

Fruit Flyer



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for Research & Innovation

FF•IPM



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Fruit Flies In-silico
Prevention & Management

FF-IPM

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This is the fourth Newsletter Publication of the EU-funded research project FF-IPM, with the aim to protect fruit production and trade from threats posed by fruit flies.

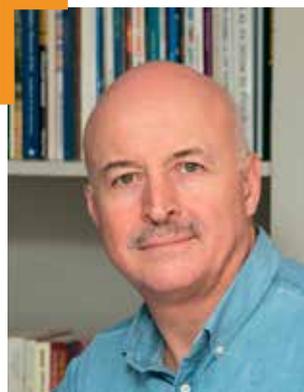
The newsletter is published quarterly, highlighting the actions, news, progress related to the issue at hand.

Editor: University of Thessaly

Contributors: FF-IPM partners and experts

Editing & Graphic design:
R&DO Ltd





Dr. Nikos T. Papadopoulos, PhD

Professor of Applied Entomology
 Director of Entomology + Agricultural Zoology Laboratory
 University of Thessaly
 FF-IPM Project Manager

Rapid and reliable identification of a detected pest is considered of outmost importance for a fast response that can prohibit establishment and dispersion of invasive species. The recently developed multi-entry electronic key for adult fruit flies, from FF-IPM partner Royal Museum of Central Africa, is a major project output that will contribute in this direction. The key, which is available as a user's friendly mobile device app, has been evaluated by stakeholders and is currently freely available. An additional, similar key that focuses on African fruit fly species has become available recently, developed by the project F3 fruit flies free.

Next steps in our work, will be focused on the development of respective identification tools for fruit fly *larvae* that are frequently intercepted in European ports of entry. Working with and for the stakeholders, the FF-IPM project recently achieved another milestone, the deployment of an early detection tool in a European port of entry. Indeed, the e-trap developed by the Agricultural Research Organization of Israel has been installed in the port of Thessaloniki, Greece with the active involvement of the Regional Plant Protection Authorities. Interacting closely with our colleagues we expect comments and remarks regarding the adoption of the e-trap to further advance the tool.

Working with and for the stakeholders, the FF-IPM project recently achieved another milestone, the deployment of an early detection tool in a European port of entry



In the current newsletter, Ana Larcher and Uli Schiefer continue their discussion with Dr. Wolfgang Reinert, Policy Officer for Plant Health at the European Commission (DG SANTE) focusing on how the trade and border controls at the EU level and how the DG SANTE is interlinked with other International Standard Setting Bodies, the DG Trade and border inspectors. The role of the European Commission and that of international organizations such as EPPO (European and Mediterranean Plant Protection Organization) and the IPPC (International Plant Protection Convention) is outlined.

The contribution of the FF-IPM project is expected to influence aspects related with regulation of imported consignment of fresh fruits and vegetables and with respective exports. Wolfgang outlines the importance of consultation with stakeholders for the DG SANTE and the

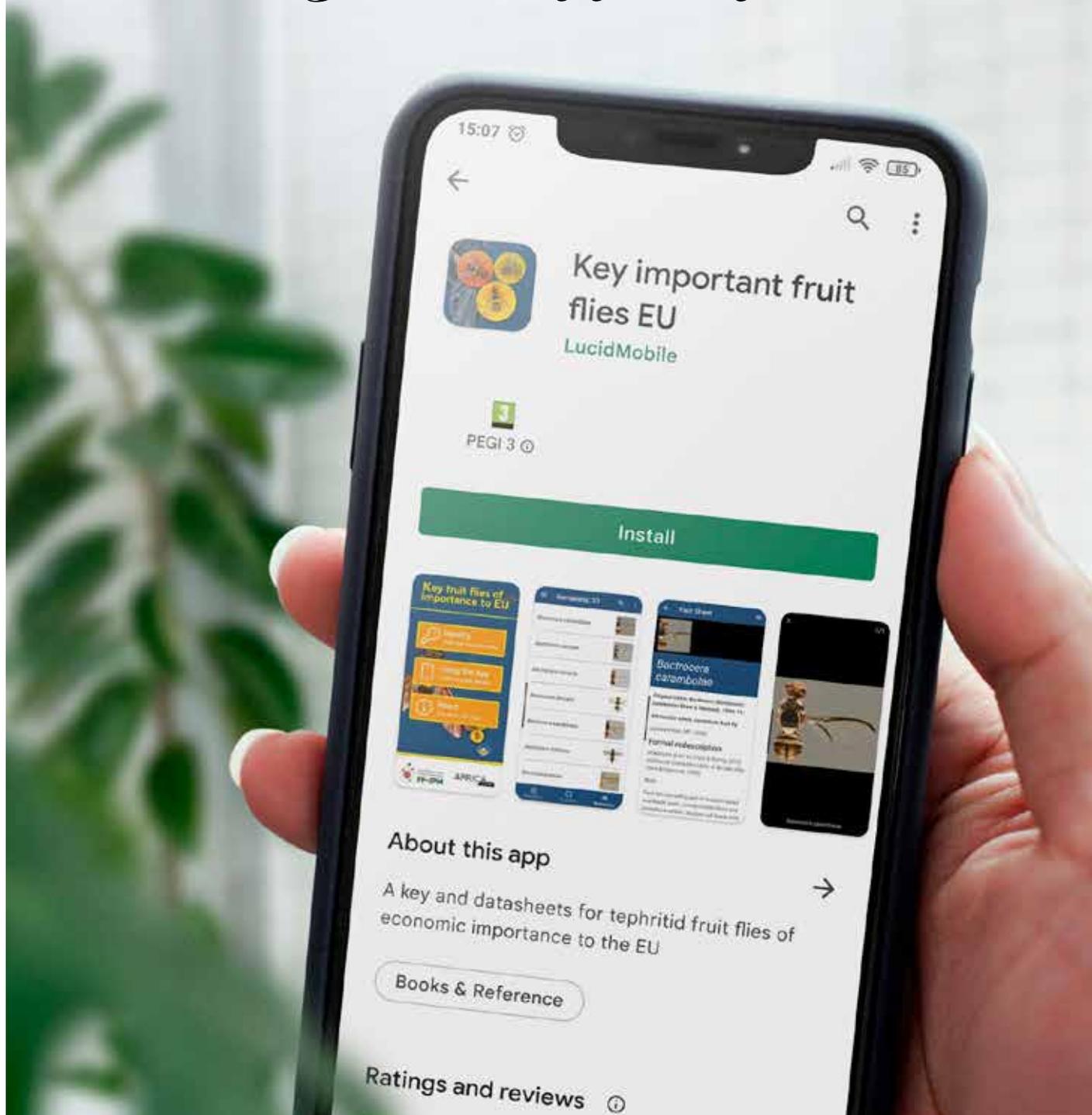
European Commission in general and thorough discussion on aspects related to plant health. Priorities and concerns of plant health are also discussed and the expectations from the FF-IPM project outlined. Finally, the importance (and the difficulties) related to the involvement of local communities and different stakeholder groups with FF-IPM for achieving the best results is analyzed.

The contribution of the FF-IPM project to climate change is also outlined in the current newsletter. In January 2022, we organized with Super Pest (<https://www.superpests.eu/>) and Optima (<https://optima-h2020.eu/>) projects a webinar on “Modern tools for Integrated Management, in the new Era of Plant Protection”. This was attended by more than 250 persons and generated an interesting discussion while establishing a framework for collaboration and interaction among the three projects.



Enjoy the 4th issue of the FF-IPM Newsletter!

Key important fruit flies EU & Key selected fruit flies Africa: Innovative apps for differentiation and recognition of fruit flies



The FF-IPM project targets three highly polyphagous fruit fly (FF) species (*Tephritidae*) that cause devastating losses in the fresh fruit producing industry, the Mediterranean fruit fly (*Ceratitis capitata*), the Oriental fruit fly (*Bactrocera dorsalis*) and the peach fruit fly (*B. zonata*). These pests pose an imminent threat to European horticulture.

One of the goals of FF-IPM is to produce rapid identification tools to intercept specimens in imported commodities and at processing industries. Rapid identification of fruit flies is crucial in preventing fruit flies from entering mainland EU territories and keeping the new populations at low levels of spreading

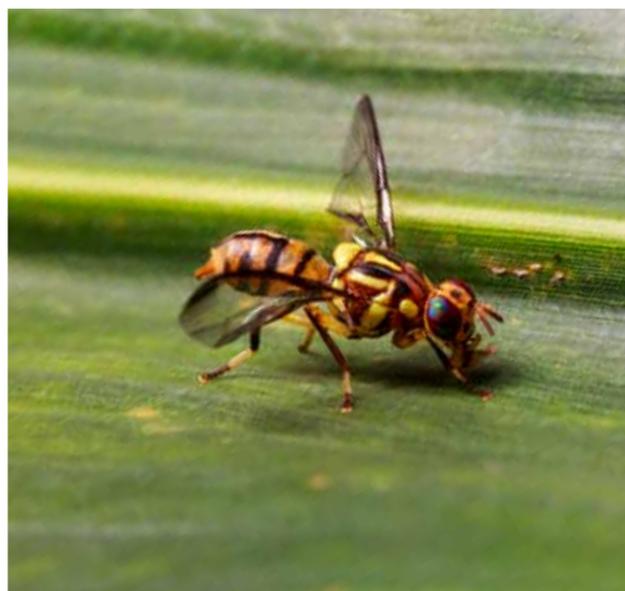
The algorithms at the service of identification!

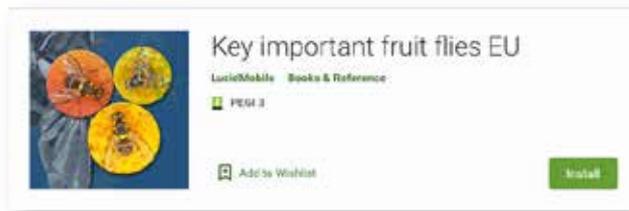
The first project research output/service is a fact! At FF-IPM, we created an electronic multi-entry identification key for fruit flies that are considered of significance for quarantine measures in the EU. The key contains characters to differentiate between adults of 23 fruit fly species of the subfamily *Dacinae*, that are determined as of economic significance to the European Union and other associated regions. The short list of 23 species includes the three target fruit flies (*Bactrocera dorsalis*, *B. zonata* and *Ceratitis capitata*) of FF-IPM and several species closely related to these.

The key was composed after consultation with different potential end-users (NPPOs, the European Reference Laboratories for Insects and Mites, EPPO). In addition, for each species a condensed datasheet is provided with the basic information regarding morphology, biology, host range, distribution, impact, and management. The key is illustrated with high resolution images taken or cropped specifically for this purpose. Also, links to more extended information sources have been included for each species.

The key contains characters to differentiate between adults of 23 fruit fly species of the subfamily Dacinae, that are determined as of economic significance to the European Union

This multi-entry identification key fits within the Project F³ Fruit Fly Free, a multi-collaborations project, project, funded by the WTO STDF, that aims to develop a regionally harmonized framework for development and implementation of recognized Pest Free Areas (PFAs) and Areas of Low Pest Prevalence (ALPPs) for regulated fruit fly pests of commercial fruit commodities in southern Africa (South Africa and Mozambique). The Project F3 Fruit Fly Free has created a key to the fruit flies in Africa of major economic significance.





Get the information you need at a glance!

These two keys are now converted to mobile applications that can be installed on your smartphone and they are downloadable for free. Lucid, an Australian developer that has been active since 2013 and its work is dedicated to identification and diagnostic tools, created the two mobile applications which you can find in the different app stores through the following links:



Key important fruit flies EU

https://play.google.com/store/apps/details?id=com.lucidcentral.mobile.fruit_flies_ffipm

<https://apps.apple.com/app/key-important-fruit-flies-eu/id1600191559>

Key selected fruit flies Africa

https://play.google.com/store/apps/details?id=com.lucidcentral.mobile.fruit_flies_africa

<https://apps.apple.com/app/key-selected-fruitflies-africa/id1600205756>

Both apps are user friendly. Firstly, the key allows the characteristics (features) of the specimen to be entered in any order. The key then sorts out those taxa possessing the features selected, rejecting those that do not match. By progressively choosing additional features, the key will eventually narrow the results to just one or a few matching taxa.

So, you make selections via the Features list of the app and in the Selections list you can find the features you have answered. In the Remaining list you see the taxa matching your selections.

As you proceed through the key by choosing features to answer, the list of

remaining taxa will be filtered to only those matching your selections. Each taxon in the key has a fact sheet and one or more images that you can access by just tapping on your screen.

Help us make our apps better!

For those interested, please have a look. We are always interested in feedback to improve the keys and to identify other parameters which concern you. You can send your comments to the following e-mail: gpahlitz@gmail.com.



DISCLAIMER: The key and fact sheets are made freely accessible. The authors take, however, no responsibility for any legal, economic or agricultural consequences by consequent actions or decisions made from using this key or fact sheets. The user is solely responsible for the scientific interpretation or any regulatory decision derived from information provided in this tool. It is recommended that the user seeks a professional identification confirmation should there be any far reaching decisions depending from identification made by using this tool.

Wolfgang Reinert (part 2)

Interview by Ana Larcher Carvalho
and Ulrich Schiefer



Wolfgang Reinert studied biology and specialized in ecology and soil biology and worked at the Julius Kühn-Institut – Bundesforschungsinstitut für Kulturpflanzen (JKI) which is the German Federal Research Centre for Cultivated Plants. He got his PhD in the area of microbiology in plant protection for grapevine. He then worked in an institute in plant breeding in Rhineland Palatinate before he moved to the unit for plant protection in the EC which deals with the assessment and approval for active substances for plant protection products.

For the last two years he has been working in the unit on plant health.

For the first part of the interview (Fruit flyer Bulletin #3), please follow this link: <https://fruitflies-ipm.eu/news-and-events/newsletter/>

During the second part of the interview with W. Reinert, Policy Officer for Plant Health at the European Commission in the Directorate-General for Health and Food Safety (DG SANTE), we carried on our discussion on the role of DG SANTE and the connections to external organizations.

This part of the interview focuses on the trade and border controls and how the DG SANTE is interlinked with other International Standard Setting Bodies, the DG Trade and border inspectors. The discussion concluded to the relevance with the goals of the FF-IPM H2020 project and how Mr. Reinert believes that our project may contribute to plant health and as a conclusion he reminds us of the importance (and the difficulties) related to the involvement of local communities and different stakeholder groups with IPM for getting the best results.

We have quite intensive cooperation with EPPO and IPPC on a formal and on an informal level. The work is defined by the treaty and depends on whether the Commission is representing the EU or not

THE LINKS TO INTERNATIONAL STANDARD SETTING BODIES

What are the links to International Standard Setting bodies?

In the area of plant health, you have EPPO (European and Mediterranean Plant Protection Organization) and the IPPC (International Plant Protection Convention). The cooperation with international organizations and reference to international standards is key in our work. This is to make sure that the decisions we take can be explained to international trading partners because they also refer to these standards. Especially if we talk about ISPM (International Standards for Phytosanitary Measures) or EPPO standards which are always recognized by all the contracting parties.

We have quite intensive cooperation with EPPO and IPPC on a formal and on an informal level. The work is defined by the treaty and depends on whether the Commission is representing the EU or not. In the IPPC, the Commission is representing the EU. The EU is a contracting party of the IPPC and

therefore we are full members. In EPPO we have the status of an observer. The work with standards is reflecting this, as in our legislation we regularly refer to ISPM standards, as we are a contracting party in ISPM and participated in their drafting process.

As EPPO is mainly dealing with European matters and is consequently regularly invited to our expert meetings.

THE LINKS TO TRADE AND BORDER INSPECTIONS

Could you tell us more about the relationship with Directorate-General for Trade (DG Trade)? And inside DG Trade with which units do you dialogue with and what is the kind of work you do together?

The contact with DG Trade is on one side with the SPS procedure (Agreement on the Application of Sanitary and Phytosanitary Measures). The countries are usually notified through the SPS, via designated SPS contact points. So, the work on the respective files is shared with DG Trade, they have their say in that, and they will take the points when there are meetings with World Trade Organization (WTO) in Geneva.

Do you have a kind of trade impact assessment of the measures or is it DG Trade that does this?

I am not aware of any guidance on a formal trade impact assessment. In the internal discussions, DG Trade will have their say on our measures. Naturally they also have their stakeholders: Third countries which are not happy with the measures we suggest make sure that not only we get to know this but also DG Trade.

So, third countries' consultation is only with DG Trade?

Third countries consultation is through the SPS procedure, so that is with DG Trade, but we are an open system, so for any stakeholders it is easy to bring forward their points through additional channels.

From the Commission's point of view everybody who is not in the Commission is a stakeholder. They know that they may contact the Commission services and the technical units at any time. If you are working on a measure, you may get some comments as soon as the draft gets out or you are contacted. Not only stakeholder consultation but also the communication about stakeholder consultation and transparency are therefore extremely important.

Regarding trade and the importation of products, do you work with border inspectors and with the procedures they use to identify the flies? I am asking this because there is always a lot of discussion if the fruit flies or eggs or larvae that are detected are alien fruit flies or not. And how you can be sure that is not Mediterranean fruit fly (*Ceratitis capitata*)? Because this can have a negative impact on the exporters. In the reports we see a lot of *Ceratitis* species. If you go to the species level in the list, how do you go from there to the implementation side?

We do not offer any expertise in this field, and we do not, from the Commission side, offer a process to harmonize different views. We have, under different pieces of our legislation, reference laboratories. There are national reference laboratories financed by the Member States, and, as a complement, we finance a network of European reference laboratories. It is the duty of these reference laboratories to make sure that there is proficiency testing on testing methods and testing standards. We agree for EU purposes on certain

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We have to be aware that not all the Member States have the same amount of resources to spend when it comes to have experts in taxonomy or taxonomic knowledge for more seldom taxonomic groups available.

When Member States at border controls cannot determine certain specimens to species level, they may use higher taxa in some cases, where that is provided for in the legislation. It is sometimes difficult to determine everything at the species level, for instance, if you find larvae or eggs, and then a higher taxonomic level would be used. So, if Member States find e.g. larvae of *Bactrocera* they have the possibility to take action.

But under the legal construction of plant health inspection of plants entering the EU is not the competency of the Union but of the Member States. Member States do controls at the border inspection posts according to our harmonized rules and schema. There is a regulation on official controls, how you carry them out, at what intervals, what you must provide and so on. But the control itself, and the results, and if they send back a consignment, that is the decision of the Member States.

Are there harmonized protocols for sampling?

Yes, there are several sets of protocols. Sometimes you have a PM (Phytosanitary Measure of IPPC) protocol, sometimes you have an EPPO standard, and sometimes you have something from our legislation. We at DG SANTE do usually not establish these protocols. We rather fall back on existing standards.

Now, if I wanted to find out what is the protocol for sampling say mangos from Senegal, because that is what the producers ask. Because they take samples and don't find anything, and then the importing countries do it and they find something. How can they know what the protocols are on the EC site?

There is legislation on official phytosanitary controls when goods are imported into the EU. In case a consignment is intercepted because a quarantine pest was found, the owner of the consignment gets a report. If they require some more details, they can contact the authorities of the Member State, which intercepted the goods.

In each Member State?

Yes, in each Member State. In some areas there are harmonized protocols. You could contact the competent authorities, to get some more information in such specific cases. For more general questions, you could as well contact our unit, either directly or online through the 'Europe Direct Contact Center'.

POLICY COHERENCE AND STAKEHOLDER CONSULTATION

How do you ensure policy coherence between plant protection, plant health and food law within the EU?

In the Commission there are strong mechanisms to ensure that nothing goes out as an official document that is not intensively discussed internally. There are procedures in DG SANTE for internal consultation and for inter DGs consultation. These are very formal and lengthy processes, but they ensure that everybody who needs to comment on any initiative has the possibility to do so. That is the position within the Commission. For other institutions in plant health, we have a direct link with the European Council. Legislation exists with shared competencies between the Commission and the Member States or with exclusive competencies of the Member States.

There is a kind of mosaic, it is necessary that the Commission and the Member States have a good understanding of what the other parties do and that there is a lot of consultation. The strongest working relationship is with the Council.

The link between the Commission, the European Parliament and the Council is guaranteed by the fact that all the legislation we are dealing with in our daily work falls under the comitology procedure. In the fields of plant health and plant protection, any legal draft which is produced by the Commission,



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and which is not a basic act (which are submitted to the co-decision procedure and would be adopted by Council and European Parliament) but which is based on such a co-decision act, the so-called implementing and delegated decision is always discussed with the Standing Committee where all the Member States are represented. Before such an act may be adopted by the Commission, the European Parliament has the right of scrutiny. Once the proposal is adopted by the Standing Committee with a qualified majority, the European Parliament has the possibility to scrutinize whether the legal act is in line with basic legislation, as for this type of legislation, the Commission has delegated power from the co-legislators (Council and European Parliament) to adopt legislation.

How would you ensure that other stakeholders are heard in this process?

In DG SANTE we have a well-structured stakeholder dialogue. This dialogue is partly organized under the umbrella of the Better Regulation initiative, which applies to all DGs, and partly specific for DG SANTE. There are procedures where we listen to stakeholders by publishing draft documents and giving a public

comment deadline, and others, where we actively approach key stakeholders. For the latter approach, DG SANTE is hosting an advisory group, in which all our key stakeholders are represented as well as a number of action platforms on more specific topics. SANTE's key stakeholders come from NGOs, consumer organizations, producers, traders, and industry. They are kept aware of important initiatives, as well as of routine measures. Under the Better Regulation initiative, there is an obligation to organize stakeholder consultations for certain types of legal initiatives, where you must reach out to stakeholders and actively request their comments.

MAIN PRIORITIES AND CONCERNS FOR PLANT HEALTH IN DG SANTE

What are the main priorities and main concerns for the plant health unit in DG SANTE? What are you worried about?

Our main priorities include the implementation of the new legislation: we have the basic act Regulation No 2016/2031 which became fully applicable at the end of last year and we are still working out how to implement this legislation, to give advice to Member States and stakeholders, etc. And we work on the revision of some former Annexes of the legislation, for instance, the list of quarantine pest and the list of regulated non quarantine pests: all these long lists of pests which used to be annexes have formally to be transferred into new legislation for legal reasons, and we also try to update and revise them. That is one of our priorities now for the short time.

Is this one piece of legislation or several?

There are several. This is a new tendency in our legislation. In the past, you had one Directive with several Annexes where you found all the technical information.



Nowadays, you have one basic regulation with the fundamental legal provisions and what used to be the annexes now become separate 'daughter' Regulations. In first instance, the provisions of the former Annexes were basically copied and pasted into a daughter Regulation. Now we revise them in terms of content and format. Because you have some incoherencies amongst different parts and different annexes in terms of format, but also on technical details or terminology. For instance: if you want to refer to all species of a genus do you use just the genus name, or do you use the genus name plus 'spp.'? For the sake of legal clarity, these issues should be addressed in the same way throughout one piece of legislation, but nowadays it is not, because these pieces of legislation grew historically and were drafted by different people without sufficiently checking for coherence and consistency.

The quarantine pest lists together with other lists of pests or plants are now in one separate Regulation. It is Regulation

No 2019/2072. There you have different annexes, and annex 2 is the quarantine pests.

Other priorities which will remain are things like *Xylella* (*Xylella fastidiosa*) and the *pine wood nematode* (*Bursaphelenchus xylophilus*). These still have an enormous dispersal power, and it is not clear whether we can stop them. But we did not give up so far.

What is important as well is the concept of high-risk plants and priority pests, which is laid down in the new legislation, but which did not exist before. We have now created legal provisions and we must explore now with trading partners how this will be handled in practice. High risk plants are not allowed to be introduced into the EU because they have an unusual high risk of being infested with quarantine pests. Trading partners and companies that want to export something to the EU have to submit a dossier through the competent authorities of the country in question in which they lay down how they make sure sanitary measures are met.

Before you also had to guarantee the phytosanitary standard?

Yes, but now it is much more detailed. You must figure out the systems approach in the production of your plants before you export them to the EU. Before, the only option to be to put on the PC (phytosanitary certificate) was, that the material is “free from” certain pests. Although this means, that the exporting country is taking responsibility for such statement, misuse could not always be excluded, as for some plants there were high numbers of interceptions.

This is about high-risk plants. Now what about priority pests?

There are some quarantine pests, like *Xylella*, which are pests that need to be dealt with priority. An initial list of priority pests has been established already and further pests may be added, if it appears that they may form a particular threat.

In addition to that, there might be some new pests, which were not known before, or which were under the radar before, but which might need to be regulated under our legislation. In this process, the Commission is supported by EFSA who carries out assessment of pests which are potential candidates to become quarantine or regulated non-quarantine pests.

FRUIT FLY PROBLEMS AND FF-IPM

Focusing on the problem of fruit flies, how important do you think these pests are for the EU?

The worry on fruit flies is that, for one, we have several species among them which are highly dispersive, especially under the conditions of climate change. Second, many of them are not feeding just on one plant, but they are polyphagous which makes it much easier for them to establish in any new territory. They are at the same

*There might be a chance to eradicate very small populations in a very early stage. The example we have seen with *Bactrocera* in California, which has been eradicated and later on came back several times*

time very damaging because many of them are quality pests, they deteriorate the quality of the fruit. The latter, if you wait for a few days, you have maggots in the fruit, and nobody wants to buy it. So, the damage potential is very high, because we also find them in high value crops. Fruit production in itself is very often a high value production. The last thing, it is quite difficult to determine, if it is a quarantine pest or not, so this may lead to discussions about introduction, so when you send back a consignment, the sender may start arguing that it is not a quarantine pest. So, these are the important points. And, as far as we see it, there is a big danger, that once these pests are established somewhere, you cannot eradicate them anymore. There might be a chance to eradicate very small populations in a very early stage. The example we have seen with *bactrocera* in California, you can claim that you eradicated it, but you can never be sure. It reappears magically out of nothing. So, this is a concern.

How can the FF-IPM project contribute to improve plant health in general?

For me the most interesting elements in the FF IPM project are the new approaches, the new ideas, the development about trapping, e-trapping and detection and e-detection.

So, we expect that it will have the potential of a substantial impact on border control through the possibility to detect early at the border control posts or as early as possible in trade.

I remember once, I visited a retailer during an inspection and then you see fruit flies everywhere and then you hope there is no *Bactrocera dorsalis* between them. But if you had specific trapping methods, highly effective, automated trapping methods which will work independently and where you do not have to change the traps every day that would be an enormous help.

Also as regards to species determination: there are various problems in determining the species, so it would be good to have more intelligent and electronic methods to do that. I have seen one study on mass trapping. That would be helpful for us to better judge how big the chance to achieve early eradication is. If you can immediately use mass trapping.

The other elements I have seen which are very interesting are based on the forecast tools, I think forecast tools are necessary for IPM. If you want to fully explore the possibility of IPM you need a forecast about what pests are expected to come or not. For managers and for decision makers it would be good to have forecast tools that would tell us for example, look this species will not establish in the next ten years, but after that, you must be more careful. This would be very important for us.

Also, the detection of low-density populations. As we do not know whether you can ever eradicate them after they

have established it will be crucial to have a high detection power to reliably detect low populations of fruit flies.

I found the idea of the virtual farm and the virtual farm toolbox something really intriguing. In its importance it goes beyond this project. Here I have the impression that we can already create test cases. In the FF IPM project, we could gain experience and see what works and what does not. Such things always need a lot of time in development. They look very easy when you start developing them, I still remember one thing that is GPS assisted ploughing or tilling, which looked extremely clever in the beginning but then it took 20 years before you really had results you could present to farmers which they would embark on.

This is a bit similar. The more we look into IPM and the more we say that IPM is the flagship for plant protection, the more we depend on the collaboration of the farmer. These methods challenge the willingness and the competency of farmers to work with new methods and this means that we are more and more depending on them. In the "good old times" it was enough to approve DDT and you "solved all the insect problems", but if you try to achieve good effects with IPM it requires much more. You need to involve much more layers and many more different groups in society.

There are various problems in determining the species, so it would be good to have more intelligent and electronic methods to do that. I have seen one study on mass trapping

The contribution of FF-IPM to climate change after COP26



Climate change has emerged as the main global problem of our era. In Europe, all regions are vulnerable to climate change, but some will get affected more than others. Southern and Southeastern Europe will face the most adverse aftereffects, related to the current situation.

The area is already experiencing a significant increase in remarkably high temperatures and a decrease in precipitation and river flows, which have increased the risk of more severe droughts, crop reduction, loss of biodiversity and forest fires. Changes in the distribution of climate-sensitive infectious diseases increase the threats to human health and life.

Changes in weather and seasonality have an impact on agricultural practices and cultivated species. New crops in new soils result in the transfer of pests and diseases to areas where they had not appeared before. Invasive pests, plants, or animals enter new areas threatening natural biodiversity.

FF-IPM is a project ready to join the #ClimateShot agenda decided at COP26. Since the initiation of the FF-IPM project (September 2019) the pressure of potential fruit fly invasion and dispersal is still high and increasing, and hence the developments of the project are increasingly relevant, with major contribution potential to the fruit producing systems in the EU and the fruit trading industry.

One of our goals brought about by the implementation of FF-IPM strategies is to have a strong impact on restoring the “lost” biodiversity at the farm and at region level

How do we plan to help closing the innovation gap in agriculture and reach the 4 targets of the #ClimateShot race, as they were presented at the United Nations Climate Change Conference (COP26):

TARGET 1 Reducing greenhouse gas emissions from agriculture

FF-IPM aims to a new paradigm of pest management (OFF-Season approach) to determine the proper timing and place of the off-season interventions. The Integrated Pest Management tools we are testing (mass trapping with no pesticide use, biological control with nematodes, fungi, and ground predators) will contribute to sound management of fruit fly populations. The expected impact is a decrease in pesticide use which is linked with a strong percentage of gas emissions (30% of emissions comes from agriculture).

TARGET 2 Improving productivity and the incomes of those who work in agriculture

Our fruit fly surveillance proposal (e-traps with real time capturing and generating data) minimizes the surveillance costs in the field by 15%. Our ecological managing strategies at local and regional scale are meant to help farmers on taking quicker decisions, leading to faster actions which will ultimately result in lower costs and lower crop losses. At the EU level, we aim on reducing the response time of the Member States and the relevant authorities in case of an invasion event by an exotic fruit fly. These combined efforts will prevent and mitigate the negative impact of fruit fly invasions.

A more long-term achievement of the FF-IPM surveillance proposal in the health of farmers, farm workers, urban inhabitants and fresh fruit consumers is interlinked with the minimizing pesticide utilization. The expected high reduction

in pesticide use to control Cc (*Ceratitis capitata*) will diminish chronic and acute health problems of these groups, and by reducing health issues, more productivity of the farmers and farm workers themselves can be achieved.

TARGET 3 Strengthening the resilience of farmers to climate change, especially women, youth and marginalized groups

The impact of the FF-IPM project on generating new knowledge for fruit flies is already substantial. We have been generating regarding the overwintering of fruit flies in different EU countries, and thus we contribute to having a better understanding of their capability to survive the long and cold winters of central European countries. By helping farmers to gain more knowledge and tools, we can help them be more resilient to climate change.

TARGET 4 Increasing biodiversity, improving soil health and strengthening efforts in water conservation

The IPM tools that we are developing will minimize pesticide utilization and residues on the crops. On the other hand, it will have a positive effect on the biodiversity in agrosystems and surrounding natural ecosystems. In this direction we are providing experimental data on the OFF-Season efficiency of different nematode strains and the entomopathogenic fungi *Bauveria bassiana*. One of our goals brought about by the implementation of FF-IPM strategies is to have a strong impact on restoring the "lost" biodiversity at the farm and at region level, including biological control agents, pollinators and non target arthropods

Recent experiments by the coordination of the FF-IPM project in the ENPI-Med project fruitflynet (<http://fruitflynet.aua.gr>) have shown that dwelling arthropods recover relatively fast following reduction of pesticide use.



N. Papadopoulos, A. Ifoulis, E. Makridou

Fruit fly detection (e-trap)

The FF-IPM project recently achieved another milestone, the deployment of an early detection tool in a European port of entry. Specifically, the e-trap developed by the Agricultural Research Organization (ARO) of Israel was installed in the port of Thessaloniki, Greece, at the end of last year, with the active involvement of Dr. Ifoulis and Dr. Makridou of the Regional Plant Protection Authority of Thessaloniki. During the installment of the e-trap, Dr. Ifoulis mentioned that “it is very challenging to detect fruit-fly activity at ports of entry and a real time system like the e-trap has the potential to be an effective tool in fruit-fly detection.”

Interacting closely with regional authorities and working with and for our project stakeholders, we expect to further advance the tool and explore its use in Israel and other EU countries. In this direction, e-traps have been assembled and shipped to all participant partners and the algorithm for automated recognition of fruit flies has been improved. The e-traps have been evaluated and validated in five participant counties, under field conditions.

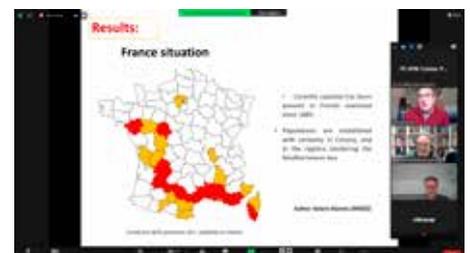
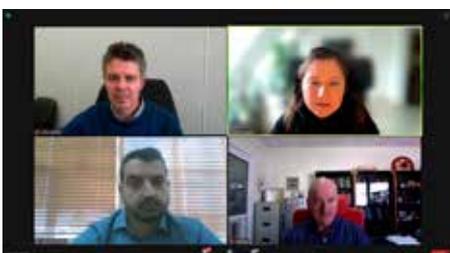
WEBINAR

Modern tools for Integrated Management, in the new Era of Plant Protection

On the 19th of January 2022, FF-IPM co-organized and participated in a webinar along with two sister projects, OPTIMA and SuperPests. The webinar was structured in two sections. During the morning section, Prof. Nikos T. Papadopoulos made a presentation of the FF-IPM project and explained its targets, the managing strategies, and the results so far. He also

mentioned the first project research output/service, the “Key important fruit flies EU” an electronic multi-entry identification key for fruit flies in the form of a mobile app.

The afternoon session of the webinar was of parallel, specialized seminars of each project. During the FF-IPM’s seminar which was entitled “Fruit fly trapping & surveillance” David Nestel from ARO, Andrea Sciarretta from UNIMOL (both important partners of the project) and David João Horta Lopes from the University of Azores, presented the known and the emerging technologies and strategies related to trapping and surveillance, providing experimental and working data, real case studies and more.



2 years FF-IPM:

The progress during the 2nd year

2020-2021: The technical milestones and achievements of FF-IPM

- Report of the host status of fruitlets of apple, peach and citrus species for *Ceratitis capitata*
- Improved and tested Delta and McPhail e-traps
- Technical documentation for application of lure and kill as OF-Season IPM tools
- Draft documentation of prototype Virtual-Farm DSS tool
- Initial version of FF-IPM management platform fully functional

2020-2021: The impact of FF-IPM

Drivers of pest emergence

- Novel data on plastic and adaptive response of three FF species to abiotic stress have been generated.
- Data on overwintering already considered by modelers
- Climex, Dymex and Pest on farm modelling has been advanced covering the whole spatial continuum
- Climate change scenarios can be addressed considering the above modelling approaches

Prevention, detection and control tools

- Progress of spatial modelling provides the foundation for the development of a "Pan-European FF Alert system"
- Progress on e-nose system development and the ID tools that have been advanced contribute to improve FF interception in EU ports of entry
- Progress on e-trap and image recognition algorithm development contribute to advance the FF detection approaches

Sound solution for pest management

- The virtual farm DSS has been advanced
- The overwintering drivers of Cc in several pilot sites has been determined.
- The off-season performance of various IPM tools have been determined.
- All the above provide the foundation for the development of the OFF-Season management approach.

Reduction of economic, social & environmental losses

- E-trap development and advances in spatial modelling suggest that the expected 15% reduction in surveillance cost can be achieved

Support EU plant health policies

- The already established network of major stakeholders (NPPO, EPPO, IAEA, EFSA) assures the smooth delivery of the FF-IPM generated knowledge to policy implementing authorities
- Already developed risk maps based on Climex modelling can be used by policy implementing authorities

FF-IPM presentation at the 15th Slovenian Conference on Plant Protection with International Participation

From Tuesday, March 1, 2022, until Wednesday, March 2, 2022 the 15th Slovenian Conference on Plant Protection with International Participation took place in the Grand Hotel Bernardin Congress Center in Portorož, Slovenia. The conference of the Plant Protection Association of Slovenia is the most important event of Slovenian experts in the field of plant protection.

The presentation of Prof. Nikos T. Papadopoulos was entitled **“Addressing invasive pests in European fruit production systems”**. Read the abstract below:



Biological invasions are currently, considered one of the main concerns affecting national and regional economies, ecosystems functions, sustainable production of agricultural goods, pesticide use, conservation and epidemiology of vector borne diseases. Despite intense efforts within the European Union to impose, support and coordinate the implementation of actions to address invasive pests, there is an increasing record of invasion events and a rather slow and often unsuccessful response. Fruit and vegetable production systems are amongst the most vulnerable to invasion, mainly because of fresh commodities trading and the human mobility that results in dispersion of propagules in long distances.

Bringing true fruit flies as a model system, the Horizon 2020 funded project FF-IPM “In-silico boosted, pest prevention and off-season focused IPM against new and emerging fruit flies” tackles all phases of invasion (arrival, establishment,

naturalization, and dispersion) and generates novel tools and approaches to enhance stakeholders’ capacity to predict invasion risk, intercept, and detect invasive species, and apply novel, ecologically friendly management approaches. Novel e-nose systems to intercept fruit fly infested fruits in cargo shipments, as well as electronic traps and advanced detection and surveillance systems have been developed. Thorough climatic and population modelling that estimates establishment risk at a spatial and temporal continuum for three fruit fly species have been generated. Last but not least, computer assisted Integrated Pest Management (IPM) strategies for off and on season implementation are currently pilot tested. Bringing concepts, approaches, and developments of the FF-IPM project as a “live example” the current paper discusses the weaknesses of the European system to deal with ongoing invasion events and the opportunities to establish a more efficient preparedness strategy against biological invasions in fruit producing systems.



Fruit Flies In-silico
Prevention & Management
FF-IPM

 Horizon 2020
European Union Funding
for Research & Innovation

