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Invasive mealybugs (Hemiptera: Pseudococcidae) and the threats they present to Mediterranean countries

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Due to their small size and cryptic habits, alien mealybugs (Insecta: Hemiptera: Pseudococcidae) can easily enter countries around the Mediterranean basin through trade in live planting material and fresh produce. The recent increase in mealybug introductions probably reflects ever-faster transport in globalised trade, the free movement of goods within the European Union and the weakness of plant quarantine screening by national plant protection organisations. Purchases over the Internet, shipments of plants by post and exchanges of material by plant hobbyists escape control by quarantine services and contribute substantially to mealybug introductions on plants like bamboos and succulents.

Initial establishment frequently occurs in cities, where many factors influence survival including climate, the presence of suitable host-plants, the absence or disruption of specific natural enemies, the effects of urban warming and air pollution. These directly influence mealybug development and survival, and can indirectly affect trophic inter-relationships between mealybugs, their host-plants and natural enemies. Global warming probably facilitates mealybug acclimatisation by providing warmer winters, changing the phenology of host-plants and increasing opportunities for the establishment of species originating from tropical and sub-tropical countries.

Significant recent mealybug introductions to countries around the Mediterranean include: *Crisicoccus pini*, infesting pine trees; *Maconellicoccus hirsutus*, *Phenacoccus madeirensis* and *Ph. peruvianus*, affecting herbaceous and woody ornamental plants; and *Paracoccus marginatus*, *Phenacoccus solani* and *Ph. solenopsis* damaging ornamentals (including succulents) and herbaceous crops, both under glass and in outdoor conditions.

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Trade in fruit trees and ornamentals seems to be a common means of mealybug introduction. The introduction histories of invasive mealybugs in Mediterranean countries and beyond reveal distinct entry pathways and dispersal patterns. Some examples include: (i) passive dispersal on strong winds, e.g. a mealybug host-specific to *Tamarix* spp., *Trabutina mannipara*, entered Mediterranean countries from North Africa; (ii) direct import of host-specific mealybugs on infested ornamentals like bamboos, proteas and succulents, directly from their distant areas of origin, e.g. *Antonina socialis* and *Palmicultor lumpurensis* on bamboos; (iii) introduction of less host-specific mealybugs have been imported either directly from their distant areas of origin, e.g. *Delottococcus euphorbiae* and *Paracoccus burnerae* on ornamentals from South Africa, or from countries close to the Mediterranean where they are already established, e.g. *Maconellicoccus hirsutus*, *Phenacoccus madeirensis*, *Phenacoccus solani*, *Ph. solenopsis* and *Vryburgia amaryllidis*. The latter pathway highlights the need for organisations like EPPO to monitor introductions in nearby, non-EPPO countries that present potential sources of infestation. Once a species becomes established in a EU country, subsequent local trade within the EU can result in very rapid dispersal of the pest over large areas, e.g. *Phenacoccus peruvianus* was introduced to the EU in 1999 and is now present in at least 12 countries.

In the past, mealybug introductions to Mediterranean countries mainly impacted ornamental plants, but more recent introductions like *Paracoccus marginatus* and *Phenacoccus solenopsis* also threaten vegetable and field crops and potentially also native flora. *Crisicoccus pini*, on pine trees, may invade natural woodlands where native *Pinus* spp. could be adversely affected.