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EPPO STANDARD ON DIAGNOSTICS

PM 7/38 (2) *Unaspis citri*

Specific scope: This Standard describes a diagnostic protocol for *Unaspis citri*[1].
This Standard should be used in conjunction with PM 7/76 Use of EPPO Diagnostic Standards.
Specific approval and amendment: Approved in 2003-09. Revised in 2025-10.
Authors and contributors are given in the Acknowledgements section.

1 | INTRODUCTION

Unaspis citri is a serious pest which is widely distributed on citrus throughout the main citrus-growing areas of the world (EPPO, 2025a). This scale insect is often detected on consignments of citrus fruits in international trade but it has also been recorded on other crops, mostly fruit and ornamentals such as species of *Acacia, Ananas, Annona, Artocarpus, Capsicum, Citrus, Cocos, Euonymus, Fortunella, Glycosmis, Hibiscus, Inga, Mangifera, Murraya, Musa, Nephelium, Olea, Osmanthus, Persea, Pittosporum, Poncirus, Psidium, Rollinia, Severinia* and *Tillandsia*. In total, it has been reported to attack plants of 25 genera from 17 plant families (Kondo & Watson, 2022), but it seems to prefer Rutaceae (e.g. *Citrus*). The origin of *U. citri* is in South-East Asia and it is now present in Australia, North, Central and South America, the Pacific Islands, Egypt and Sub Saharan Africa, Syria and China. The pest is already present in the EU, in the Azores islands (PT) (Franco et al., 2011; Soares et al., 1997). For an updated geographical distribution consult EPPO Global Database (EPPO, 2025a). A datasheet providing more information on biology is also available in EPPO Global Database (EPPO, 2025b).

2 | IDENTITY

Name: *Unaspis citri* (Comstock, 1883).
Other scientific names: *Chionaspis citri* Comstock, 1883; *Dinaspis annae* Malenotti, 1916; *Dinaspis veitchi* Green & Laing, 1923. Other former scientific names include: *Chionaspis annae, Chionaspis citricola*, *Diaspis annae, Howardia citri, Prontaspis citri*, *Trichomytilus veitchi* and *Unaspis annae* (Garcia Morales et al., 2016).
Taxonomic position: Insecta, Hemiptera, Sternorrhyncha, Diaspididae, Diaspidinae.
EPPO Code: UNASCI.
Phytosanitary Categorization: EPPO A1 List: n° 226, EU Quarantine pest (Annex II, Part A[2]).

3 | DETECTION

Unaspis citri can be found on plants (on bark and, when the population density is high, also on fruits and leaves) of all citrus species, especially orange (*Citrus sinensis*). In the field, heavy infestations are easily detected because of the presence of the numerous white scale covers of males (Figures 1 and 2). Infestation of the canopy (leaves and fruits) is only evident in the case of high population densities. Infestation begins on the trunk and main branches but quickly spreads to other branches and twigs and may cause weakening of the tree and dieback. This predisposes the tree to attack by other pests. Leaves may develop yellow spots at the feeding sites and heavy infestations may result in chlorosis and early leaf fall.

Normal growth of the bark is prevented. Although growth of the trunk and main branches resumes after a reduction of the pest population, the toughened bark may not be able to resume growth, and may split, thus allowing access to borers and pathogens. Infested fruits are stunted and have a pitted appearance.

Armoured scales should be sampled by collecting the infested plant part (parts of bark, leaves, fruits) with the scales attached.

The shape, dimension and colour of the cover of armoured scales can be important for their identification. For this reason, the infested part of the plant has to be examined under a stereomicroscope. However, a formal species identification requires the specimens to be examined under a compound microscope.

4 | IDENTIFICATION

Identification of scale insects requires specimens to be cleared, stained and mounted on microscope

[1]Use of brand names of chemicals or equipment in this EPPO Standard implies no approval of them to the exclusion of others that may also be suitable.

[2]Commission Implementing Regulation (EU) 2019/2072.

FIGURE 1 Adults of *Unaspis citri* on leaves. Courtesy: Fera Science Ltd. (GB).

FIGURE 2 Females and males of *Unaspis citri* at the petiole insertion. Courtesy: C Malumphy, Fera Science Ltd. (GB).

FIGURE 3 *Unaspis citri*, slide mounted specimen: Whole body. Courtesy: S Chérasse, ANSES (FR).

slides. Only one life stage, the adult female, can be identified to species level since there are no adequate keys for the separation of species based on nymphs or adult males. For slide mounting, covers of specimens are removed with a needle or forceps to collect scale bodies. These specimens should then be prepared for morphological study under a microscope. Among the numerous methods for preparation of scale insects, the one by Kondo and Watson (2022) is described in Appendix 1.

4.1 | Morphological identification

4.1.1 | Genus identification

The genus *Unaspis* belongs to the Diaspididae, which are characterized by the presence of 'two-barred' macroducts on the pygidium (in ducts of this type, the closure of the inner end seems to be formed by internal tubular vestibules of wax glands with two parallel, transverse, sclerotized rings on their inner end i.e. two bars—see Miller & Davidson, 2005).

The adult female has an elongate to fusiform body, widest at metathorax or abdominal segment I, with the prosoma sclerotized at maturity (Figure 3). Anterior spiracle associated with a compact cluster of disc pores (Figure 4), posterior spiracle with usually fewer or no disc pores (Figure 5). Presence of duct tubercles on metathorax and on first abdominal segment. Pygidium slightly rounded. Three pairs of prominent pygidial lobes; the median one not zygotic (bases not yoked together by an internal sclerosis (Figure 13); in contrast see Figure 10 for an example of zygotic lobes), rounded or serrate, either widely spaced, symmetrical and parallel-sided, or set close together basally and divergent, with inner margins longer than outer margins; the others well developed, deeply bilobed, with the lobules rounded, similar in size. Gland spines well developed, absent from between median lobes but present laterally, more numerous after the second abdominal segment. There are 6 or 7 pairs of marginal

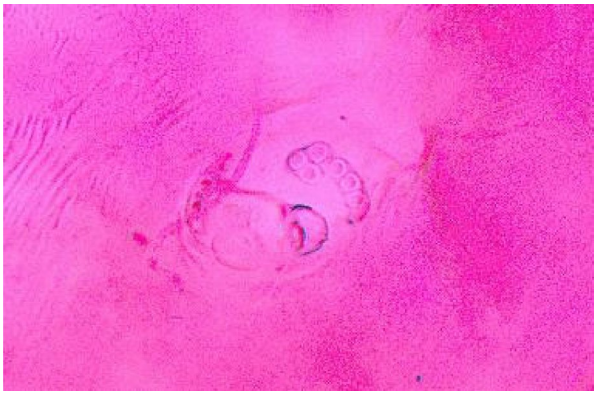

FIGURE 4 *Unaspis citri*, slide mounted specimen: Cluster of disc pores above anterior spiracle. Courtesy: S Chérasse, ANSES (FR).

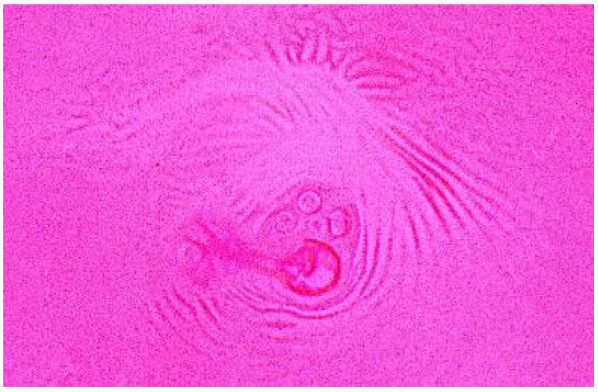

FIGURE 5 *Unaspis citri*, slide mounted specimen: Disc pores above posterior spiracle (note: Lacking in some specimens). Courtesy: S Chérasse, ANSES (FR).

FIGURE 6 *Unaspis citri*, female scale cover. Courtesy: C Malumphy, Fera Science Ltd. (GB).

macroducts, absent from between median lobes. Dorsal pygidial ducts numerous. On ventral surface, perivulvar pores present or absent.

FIGURE 7 *Unaspis citri*, male scale cover. Courtesy: C Malumphy, Fera Science Ltd. (GB).

Good descriptions of the genus are provided by Rao (1949), Watson (2015) and Niu and Feng (2019).

4.1.2 | Species identification

The female scale cover (Figure 6) is mussel-shell shaped, brown or brown black, with a distinct longitudinal dorsal ridge which, in some specimens, may be poorly developed. The exuviae are terminal, brownish yellow, about a third of the length of the scale cover. The female under the cover is yellow to orange. The length of the scale cover is about 2–2.5 mm. The male scale covers (Figure 7) are smaller than the females', white, felted, elongate and have three longitudinal ridges. The adult male is about 1 mm long, winged and light yellow.

Good descriptions of the species are provided by Rao (1949), Balachowsky (1954) and Williams and Watson (1988).

The identification of *U. citri* requires examination of the morphology of adult females mounted on slides. Morphological characteristics of the species include: presence of disc pores above posterior spiracle; marginal macroducts numbering 7 on each side of pygidium (absent from between median lobes), each side with 1 between median and second lobes (on abdominal segment VII), and 2 on each of segments IV, V and VI; perivulvar pores numbering 0–8, in up to 3 groups; median lobes diverging apically separated over entire length with serrated margins; space between bases less than the width of a median lobe; median lobes less than twice as long as second lobe; interlobular spaces (except between median lobes) each containing a single gland spine; posterior spiracle associated with pores.

Table 1 provides a simplified key which includes other genera and other species of *Unaspis*; Niu and

TABLE 1 Simplified key to Diaspididae on citrus in the EPPO region.

1	Dorsal macroducts 1-barred. Plates present, fringed; gland spines absent. Second and third lobes never bilobed (Figure 8)	Subfamily Aspidiotinae
	Dorsal macroducts 2-barred. Plates absent, gland spines present (sometimes replaced by plates). Second and third lobes, when present, often bilobed. (subfamily Diaspidinae)	2
2	Gland spines present between median lobes, sometimes minute (Figure 9)	*Lepidosaphes* Shimer
	Gland spines absent from between median lobes	3
3	Median lobes joined at base by an internal sclerosis (Figure 10)	*Pinnaspis* Cockerell
	Median lobes separated at base, although at times the bases may be close together	4
4	Widely separated median lobes and numerous dorsal pygidial macroducts (more than 90) (Figure 11)	*Unaspis yanonensis* (Kuwana)
	Median lobes close together and fewer dorsal pygidial macroducts (fewer than 75) (Figures 12 and 13); perivulvar pores, present or absent	*Unaspis citri* (Comstock)

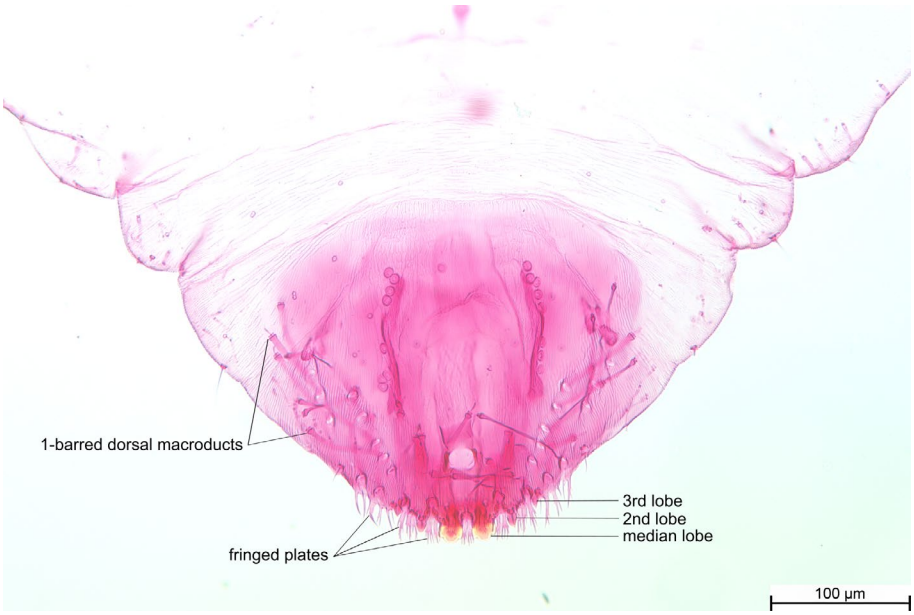

FIGURE 8 *Hemiberlesia cyanophylli* (Signoret, 1869), slide mounted specimen: Pygidium. Courtesy: S Chérasse, ANSES (FR).

Feng (2019) published a key of the *Unaspis* species of the world.

4.2 | Possible confusion with similar species

Unaspis citri can be confused with other species of armoured scale insects living on citrus. It differs from *Lepidosaphes* spp. in the colour of the male cover which is white in *U. citri* and brown with no ridges in *Lepidosaphes* spp. Moreover, the adult female-cover usually has a median ridge that is not present on the cover of *Lepidosaphes*. In female *Lepidosaphes* spp., gland spines, even if minute, are present between median lobes, whereas they are not present in *Unaspis*. Other similar species belong to the genus *Pinnaspis*, but they can be separated from *Unaspis* because of basally joined medial lobes present in *Pinnaspis* spp. The arrowhead scale, *Unaspis yanonensis* (Kuwana), is already present in the EPPO region (Figure 11) and is very similar to *U. citri*. The two species can be separated using microscopic characters such as position of median lobes and number of pygidial macroducts, as described in Table 1. Moreover, *U. citri* is less frequently found on fruits and leaves than *U. yanonensis*.

4.3 | Molecular tests

Molecular identification based on four genetic markers (a region of mtDNA encompassing partial sequences of cytochrome oxidase I and cytochrome oxidase II

(COI-II), elongation factor-1 alpha (EF-1α), part of the large subunit ribosomal RNA (28S) and a segment of the small ribosomal subunit of the primary diaspidid endosymbiont, *Uzinura diaspidicola*, (16S)) was carried out by Normark et al. (2019). It is worth noting that the marker COI-II is different from the COI barcode recommended in PM 7/129(2) *DNA barcoding as an identification tool for a number of regulated pests* (EPPO, 2021) for which no reference sequences are available for *Unaspis citri*. Guidance for sequence analysis is given in Appendices 7 and 8 of PM 7/129. Due to the lack of validated molecular test, morphological identification is the recommended method to confirm the identity of *U. citri*.

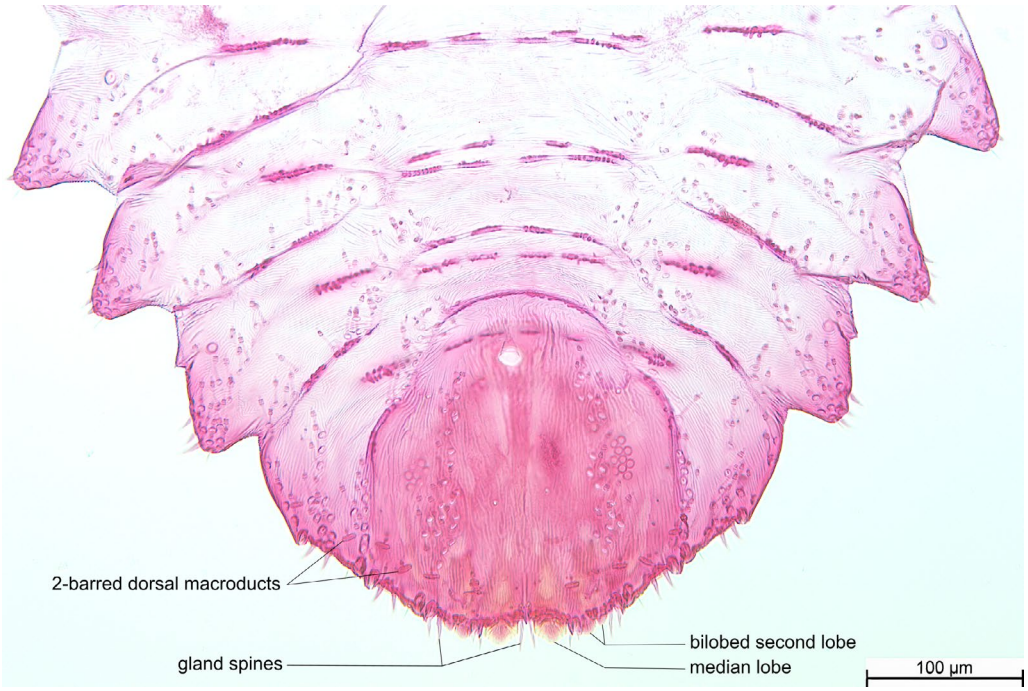

FIGURE 9 *Lepidosaphes beckii* (Newman, 1869), slide mounted specimen: Pygidium. Courtesy: S Chérasse, ANSES (FR).

FIGURE 10 *Pinnaspis strachani* (Cooley, 1899), slide mounted specimen: Pygidium. Courtesy: S Chérasse, ANSES (FR).

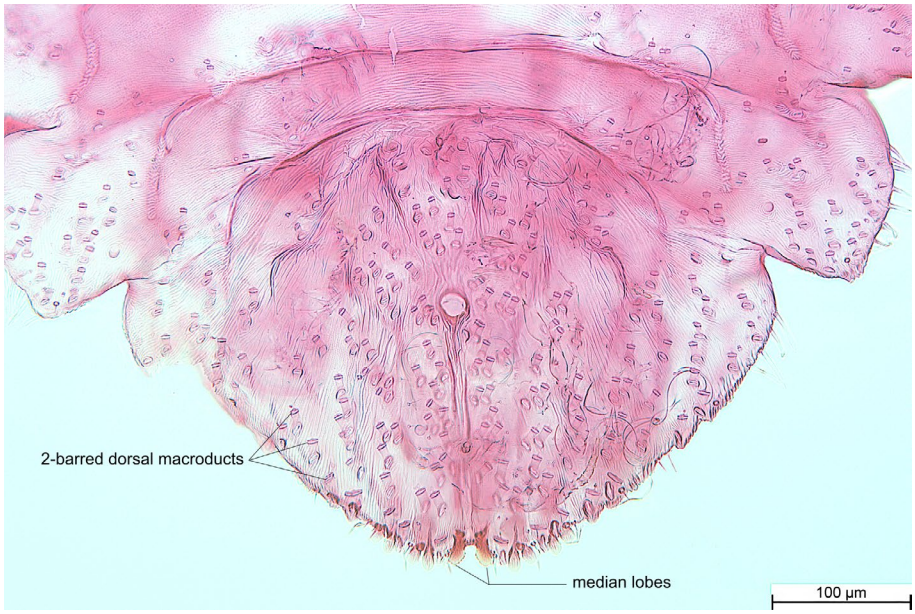

FIGURE 11 *Unaspis yanonensis* (Kuwana, 1923), slide mounted specimen: Pygidium. Courtesy: S Chérasse, ANSES (FR).

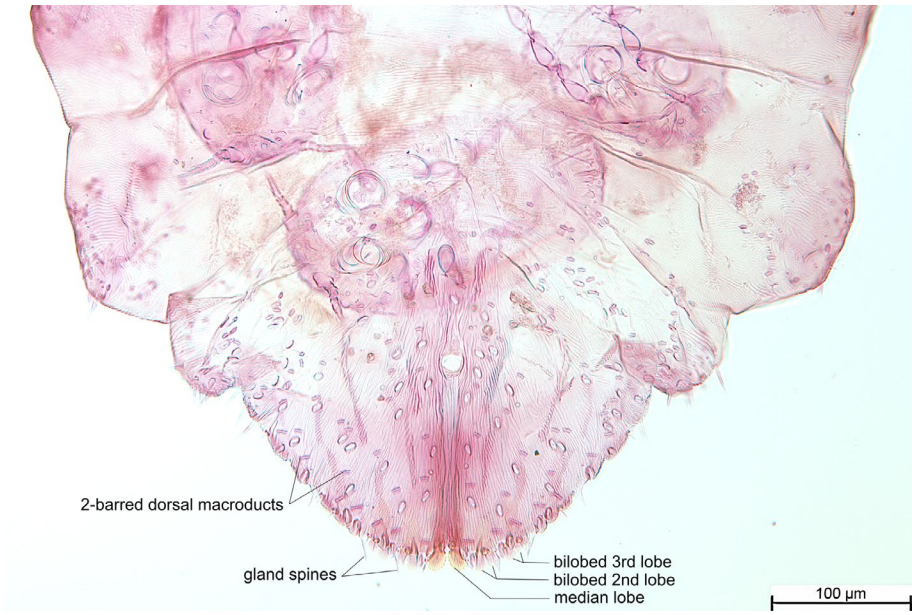

FIGURE 12 *Unaspis citri* (Comstock, 1883), slide mounted specimen: Pygidium. Courtesy: S Chérasse, ANSES (FR).

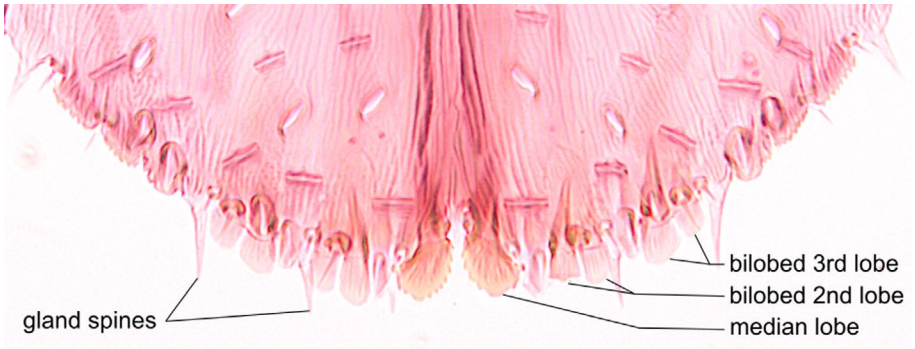

FIGURE 13 *Unaspis citri* (Comstock, 1883), slide mounted specimen: Pygidial lobes. Courtesy: S Chérasse, ANSES (FR).

5 | REFERENCE MATERIAL

Reference material of *U. citri* is hosted by

- ANSES-LSV, 755 Avenue du Campus Agropolis, CS 30016, 34988 Montferrier-sur-Lez Cedex, France.
- Netherlands Institute of Vectors, Invasive plants and Plant health (NIVIP), Geertjesweg 15, 6706 EA, Wageningen, Netherlands.

6 | REPORTING AND DOCUMENTATION

Guidelines on reporting and documentation are given in EPPO Standard PM 7/77 Documentation and reporting on a diagnosis.

7 | PERFORMANCE CHARACTERISTICS

When performance characteristics are available, these are provided with the description of the test. Validation data are also available in the EPPO Database on Diagnostic Expertise (http://dc.eppo.int), and it is recommended to consult this database as additional information may be available there (e.g. more detailed information on analytical specificity, full validation reports, etc.).

8 | FURTHER INFORMATION

Further information on this organism can be obtained from:

Ms. Gaetana Mazzeo, Dipartimento di Agricoltura, Alimentazione e Ambiente, Sez. Entomologia applicata, Via Santa Sofia, 100, 95123 Catania (IT); gaetana.mazzeo@unict.it.

ANSES-LSV, 755 Avenue du Campus Agropolis, CS 30016, 34988 Montferrier-sur-Lez Cedex (FR); montpellier.lsv@anses.fr.

9 | FEEDBACK ON THIS DIAGNOSTIC STANDARD

If you have any feedback concerning this Diagnostic Standard, or any of the tests included, or if you can provide additional validation data for tests included in this Standard that you wish to share, please contact diagnostics@eppo.int.

10 | STANDARD REVISION

An regular review process is in place to identify the need for revision of Diagnostic Standards. Standards identified as needing revision are marked as such on the EPPO website. When errata and corrigenda are in press, this will also be marked on the website.

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APPENDIX 1 - Preparation of specimens (according to Kondo & Watson, 2022)

The best sample to make a good slide is a teneral adult female, unsclerotized and with the body not yet expanded. Make a small puncture with an insect pin to one side of the mid-line in the body of the specimen to help to clear the body content. Place the specimen in a 10% solution of KOH at room temperature overnight or heat until the body contents become translucent. Transfer to distilled water and, if necessary, expel the body contents using gentle pressure. Transfer from water after 5–10 min to acidified 80% alcohol (20 parts glacial acetic acid + 80 parts 50% ethanol) for at least 10 min. Stain in a mixture of acid fuchsin stain (composed of 3 parts of acid alcohol (20 parts glacial acetic acid + 80 parts 50% ethanol) and 1 part of acid fuchsin (0.5 g acid fuchsin powder +25 mL 10% HCl+300 mL H_2O)) and Essig's aphid fluid (composed of 20 parts lactic acid (reagent grade 85%), 2 parts phenol (liquefied), 4 parts glacial (100%) acetic acid and 1 part of distilled water; heat at 56–60°C for 30–60 min then store in dark bottle) for 12–24 h. The staining process can be sped up by heating for half an hour to several hours. To avoid using phenol, an alternative staining solution can be prepared by mixing 1 part of lactic acid, 1 part of glycerine, 1 part of distilled water and a pinch of acid fuchsin powder to obtain a dark pink colour (ANSES (FR), internal procedure). If this alternative staining method is used, staining time should be approximately 30–60 min without heating. Transfer from the stain to acidified 80% isopropanol or ethanol until the membranous cuticle becomes pink and cuticle remains red. Then quickly transfer to 95% isopropanol or ethanol to fix the stain, and soak for about 10 min to dehydrate the cuticle. Transfer to clove oil for at least 10 min. Place the specimen on a small spot of clove oil on the slide and position it with the ventral side up. Then remove surplus clove oil by means of fine filter paper. Put a drop of Canada balsam on the specimen and gently lower the coverslip and dry for 10–15 min. Dry slides at 40°C in an oven for 3 months.