

EU-project DROPSA: first achievements regarding pathway analyses for fruit pests

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The EU project ‘DROPSA’ started in 2014 and aims to improve plant health strategies in the fruit sector. The project is being conducted by an international consortium of 26 partners consisting of phytosanitary organizations, companies, research institutes and universities and will last 50 months. Results will be disseminated via conventional publications and will be brought together in the development of risk-based strategies to prevent the introduction of new fruit pests. This article describes the task related to the preparation of alert lists of pests that may be introduced into Europe with the trade of fruit. Activities of this task include the investigation of pathways of introduction for fruit pests into Europe, the development of alert lists for selected fruit crops and a review of current legislation. A review of introductions, interceptions and outbreaks that occurred during the last 10–15 years was conducted and is summarized, showing the relevance of fruit trade for the international movement of pests. Work has started on the development of alert lists for selected pathways. In this context, important fruit crops (including *Malus*, *Vaccinium*, *Vitis*, *Citrus*) were selected.

Introduction

The fruit sector plays an important economic and social role in the EU. Every year, around 78.5 million tonnes of fresh fruit and vegetables are produced within the EU, around 4.5 million tonnes (worth 3.9 billion EUR) are exported and more than 12 million tonnes (10.4 billion EUR) are imported from outside the EU (Freshfel, 2011). Trade of plants is recognized as a major pathway for the introduction of pests (EPPO, 2012), but global fruit trade also brings with it a risk of international movement of pests. Most commercial fruit varieties are susceptible to many pests that may be present in the crops at harvest and thereby become associated with consignments of traded fruit. The necessity to protect fruit crops from pest pressure is the main reason why, compared to other commodities, the fruit sector has shown the lowest growth rates in percentages of organic production (1–5%) since the 1990s (Tamm *et al.*, 2004). The invasion of the spotted-wing drosophila *Drosophila suzukii*, native to Asia and introduced to continental North America and to Europe in 2008, has caused a lot of concern for the fruit industry, because of its rapid spread and the huge losses in the cultivation of small fruit. For example in three US states (California, Oregon, Washington), where more than 80% of the US cherry and strawberry production and almost all raspberry and blackberry production is located, losses of more than 450 million USD in these crops in 2008 due to *D. suzukii* are estimated (Bolda *et al.*, 2010). In Trento province (Italy), yield losses in the cultivation of small fruit

amounted to 500 000 EUR in 2010 and 3 million EUR in 2011 (Ioriatti *et al.*, 2011 in Cini *et al.*, 2012).

In the research project DROPSA (‘Strategies to develop effective, innovative and practical approaches to protect major European fruit crops from pests and pathogens’¹), experts from Europe, Asia, Oceania and North America work together, for the first time, on the improvement of plant health strategies in the fruit sector (see the website for a list of the 26 project partners: www.dropsaproject.eu). The project started with the kick-off meeting in York (UK) in January 2014 and has a funding period of 50 months. The project is structured into nine work packages (WPs), dealing with:

- analysing pathways of introduction of fruit pests (WP 1);
- investigating the biology, ecology and epidemiology of *D. suzukii* and quarantine pests of fruit crops (WP 2, WP 3);
- finding effective and practical solutions to control fruit pests and combine the best ones, also from an economical point of view, as integrated pest management (IPM) strategies (WP 4, WP 5, WP 6, WP 7);
- the coordination and management of the project and ensuring proper dissemination of the outcomes (WP 8, WP 9).

This article focuses on one task under the work package 1 ‘analysis of pathways of introduction of fruit pests and pathogens into the EU’, carried out by the European and Mediterranean Plant Protection Organization (EPPO) and the Julius-Kuehn-Institute (JKI, Germany).

¹Throughout the text the term ‘pests’ is used, which, in accordance with EPPO and IPPC terminology, also includes pathogens. The study covers all pests except plants.

Note: In this study, ‘fruit’ was not defined in the botanical sense, but as this term is used in the common language. It thus excluded fruits that are commonly considered as vegetables, such as cucumber.

Review of pathways of introduction of fruit pests into Europe

A review of non-native fruit pests recorded in Europe during the last 10–15 years was conducted in order to identify important pathways for fruit pests. Official data regarding introductions, outbreaks and interceptions [see text box, from definitions in FAO (2013)] were screened for all pests that either have fruit or nut species among their hosts or were found on a fruit or nut species (including both fruit pests and ‘hitchhikers’). Introduction data were extracted from PQR database (EPPO, 2014). For outbreaks, only EU data were used (extracted from Europhyt and previous database versions), while interception data included approximately 15 000 records from EU countries and approximately 850 records from non-EU EPPO countries (gathered by EPPO and published in the EPPO Reporting Service).

Introduction (of a pest): The entry of a pest (i.e. movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled) resulting in its establishment.

Outbreak: a recently detected pest population, including an incursion (i.e. an isolated population of a pest recently detected in an area, not known to be established, but expected to survive for the immediate future), or a sudden significant increase of an established pest population in an area.

Interception (of a pest): the detection of a pest during inspection or testing of an imported consignment.

The review identified 387 taxa, of which 68.5 % are insect pests (Fig. 1). Although the original task related solely to pests that have been introduced into Europe with the fruit trade, in most cases it is difficult to ascertain via which pathways pests have been introduced. The pathway of introduction is often not known and, in most cases, the only information on pathways relates to potential pathways, based on the biology of the pest and its hosts. The review identified many pests that were probably not introduced with fruit, or for which the pathway of entry is not known and can only be assumed from the information available on the biology of the pest. It was considered too restrictive to focus only on pests that have a clear association with the fruit trade, and other groups of pests were studied in order to illustrate the diversity of pests of fruit species and of their introduction into Europe.

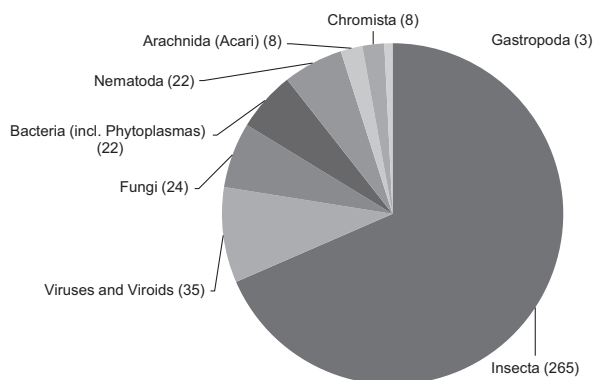


Fig. 1 Proportions of eight different pest groups among the 387 pests of fruit species identified in the review. Within the last 10–15 years, these pests have been introduced into the EPPO region, or were intercepted at a port of entry in the EPPO region, or an outbreak in an EU country was notified.

Fruit and vinegar flies

An insect group, which is very likely to be transported with fruit, are fruit and vinegar flies (Tephritidae and Drosophilidae), because eggs and larvae occur in fruit and early development stages are rarely detected. Non-European Tephritidae are included in phytosanitary regulation, as they are listed in the EU Plant Health directive 2000/29/EC (Annex I/A1). As a consequence, fruit consignments imported in the EU are requested to be free from any non-European Tephritidae. This group has a high potential to cause economic damage, because fruit flies may attack and destroy healthy fruit. Species for example of the genera *Anastrepha*, *Bactrocera* and *Ceratitis* are frequently intercepted during import inspections on exotic fruit and infested consignments are subjected to phytosanitary action as, for example, rejection or destruction. Drosophilidae are not listed in the EU Plant Health directive. Most vinegar flies attack only overripe fruit, already beginning to rot, and no economic damage is caused. Nevertheless, recently, *D. suzukii* was introduced into Europe causing severe damage in fruit cultures, as it has a wide host range (all soft-shelled fruit) and is able to lay eggs into healthy fruit.

Scale insects

Another insect group that is often found in import inspections on all above ground parts of plants, including fruit, are scale insects (Coccoidea). Although frequently found on fruit, no examples were recorded, where fruit were clearly identified as a pathway leading to the establishment of a scale insect species in Europe. *Maconellicoccus hirsutus* and *Pseudococcus comstocki* are examples of scale insects, which are not subject to phytosanitary regulation and were intercepted on fruit of

Annona and *Malus* respectively, and still have only established in a few EU countries.

Fungi

Fungal pests may be distributed over large distances with planting material or with fruit. For example *Monilinia fruticola*, which has recently been deregulated, because it has spread considerably in the EU, has frequently been intercepted at ports of entry on *Prunus* fruit. Import inspectors also frequently intercept citrus fruit infested with fungi of the genus *Phyllosticta*.

Viruses

Viral pests are in general very unlikely to be transported from one country to another on fruit. For example the EU quarantine pest *Citrus tristeza virus* (CTV) probably originates in Asia and has been introduced to many citrus growing countries also within the EU. CTV is spread with infected planting material and depends on vector aphids or grafting to be transmitted. The only known example, where infected fruit are considered to be the pathway of introduction, is the mechanically transmitted *Pepino mosaic virus* (PepMV) that does not depend on a vector for transmission. Initially described in Peru on pepino plants sampled in 1974, it was found in the EU on tomato in 1999. Different strains of PepMV could be distinguished and in Europe not only tomato strains occur, but also the original Peruvian strain isolated from pepino was found in Spain (DEFRA, 2010).

Bacteria

For bacterial pests the most likely means of international transport is with plants for planting (including seeds for seed-borne species). Most interceptions for the species identified in the review were on these commodities, with the exception of *Xanthomonas axonopodis* pv. *citri* with numerous interceptions on citrus fruit.

'Unknown risks'

The review also summarized a group of pests under 'unknown risks' grouping together pests that are not regulated, but are pests of important crops, and for which their potential importance is not always known. Examples are *Aphis illinoensis* (Aphididae) attacking grapevine or *Stelidota germinata* (Nitidulidae) attacking strawberries and other mature fruit. Both originate in the Americas and have been introduced into the EU. *Aphis illinoensis* is so far considered a minor pest in Mediterranean countries. *Stelidota germinata* caused significant damage in strawberries in Italy in recent years.

'Tropical fruit pests'

Another group comprises 'tropical fruit pests' originating in tropical regions, being introduced to islands such as the Azores or Canaries and later on found in continental Europe. *Aulacaspis tubercularis*, the white mango scale, and *Dysimococcus brevipes*, the pineapple mealybug, belong to this group.

'Hitchhikers'

Finally, the review identified 'hitchhikers' that do not have fruit species among their hosts or are not even pests, but were found on fruit during import inspections. For example the legume pod borer *Maruca vitrata*, which is absent from Europe, was intercepted on citrus fruit from Asia; the vineyard snail *Cermea virgata*, which feeds on green or decaying plant material, was found on apples; the parasitic wasp *Syrphophilus bizonarius*, which is used as natural enemy against the sorghum shoot fly, was also intercepted on apples.

For many introduced pests, the pathway of introduction is unknown and the most probable pathway may be inferred taking into account the practices in fruit trade and the biology of the pest. However, the review identified a high number and high diversity of pests associated with fruit, showing that the fruit trade may play an important role for the international movement of pests.

Pathway studies to establish alert lists of pests

Alert list of pests, which have a high risk of being introduced into Europe with the fruit trade, will be produced for selected crops. In order to identify such pests, a methodology and criteria were developed to screen the pests identified for a given fruit crop and identify those that present the highest risk of being introduced with traded fruit. The methods are, with minor modifications, adopted from the EPPO commodity study on tomato fruit (in this issue of the EPPO Bulletin pages 153–156). A three-step approach was followed:

- In Step 1, a worldwide list of pests for the fruit species considered is established, with basic information on each pest; pests that are not likely to be carried by the fruit trade are excluded from further consideration.
- In Step 2, more information for remaining pests is sought, and the pests are screened against criteria such as: whether the pest may be carried with traded fruit; whether it is present (or not) in the EU; whether it is polyphagous; climatic similarity between its areas of origin and the EU; recorded impact; previous records of interception; whether the pest is known to have spread or to be an emerging pest. An overall rating is given to each pest and a number of pests selected for further consideration.

- In Step 3, records are prepared for the pests selected, in the format of EPPO Alert List records.

Conducting this type of analysis requires a considerable amount of time for each fruit species, therefore a priority list of fruit crops was established, to be taken in order until the time allocated to this task is exhausted. Important factors for prioritizing the crops were for example trade volumes into the EU, the area of production in the EU, origins of trade (emerging markets), and the prior history of pest introduction (following the review). Furthermore, the overall selection aimed to provide a good geographical coverage of fruit production in the EU, to ensure a balance between fruit species (both regulated and non-regulated for fruit in the EU, and to cover crops from different groups (e.g. pome fruit, stone fruit, citrus, small fruit). The preliminary priority list, which may be adjusted during the course of the project, is as follows:

- (1) apples;
- (2) *Vaccinium* berries;
- (3) grapes;
- (4) oranges and mandarins (taking account of other *Citrus* species where necessary);
- (5) raspberries;
- (6) cherries;
- (7) peaches/nectarines;
- (8) kiwis;
- (9) strawberries.

The preparation of lists of pests and screening has started for fresh apples (*Malus* sp.) and *Vaccinium* berries. It is recognized that the priority list above focuses on fruit species of current importance in the EU, that is also those for which data are available. It overlooks emerging fruit trade, especially of tropical fruit species, which may lead to introduction of polyphagous pests that may then transfer to fruit species of importance in the EU. In the coming months, attempts will be made to obtain data on such trade, and relevant emerging fruit species may be added to the priority list.

Future plans

The current EU legislation will be reviewed to consider how it covers the pathways studied. The outcome of the task will be used in other tasks of Work package 1. One task, led by Imperial College London (UK), is developing specific methods to quantify the risk of introduction, using research findings of other projects (e.g. EFSA-projects 'QPA Food' – Quantitative pathway analysis for pest entry with food products – and 'Prima phacie', MacLeod *et al.*, 2010). Pests identified in the review or from the alert lists will be used as case examples in that task. Another task aims to identify risk-based management options to develop and recommend preventive strategies to prevent the further spread of pests that are already introduced and the introduction of new fruit pests.

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Projet européen DROPSA: premiers résultats relatifs à des analyses par filière pour les organismes nuisibles des fruits

Le projet de l'UE "DROPSA" a débuté en 2014 et vise à améliorer les stratégies phytosanitaires dans le secteur des cultures fruitières. Le projet est mené par un consortium international de 26 partenaires comprenant des organisations phytosanitaires, des entreprises, des instituts de recherche et des universités, et il durera 50 mois. Les résultats seront diffusés au moyen de publications classiques et permettront l'élaboration de stratégies fondées sur le risque pour empêcher l'introduction de nouveaux organismes nuisibles des cultures fruitières. Cet article décrit la tâche visant à préparer des listes d'alerte d'organismes nuisibles susceptibles d'être introduits en Europe avec le commerce des fruits. Les activités comprennent notamment l'étude des filières d'introduction des organismes nuisibles des cultures fruitières en Europe, l'élaboration de listes d'alerte pour des espèces fruitières sélectionnées, et l'examen de la législation actuelle. Les introductions, interceptions et foyers des 10-15 dernières années ont été recensés et résumés, et démontrent la pertinence du commerce des fruits pour la dissémination internationale des organismes nuisibles. L'élaboration de listes d'alerte pour des filières sélectionnées a commencé. Des cultures fruitières importantes ont été sélectionnées (y compris *Malus*, *Vaccinium*, *Vitis*, *Citrus*).

Проект DROPSA: первые достижения в отношении анализа риска для путей распространения вредных для плодовых культур организмов

Проект Европейского Союза под названием «DROPSA» был предпринят в 2014 г. и нацелен на совершенствование стратегии по улучшению фитосанитарии в секторе пловодства. Проект проводится международным консорциумом из 26 партнеров, состоящих из фитосанитарных организаций, различных компаний, исследовательских институтов и университетов, и продлится 50 месяцев. Результаты исследований будут распространяться через обычные публикации и объединяться в разработке основанных на оценке риска стратегий, позволяющих составить сигнальные перечни новых вредных для плодовых организмов. В статье приводится описание задачи, связанной с составлением сигнальных перечней

вредных организмов, которые могут быть интродуцированы в Европу в ходе торговли плодами. Конкретные мероприятия этой задачи включают исследование путей интродукции вредителей плодовых в Европу, разработку сигнальных перечней для конкретных плодовых культур, а также пересмотр действующего законодательства. Приводится анализ интродукций, выявлений при досмотре и вспышек размножения, которые встречались за последние 10-15 лет, заостряющий внимание на роли торговли плодами в международном перемещении вредных организмов. Изначально эта работа была предпринята для составления сигнальных перечней для конкретных путей распространения. В этой связи были отобраны важные плодовые культуры (включая *Malus*, *Vaccinium*, *Vitis*, *Citrus*).

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