4. Family Tenuipalpidae

1.4.1. Morphological characteristics

1.4.2. Biological characteristics

1.4.3. Feed

What is a mite?

Systematic position

- Phylum: Arthropoda
- S/ Emb: Chelicerata
- Class: Arachnid
- Order: Acarida

General

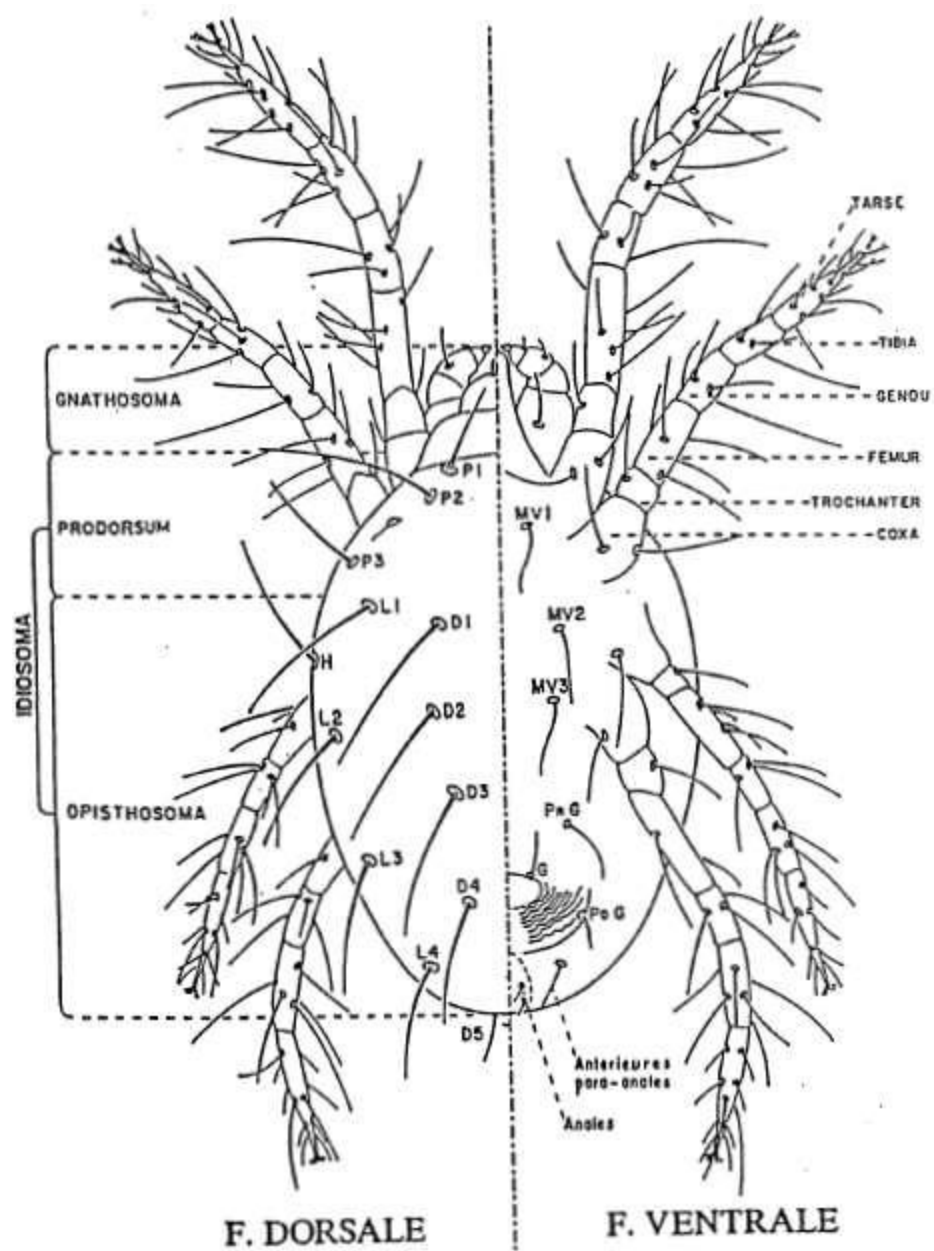
- Have colonized all terrestrial and aquatic environments
- Some are free, others parasites of man, animals, insects and plants
- Free-living mites: soil, organic matter, air, predators of other mites or insects
- Parasitic mite: hematophagous or phytophagous
- Size rarely exceeding mm

Morphology

Difference morphological between mites, spiders and insects

Characters	Mites	Spiders	Insects
Tags (division of body)	gnathosomal Idiosome (posterior part of body)	Cephalothorax + opisthosoma	Head+Thorax+Abdomen
Number of legs	Larvae: 3 pairs, post instars larvae 4 pairs	4 pairs	3 pairs
segmentation of paw	Coxa, trochanter, femur, knee, tibia and tarsus	Coxa, trochanter, femur, knee, tibia and tarsus	Coxa, trochanter, femur, tibia and tarsus
Eyes	Eyespots	Compound eyes	Eyespots
Antennas	Absent	Absent	present

wings	Absent	Absent	present
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1. Phytophagous mites

Tetranychidae, Eriophyidae, Tarsonemidae, Tenuipalpidae

1.1. Family of Tetranychidae

1.1.1. Morphological characteristics

- Oval, yellow, green, red or brownish females
- Males smaller and usually more pointed ~~towards rear~~ than females
- Gnathosoma includes: sensory palps + chelicerae
- Idiosoma has 4 pairs of legs
- Special organs on the dorsal side: eyes, ~~bristles~~ sensory and other hairs
- On the ventral side, there may be groups of hairs + genital and anal organ

1.1.2. Biological characteristics

- 3 active larval stages (Fig. 2) which alternate with 3 resting stages (Fig.2)
- Oviparous; very small eggs (0.02mm 0.03mm), spherical, transparent when fresh, pink or red after a few days
- The egg hatches and gives ~~birth to~~ a hexapod larva ~~called 1-st~~ stage, which rapidly molts into larvae octopod, called protonymph
- The hexapod larva feeds actively then enters a ~~1-er~~ resting phase (R1) or protochrysalis. The next active stage is the protonymph (P), then it is a 2nd phase of rest (R2) or deutochrysalis, followed by the last larval stage or deutonymph (D), which differs from the protonymph in size. It's finally the 3rd resting stage (R3) or teliochrysalis to which the adult follows
- ~~Spider mites~~ evolve very quickly under the conditions optimal (Greenhouses or tropical regions)
- The complete development of an individual can take place in 15 days

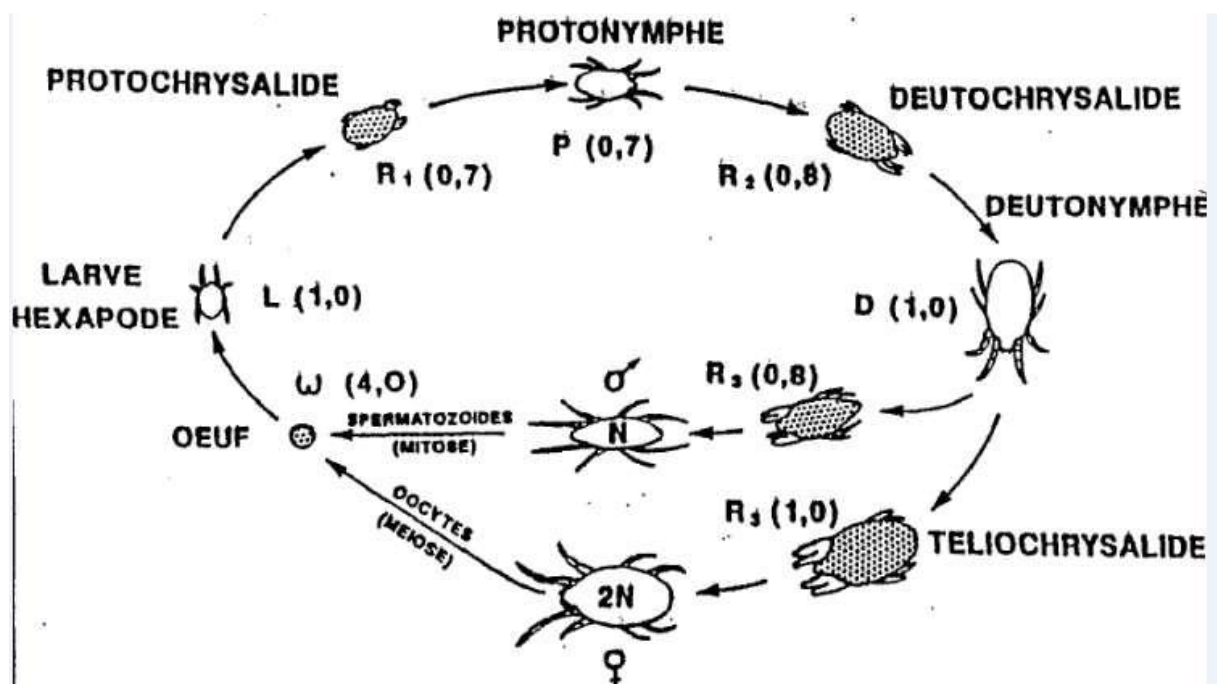


Figure 2. Development cycle of spider

- Spider mites reproduce by parthenogenesis arrhenotokic
- Females can produce males (rarely females) without prior fertilization
- Therefore, 1 single unmated female can establish 1 new population by producing males and then mating with his sons to produce females
- In most mites in temperate countries, the majority of species go into diapause during the season winter
- The winter is passed as eggs, or as a female, orange yellow in color
- Diapause affects all stages of development
- It can take place in winter if the temperature is too low (wintering), and even in summer if there is excess heat (aestivation)

1.1.3. Feed

- Very polyphagous on different cultivated plants (culture market gardening, fruit trees, ornamental plants)
- The causes of the proliferation of spider mites may be due to biological imbalances caused by
 - insecticide treatments
 - appearance of strains resistant to insecticide products and acaricides
 - destruction of natural enemies by the effect of pulverized substances
 - large number of individuals per generation
 - short life cycle + high number of generations per year
- Spider mites have been considered for several years as pests of economic importance in several crops
- Their stings cause discoloration spots on the leaves. (speckling), which can lead to leaf dryness
- If the attack is important, they cause an alteration of the tissue leaf of affected plants by absorbing the contents of the cells of the parenchyma

- The mechanical attack of the epidermis and the cells of the parenchyma causes significant water loss
- The chloroplasts of the cells are destroyed and there is a reduction in the intensity of photosynthesis
- Metabolic disturbances lead to reduction in growth, flowering and production
- When infestations are not checked by regulating factors such as climate or predators, the whole plant can dry out quickly prematurely
- The main phytophagous mites that belong to the Tetranychidae family in Algeria are: *Tetranychus urticae* (Koch), *Panonychus ulmi* (Koch), *Panonychus citri* and *Oligonychus afrasiaticus* (Mcgregor)

Tetranychus urticae

- Also called weaver mite, A. yellow or A. at 2 pts
- Presents 1 yellow coloration but can also sometimes be red
- It is the feared pest of many greenhouse and outdoor crops.
field
- It is 1 cosmopolitan species, very polyphagous, encountered in more than 1000
plant species
- Capable of weaving webs that can completely cover plants
- These canvases
 - facilitate their movement
 - offers them protection against predators and bad weather
 - can even create a barrier against acaricides
- globular body of obovate shape, convex more widened at the front, measuring
about 0.5 mm Fig. 3
- has a median dorso band and provided with fairly long light hairs
- Greenish yellow female with two lateral dorso spots
- Slightly + small males with a pointed abdomen at the base



Figure 3. *T. urticae* (adult and egg)

- Can develop at the rate of 1 generation/10 d, if the temperature exceeds 30C
- In unfavorable climatic conditions, many females go into diapause
- A sucking, biting type pest that damages plants by feeding on the cellular contents of the leaves using a stylet
- Adults and larvae live on the underside of leaves and insinuate their rostrum in the tissues of the epidermis and underlying cells lacunae tissue to suck nutrients out of it
- The absorption of food by the stylets leads to discolorations leaves by whitish or yellowish punctuation then by patches whole, thus considerably limiting photosynthesis
- When spider mites are numerous, the leaves dry up and end up falling
- At high density, they weave webs (Fig. 4) which can be responsible for indirect yield losses when they cover the fruits, reducing their quality and accessibility for pickers
- In addition, some spider mite species are responsible for the virus transmission to the host plant. Which can lead to additional yield losses



Figure 4 . *T. urticae* damage; A: on tomato leaves; B: on sheets of zucchini

Panonychus ulmi

- Also called red mite
- It is the most common sp on trees and the one that causes the most damage
- It is a serious enemy, especially of many fruit trees and reigns in many countries of the world
- Major pest for several decades
- Its ability to quickly acquire resistance to products used to combat it has made crop protection difficult against this pest
- Dark red female, with a globose body of about 0.5mm, with a strongly rounded back adorned with bristles from a tubercle
- Male, much smaller, fusiform, orange with spots blackish and inconspicuous protuberances (Fig. 5)
- Brick red winter egg, + small, is pigmented



Figure 5 . *P. ulmi*; A: egg, B: Adult

- Overwinters / forms eggs deposited near the buds, at the level of the wrinkles, mainly on 2-year-old branches
- Development to adult takes about 20 days in spring and 8 days in summer
- Males live 10 days, females 12-18 days
- Duration of the evolutionary cycle is closely dependent on the conditions climatic (optimum of 20 to 25C with very high humidity)
- The 1 st adults meet in early May followed by 5 8 overlapping generations
- All mobile forms sting the cells on the underside of the leaves and empty them
- It mainly damages fruit trees, especially on the Apple tree (Fig. 6), pear tree, plum tree and quince tree
- Mainly observed on the underside of leaves where it feeds on the cellular content
- Its pullulation gives the leaves a bronzed appearance which decreases the efficiency of photosynthesis and can cause them to drop
- Leaf damage has 1 impact on fruit filling and leads to 1 reduction in caliber when its presence is prolonged in end of season



Figure 6. *P. ulmi* damage on apple tree

Panonychus citri

- Eggs, red, rounded, diameter: 0.13 0.15 mm
- Laid singly on the leaves (on the upper surface and preferentially along the midrib, twigs or fruits (Fig. 7
- Adults, purple-red, have a body surface velvety in appearance and have long bristles whitish, yellowish legs
- Female: 0.5mm and Male 0.3mm; the latter has a body more slender than that of the female



figure7 . Eggs and Adult of *P. citri*

- Adult females lay an average of 2 4 eggs per day for 3 - 4 weeks
- Eggs hatch after about a week
- larval development: 3 stages each punctuated by a stage
motionless (white in color
- development time from egg to adult varies depending on the
temperature and humidity and is on average 10 days at 26 C and
70% RH
- There can be up to 16 generations / year
- host plants: 3 types: primary host Citrus sp), secondary host
Malus pumila) and wild hosts (deciduous trees and shrubs
- feeds preferentially on the upper surface of young leaves
rather than on green stems or fruits
- Leaves dotted with silver-gray or yellowish spots (Fig. 8
- fruits show the same kind of symptoms that give them a
pale appearance
- damage caused represented by the fall of the leaves with all
the physiological consequences that this entails: drop in activity
photosynthetic, death of twigs, poor quality and fall of
fruits



Figure 8. Citrus leaf bronzing symptom caused by *P. citri*

Oligonychus afrasiaticus

- Also called yellow mite of the date palm better known by its local name of “Boufaroua”
- 0.2 0.3 mm, pale yellow oval body
- has a small number of long, spaced hairs on the body
- Male smaller and more elongated than female
- Spherical-shaped egg, 0.1 mm in diameter, pink, red or YELLOW
- overwinters in different stages on the date palm itself or on certain host plants, in particular weeds as well as Cucurbitaceae and Solanaceae
- In the spring, its activity increases rapidly and from of the month of May, it becomes very important coinciding with the appearance of bunches that bear dates in formation
- In Algeria, the strongest pullulations are observed between May and July and this in relation to the climatic conditions particularly high that promote the development and multiplication of mites in dates.

- Attacks can occur from fruit set and continue throughout the fruit enlargement stage
 - feeds by sucking sap from plant tissue
- dates
- attacks start from the peduncle, then gain all the fruit
 - Following numerous bites, the skin of green fruits is quickly destroyed
 - These become rough and then take on a tint reddish pigmented
 - heavily attacked fruits will be unsuitable for consumption
 - presence of mites on dates revealed by the existence silky webs (Fig. 9) white or greyish



Figure 9 . Damage of *O. afrasiaticus* on the date palm

1.2. Family of Tarsonemidae

1.2.1. Morphological characteristics

- small mites
- elliptical shape
- Yellow female, oval and elongated shape
- 0.2mm
- Male + stocky, with long legs whose 4th is terminated by a tuber instead with a claw
- adults barely visible, actively moving

2.2. Biological characteristics

- eggs laid singly in depressions of the leaf and hatch after 3 4 d
- stage of development (Fig. 10) only includes only the egg, the larva and the pupa which precedes the adult
- The larval stage lasts 2 days and the pupal stage from 1 to 2 days
- can exist one generation/ week

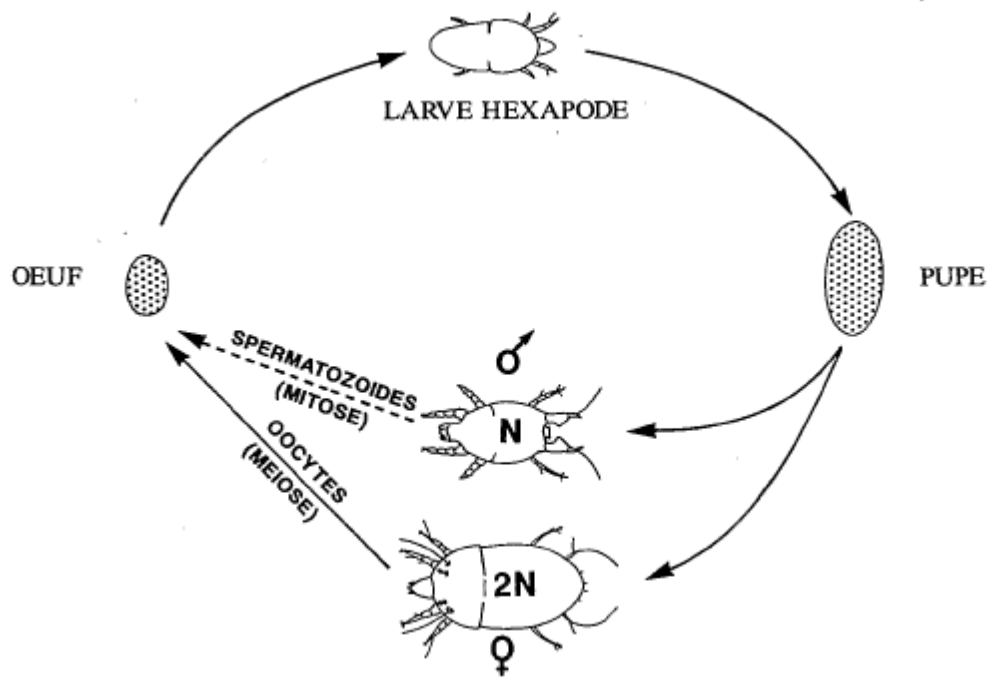


Figure 10. Development cycle of Tarsonemidae

2.3. Feed

- Damage translates to 1 browning and 1 necrosis of the lower part of the leaf which gradually creases
- young twigs and older leaves can be simultaneously attacked
- Sp of economic importance: *Tarsonemus pallidus* and *polyphagotarsonemus latus*

Tarsonemus pallidus

- also called Common Tarsonemus
- It is almost cosmopolitan and largely widespread in Europe
- important pest of ornamental plants grown in greenhouses such as Aralia, Begonia, Cyclamen, Gloxinia, Impatiens, Ivy
- Under favorable conditions, it survives the winter on outdoor plants

Polyphagotarsonemus latus

- also known as Tarsonema of the greenhouses
- very widely represented / the tropics and only grows only in greenhouses in temperate regions
- lives on a very large number of cultivated plants or spontaneous
- Female: 0.14 0.24 mm, whitish, translucent, often greenish or yellowish
- Very wide and oval body
- Male: 0.07 0.11 mm, flattened and smooth (Fig. 11) on the face ventral
- On the back, we can distinguish several rows of large whitish tubers

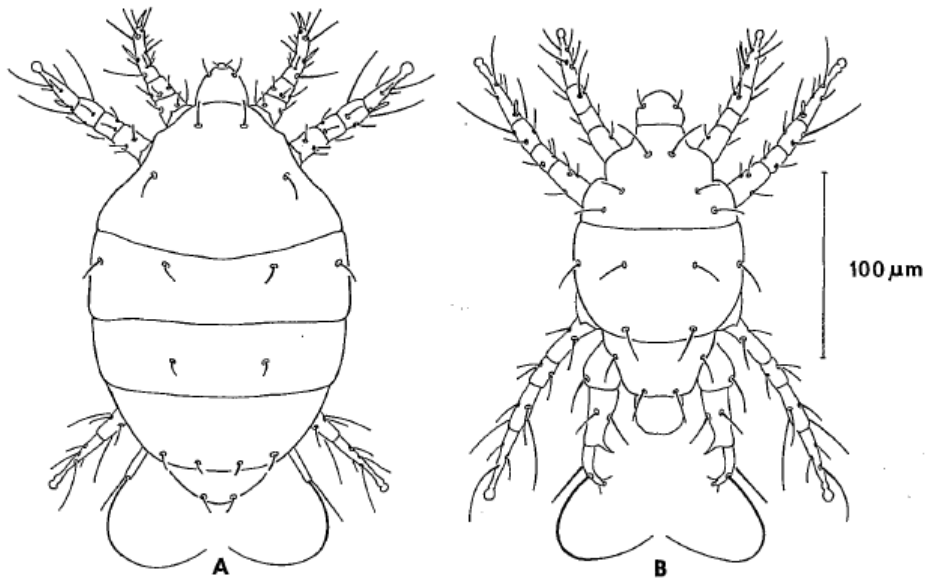


Figure 11 . *P. latus* (Banks) on the dorsal side; A: female, B: male

- After actively feeding, the larvae of this mite immobilize to transform into a stage called the pupa, which gives rise to the adult
- At a temperature of 26-30°C, linked to a high humidity, 4-5 days only are needed to grow from egg to adult (Fig. 12), so that this species is likely to increase very quickly its populations
- average laying under these conditions: 3 eggs/d for 6 days
- Dispersion favored by the wind and by the practice of phoresy on different insects



Figure 12. Adult and eggs of *P. latus*

- Lesions create deformities in the margin
limbus and even performances of the
leaf (Fig. 13), resulting in lacerations
- disturbances in plant physiology
result in 1 shortening of the between
knots and a reduction in boll weight
- new shoots of infested plants
stunted and discolored and often shiny,
brittle and deformed
- severe infestations kill plants
- Pullulations clearly favored by
hot and humid environments



Figure 13. *P. latus* damage on pepper (A: on fruit; B: on leaf)

1.3.Family of Eriophyidae

1.3.1. Morphological characteristics

- Eriophyides are mites of very small size (0.1 0.25 mm), hardly visible
- vermiform appearance and presence of 2 pairs legs
- mouthparts: tiny stylets chelicerals that drive it shallow in plants
- tiny, whitish, spherical eggs

3.2. Biological characteristics

- Eggs laid in small depressions in leaf and fruit
- Hatching occurs 3-7 days later
- larva , very small, yellowish and vermiform, has 2 pairs of short front legs
- larval development: 2 4 d
- very simplified development cycle, with 2 nymphal stages mobile and 2 molting stages
- immature stages very similar to adults
- diapause takes place only for females / barks or / scales buds
- Rather particular reproduction
- female collects the spermatophores deposited by the males on the substrate
- The latter lays 5,100 eggs during 2 to 3 weeks of life.
- short and long development cycle of 6 12 d

1.3.3. Feed

- feed mainly on the vine or on citrus fruits
- lead either to a significant development hairiness often leading to a velvety coating on the underside of the leaves and petiole (a symptom known as erinosis name
- either at the appearance of gall or deformations leaves (blistering, embossing, curling
- species of economic importance: *Colomerus vitis* Pagenstecher) and *Aceria Sheldoni* (

Colomerus vitis

- Sp known as Erinosé of the vine,
also called mite
- grows rapidly during the years to
hot and humid spring
- mouthparts fitted with a stylet, by means of the
which leaves are pitted on their underside
- Under certain conditions, the physiology of the
plant can be strongly altered
- Erinosis is a leaf disease frequently
observed in vineyards and caused by
bites of this mite, thus inducing a
uncontrolled cell development
epidermal

Aceria Sheldoni

- The study of this particularly delicate mite because of its behavioral characteristics and its usual place of residence in inside the buds
- adults (invisible to the naked eye) measure between 0.12 mm and 0.18 mm in long
- Spherical eggs, translucent, 0.02–0.03 mm in diameter
- larvae have the shape of 1 elongated cone, 0.04 0.06 mm
- nymphs resemble adults but are smaller in size
- females live about 11 days and lay an average of 6 eggs
- fecundity can reach 12 eggs/ female, when the latter has fed in the buds during the larval stages
- Variable damage and affects flower and leaf buds at inside which they live and feed
- cause 1 abnormal bud development, leading to term to often spectacular deformations of the leaves, branches, flowers and fruit (Fig. 14)

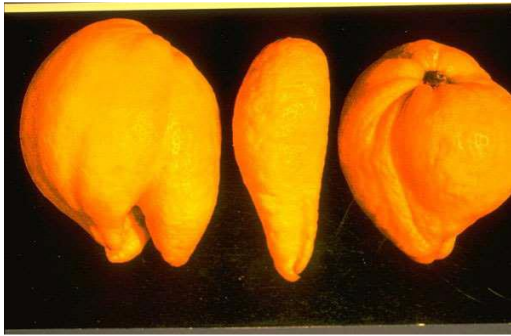


Figure 14. Damage of *A. sheldoni* on Lemon tree: (A) fruit deformation; (B) attack on flower buds

1.4. The Tenuipalpidae

1.4.1. Morphological characteristics

- called false spider mites because they closely resemble the mites of the Tetranychidae family
- also called flat mites because their bodies are rather flat compared to other mites (Fig.15)
- Seen from above, they have the shape of an egg, their dorsal surface features a net-like pattern
- Most are brick red to yellow
- have the same shape as spider mites, but are in general + small
- Mites move more slowly than spider mites
- Brevipalpus have a very flattened shape and are brick red
- there is 1 considerable morphological variation within different populations including *B. californicus*
- As for the eggs, these are light red in color and elliptical shape

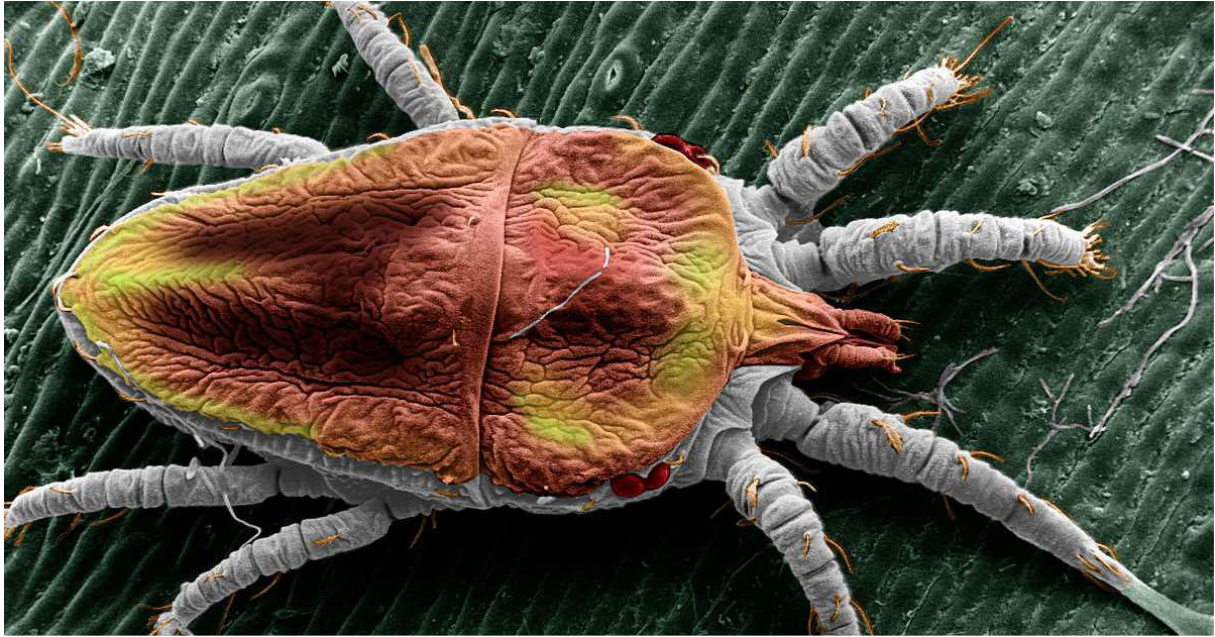


Figure 15. Morphology of a Tenuipalapidae

1.4.2. Biological characteristics

- The Tenuipalpidae have a cycle similar to that of the Tetranychidae and their reproduction is generally based on parthenogenesis
arrhenotokic
- However in the genus *Brevipalpu* the reproduction of most strains living in the tropics is done by parthenogenesis
thelytoque
- False spider mites go through the same stages of development than other mites, namely: egg, larva, protonymph, deutonymph and adult
- their mobility is very low
- The insect does not use its legs to move, because these are too thin
- Eggs laid in a leaf fold or along the midrib
median, often in fairly dense groups of several thousand

3. Feed

- Tenuipalpidae are phytophagous
- sp the + *Tenuipalpus pacificus*, which cause damage to orchids, and *Brevipalpus* which are widespread almost everywhere in the world and attack many host plants
- B. californicus*, *B. obovatus* and *B. phoenicis* are all 3 polyphagous and cosmopolitan. But they feed mainly on the cotton plant in particular in Africa but also in other regions of the world
- They live on both sides of leaves, preferably near the midrib central
- damage caused comparable to that of Tetranychidae but are many extended
- Their populations in the cotton plantations are low and their virtually negligible economic impact
- Other species such as *Raoiella indica* have also been reported on cotton plant in India, this one normally has as host plants the Palmaceae

