

IDENTIFICATION OF

false codling moth and carob moth larvae



Two species of lepidopteran larvae have been recorded to cryptically (internally) infest citrus fruit in Southern Africa – the carob moth and false codling moth. By Sean Moore (CRI, Rhodes University), Pia Addison (Stellenbosch University) and Tammy Marsberg (CRI)



The carob moth, *Ectomyelois ceratoniae* (Lepidoptera: Pyralidae) (Fig 1a) and the false codling moth (FCM), *Thaumatotibia leucotreta* (Lepidoptera: Tortricidae) (Fig 1b) have larvae that appear similar, superficially. They are of similar size and both having a pink hue, at least at some stage (Fig. 2). Neonate carob moth larvae are cream-white or light pink and about 1 mm long. They have yellow to brown head capsules. Larger larvae are light pink with a brown head capsule, and measure about 18 mm in length, in the final instar (Morland 2015). Neonate FCM larvae are about 1.4 mm long and are white with a black head capsule (Stofberg, 1948). With age, the body becomes pinkish red, generally darker than that of carob moth. The mature larva is 15 – 20 mm long (Moore 2002), the larvae of both species being slender and elongated with distinct head capsules and legs. This is unlike the fly larvae that can infest citrus fruit (fruit flies and vinegar flies). General appearance and biology of the larvae of the

two species are summarised in Table 1. Infestation and damage patterns in citrus fruit usually differ somewhat between the two species. FCM can be considered a primary pest of citrus. Female moths will lay their eggs on the fruit surface, usually singly, and hatching larvae will penetrate directly through the rind, but often through the navel end in Navel oranges. Larvae will feed in the albedo of the fruit, just under the rind, or tunnel through into the central column of the fruit to feed. Larvae will not exit the fruit at all until they are ready to pupate (Newton 1998).

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On the other hand, carob moth is often a secondary pest of citrus, being attracted to mealybug residues or those of other honeydew-producing insects. They can also attack fruit that is already damaged or move into a citrus orchard from an adjacent preferred host, such as pecans, pomegranates, or acorns. Feeding is usually superficial, with larvae often exiting and re-entering fruit. That said, there seem to be increasing cases presenting little difference in the feeding patterns between carob moth

and FCM (Honiball and Catling 1998). FCM is a regulated quarantine pest for several export markets, especially the European Union (EU), which is the biggest export market for Southern African citrus, whereas carob moth only has quarantine status for a handful of Far Eastern markets. For the EU, a risk management system

for FCM is implemented, which is based on stringent inspections from orchard to packhouse to post-packing (Hattingh et al., 2020). FCM infestation threshold exceedance can lead to stricter shipping conditions or even rejection of fruit for export. Consequently, it is important that lepidopteran larvae infesting fruit are correctly identified as either carob moth or FCM. There are several features that can be used to accurately differentiate carob moth and FCM larvae from one another

Table 1. General morphological and biological characteristics of carob moth and FCM larvae

	Carob moth	FCM
Larval length	1.0 – 18.0 mm	1.4 – 20.0 mm
Larval body colour	Creamy-white to light pink	Initially creamy white, turning pinkish red
Larval head capsule colour	Yellow to brown	Black, becoming brown
Instars (larval stages)	3 – 6 (usually 5)	5
Generations per year	4 – 5	5 – 6

Fig. 1. Adults of carob moth (a) and false codling moth (b)
Fig. 2. Final instar carob moth (a) and FCM (b) larvae. See distinctive dark circle around the seta of the eighth abdominal segment in carob moth (a) is absent in FCM.

Fig. 3. Absence of an anal comb in the carob moth larva (a) and presence of such a comb in the FCM larva (b)

Fig. 4. Indicated dark sclerotised patch on the first thoracic segment of carob moth (a); a much paler unsclerotised patch on FCM (b)



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(Morland 2015). However, for simplicity in on-farm application, only key diagnostic differences are provided here. Firstly, carob moth does not have an anal comb (Fig 3a), whereas FCM does (Fig. 3b). However, this only appears in the later instars and is often difficult to find in the folds of an imperfect specimen. By far the clearest and most reliable morphological difference between the larvae of the two species, is the presence of a dark sclerotised patch on the first thoracic segment (T1) of carob moth (Fig 4a) and the presence of a much paler unsclerotised patch on FCM (Fig 4b).

Furthermore, the sclerotised patch is anterior to (in front of) the first spiracle in carob moth and dorso-anterior (below and protruding forwards) to the unsclerotised patch in FCM.

The patch in FCM also has a very distinct shape, which is consistent from larva to larva. Finally, in carob moth there are two setae (hairs) associated with the patch, whereas in FCM there are three. However, these may not be sufficiently clear if the specimen is not in very good condition and magnification is not adequate.

Another useful feature is the presence of a dark circle around the seta of the eighth abdominal segment (A8 – third last segment from the back) in carob moth (clearly visible in Fig 2a). This dark circle is missing in FCM (Fig 2b).

If a larval sample is in good condition and the larva is not too small, it should be possible to reliably observe the described characteristics of the T1 patch, using a handheld magnifying glass (10 X magnification). However, a stereoscopic microscope will help to improve the reliability of the identification. If there is any doubt at all about the identification, the default should be to

list it as FCM, rather than carob moth, as the repercussions of an error in the other direction would be more dire.

If you would like to register for an online workshop to learn more about identification of moth larvae that are of economic significance to fruit crops in SA, please contact Caro Kapp at Stellenbosch University: ckapp@sun.ac.za. If you are at all uncertain about the identification of a larva found in a citrus fruit, please contact Dr Tammy Marsberg at CRI: tammy@cri.co.za.

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FCM is a regulated quarantine pest, particularly for the EU – the biggest export market for Southern African citrus.