Watch Letter

CIHEAM

Invasive species in the Mediterranean

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International Centre for Advanced
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CIHEAM
International Centre for Advanced Mediterranean Agronomic Studies

About CIHEAM

Founded in 1962, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) is an intergovernmental organisation composed of thirteen member states (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey).

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The Watch Letter

This Quarterly Letter has been published since 2007 and is devoted to major topics in Mediterranean Agriculture, Food and Environment.

While enabling the CIHEAM to gain a widespread recognition, it circulates analyses aimed at a heterogeneous public (policymakers, researchers, journalists, etc.) on emerging agricultural and food issues. The objective of the Watch Letter is to provide brief analyses which will fuel both the discussion on the Mediterranean and the broader global debate on food and agriculture.

The General Secretariat of Paris is responsible for the direction and the management of this bilingual publication (English and French), also available in Arabic.

Watch Letter's Organization Chart

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Editorial

Cosimo Lacirignola
CIHEAM Secretary General

In a context marked by the intensification of trade, the acceleration of population mobility and greater frequency of extreme climatic changes, crops are becoming increasingly vulnerable, especially due to invasive species. Most of the time, these invasive species manage to adapt to the spaces they invade and may significantly change existing ecosystems. They consequently become a growing problem for the countries as they affect the key sectors of their economy and present a series of emerging risks. This is particularly the case in Southern European, North African and Middle Eastern countries.

The prevention of their entrance or the rapid elimination of the inoculum once entered in a specific area or the containment of their spread if their elimination fails are the mandatory control measures which all countries should apply fulfilling the quarantine principles as it occurs in the human and animal field. Based on the experience and knowledge gained in the countries where these species are present and on the research set up in the countries in which these invasions are occurring, specific control measures should be adopted for a successful management always in the respect of quarantine principles. Therefore, for a successful control of these phytosanitary emergencies, the Mediterranean countries have to address this challenge by working together. These species have many impacts on agricultural systems but can also affect human health and the environment. Moreover, the economic impacts are significant. The Mediterranean is particularly affected and vulnerable to invasive species. Recent concerns focus on the *Xylella fastidiosa* that is affecting the olive trees in the Puglia region in Southern Italy. However, this case reminds us that other dangers for Mediterranean agriculture and ecosystems exist.

Bringing together nearly 50 international experts (thanks to all of them for the contribution), this *Watch Letter n°33* therefore aims at presenting the problem of invasive species as a whole, by providing several specific cases in different countries of the Mediterranean region. The CIHEAM has been working on this issue for several years, by seeking to advance and share knowledge and preventive or curative techniques at Euro-Mediterranean level. Besides, convinced that in the context of trade globalisation, invasive species represent a real economic, social and ecological threat for Mediterranean countries, the CIHEAM has been ceaselessly alerting the international community to the growing complexity of this issue.

More research, more interdisciplinary approaches, more cooperation and more communication will be crucial to adapt to the multidimensional challenges of invasive species. The articles published in this issue show that the subject deserves more attention from policy makers, media observers and development actors at a time when climate, agriculture and food security challenges should be addressed with a lot more interaction.

Renforcer les capacités phytosanitaires au Proche Orient pour une meilleure sécurité alimentaire

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L'accroissement des échanges commerciaux associés au mouvement des voyageurs et à l'amélioration des moyens de transports augmente les risques d'introduction et de dissémination des organismes nuisibles. Un organisme nuisible est défini comme toute espèce, souche ou biotype de végétal, d'animal ou d'agent pathogène nuisible pour les végétaux ou produits végétaux (NIMP 5). Cette définition inclut les plantes exotiques envahissantes. Par ailleurs, les changements climatiques ne font qu'accentuer ces menaces. Ils accroissent les probabilités d'installation des organismes nuisibles introduits, leur dissémination et l'ampleur des dégâts qu'ils peuvent engendrer.

Le caractère transfrontalier des organismes nuisibles nécessite la mise en place d'une plateforme internationale pour examiner les problèmes phytosanitaires actuels et potentiels afin de mettre en œuvre une stratégie concertée capable de prévenir leur dissémination et leur introduction mais aussi préserver ainsi le patrimoine agricole et la biodiversité végétale. A ce titre, la Convention Internationale pour la Protection des Végétaux (CIPV) a pour mission d'assurer la coopération entre les pays pour la protection des ressources végétales mondiales contre l'introduction et la dissémination des organismes nuisibles aux plantes, afin de soutenir la sécurité alimentaire, de préserver la biodiversité et de faciliter le commerce.

La région méditerranéenne, particulièrement vulnérable aux changements climatiques et grand centre du commerce international de végétaux et de produits végétaux, est fortement exposée aux organismes nuisibles. La CIPV opère au travers d'Organisations Régionales pour la Protection des Végétaux (ORPV) et a reconnu pour la région du Proche Orient l'Organisation Régionale pour la Protection des Végétaux au Proche Orient (NEPPO). La NEPPO est ainsi investie d'une mission de coordination entre les pays du Proche-Orient pour faire face à ces menaces phytosanitaires et protéger le patrimoine végétal et agricole de la région en mettant en œuvre une stratégie régionale répondant à ses besoins spécifiques.

En outre, les défis phytosanitaires sont nombreux dans la région méditerranéenne. Des activités et des projets sont actuellement entrepris, visant à renforcer les capacités phytosanitaires et à ainsi doter les pays des connaissances, outils et compétences requis pour lutter efficacement contre les organismes nuisibles. Pour mener à bien les missions visant à prévenir l'introduction et la dissémination d'organismes nuisibles, des besoins pressants en termes de travail en commun se confirment. Ces dynamiques appellent à davantage de coopération à court comme à moyen terme.

Contexte et défis phytosanitaires

Le contexte agricole en région méditerranéenne

La rive sud de la Méditerranée est caractérisée par un climat méditerranéen, avec des étés chauds et secs et des hivers doux et humides. La zone proche orientale est quant à elle caractérisée par des climats plus arides, voire désertiques. La production agricole au Proche-Orient[1] revêt une grande importance pour répondre aux besoins alimentaires de la population, pour l'alimentation du bétail ainsi que pour stimuler l'économie de certains pays par les exportations. Cette production est rendue difficile du fait de la rareté des terrains agricoles et du manque d'eau. Les principales productions végétales de la zone du Proche-Orient sont les suivantes, selon les données de FAOSTAT: les céréales (le blé, le maïs, l'orge, le riz, etc.), l'olivier, le palmier, les légumineuses (fèves, lupins, haricots, pois chiches, etc.), les oléagineuses (tournesol, sésame, colza, etc.) et les espèces maraîchères (pomme de terre, tomate, etc.).

Malgré les efforts investis pour augmenter la productivité végétale, la région demeure un importateur net de céréales pour subvenir aux besoins de sa population. Un facteur essentiel pour assurer la sécurité alimentaire réside dans la réduction voire l'élimination des pertes dues aux organismes nuisibles en instaurant une bonne protection phytosanitaire. Les organismes nuisibles incluant les plantes exotiques envahissantes constituent en effet une menace majeure pour la productivité agricole, pour les activités économique (notamment l'accès aux marchés) ainsi que pour l'environnement. Leurs introductions et disséminations, pour la plus grande part en tant que contaminants de végétaux et de produits végétaux, sont accélérées dans le contexte de la globalisation et du changement climatique. Les espèces tropicales, dans la zone, sont de plus en plus en mesure de s'adapter avec le changement climatique. Celle-ci doit donc gérer des organismes nuisibles présents sur son territoire, mais aussi prévenir l'arrivée de ceux à venir.

Les menaces phytosanitaires

Le secteur agricole reste ainsi handicapé par les menaces phytosanitaires. Parmi les organismes nuisibles (incluant les plantes exotiques envahissantes) qui représentent actuellement des préoccupations majeures, citons notamment :

- La mineuse de la tomate, *Tuta aboluta* (Lepidoptera : Gelechiidae), originaire d'Amérique du Sud et qui a récemment colonisé le Proche-Orient ainsi que l'Europe. L'hôte principal de *Tuta absoluta* est la tomate, mais l'espèce s'attaque également à la pomme de terre. Ce Lépidoptère a un très fort potentiel reproductif et peut générer 10 à 12 générations par an. Ceci se traduit par des dégâts occasionnant des pertes de rendement sur tomate de 50 à 100%, selon la région et le type de culture (sous abri ou en plein champ).

- Le charançon rouge du palmier, *Rhynchophorus ferrugineus* (Coleoptera, Curculionidae), originaire d'Asie, a entraîné des dégâts considérables dans les pays du Golfe. L'introduction de cette espèce au Maroc et en Tunisie (respectivement à Tanger au Maroc et à Carthage en Tunisie) a conduit à la destruction de centaines d'arbres de palmiers. Il nuit à la production de 45% de dattes. Sa dissémination éventuelle aux oasis, où les palmiers dattiers constituent une source de revenus appréciable, constitue une menace et aurait des conséquences socio-économique et environnementale considérables (destruction des écosystèmes, désertification et exode rural).

- Le bayoud, *Fusarium oxysporum* f. sp. *albedinis* (Hypocreomycetidae : Nectriaceae) est une maladie cryptogamique qui a détruit plus de 10 millions de palmiers au Maroc, en Algérie et en Mauritanie. Son introduction dans les autres pays de la région pourrait occasionner de graves dégâts dans la zone, première productrice de dattes au monde.

- La cératite, *Ceratitis capitata* (Diptera : Tephritidae) est une mouche des fruits largement répandue en Afrique et en Méditerranée. Cette espèce a pour hôtes majeurs *Citrus* spp. et a également de nombreux hôtes mineurs et constitue un obstacle et un facteur limitant pour l'accès aux marchés, la cératite étant un organisme de quarantaine[2] dans de nombreux pays.

- La morelle jaune, *Solanum elaeagnifolium* (Solanaceae) est une plante exotique envahissante originaire d'Amérique centrale qui s'est disséminée dans de nombreux pays de la région : Algérie, Egypte, Liban, Maroc, Israël, Tunisie, Iraq, etc. Les moyens de lutte restent difficiles à mettre en œuvre. L'espèce se multiplie aussi bien par semences dispersées par l'eau et le vent, que végétativement, un bout de racine de 2 cm pouvant donner naissance à un nouvel individu. La morelle jaune a de gros impacts sur les rendements de blé, maïs, coton, sorgho, et constitue un réservoir pour des maladies affectant les cultures.

- Le greening des agrumes, *Liberibacter asiaticus* (Proteobacteria) est une bactérie originaire d'Asie qui réduit significativement la production des *Citrus* spp. et constitue une menace pour l'accès au marché, l'espèce étant un organisme de quarantaine pour de nombreux pays. Le greening des agrumes est présent en Iran, au Pakistan, en Arabie Saoudite et au Yémen. Sa distribution doit être contenue afin que les autres pays de la zone ne soient pas affectés.

[1] La zone Proche-Orient est entendue dans cet article comme comprenant l'Algérie, l'Egypte, l'Iran, l'Iraq, la Jordanie, la Mauritanie la Libye, Malte, le Maroc, le Pakistan, le Soudan, le Sultanat d'Oman, la Syrie, la Tunisie et le Yémen.

[2] Un organisme de quarantaine est défini selon la NIMP 5 comme un organisme nuisible qui a une importance potentielle pour l'économie de la zone menacée et qui n'est pas encore présent dans cette zone ou bien qui y est présent mais n'y est pas largement disséminé et fait l'objet d'une lutte officielle.

– *Le Xylella fastidiosa* (Gammaproteobacteria : Xanthomonadaceae) est une bactérie originaire d'Amérique du Sud qui a récemment été introduite par des plants de caféiers contaminés dans les Pouilles en Italie où plus de 8000 hectares d'oliveraies ont déjà été détruits pour tenter de contenir ce ravageur. Cette bactérie est très polyphage et peut contaminer la vigne et ses portes greffes, les fruits à noyaux (pêchers, pruniers, abricotiers, etc.) ainsi que l'olivier. La bactérie n'est pour l'instant présente que dans le sud de l'Italie, mais pourrait potentiellement constituer une menace majeure pour toute la région.

La région méditerranéenne est sujette aux attaques de bien d'autres organismes nuisibles : la mouche de l'olive *Bactrocera olea* (Arthropoda : Tephritidae), la mouche orientale des arbres fruitiers *Bactrocera dorsalis* (Arthropoda : Tephritidae), le mildiou de la pomme de terre *Phytophtora infestans* (Chromista : Peronosporaceae), le parthenium matricaire *Parthenium hysterophorus* (Plantae : Asteraceae) ou encore la jacinthe d'eau *Eichhornia crassipes* (Plantae : Pontederiace).

Les activités phytosanitaires consistent à lutter contre les organismes nuisibles déjà présents dans la région, et à prévenir l'introduction et la dissémination d'organismes nuisibles qui pourraient être introduits. Cette lutte nécessite un ensemble de compétences et de ressources en termes de surveillance, de diagnostic, de certification à l'import et à l'export, d'échange d'informations, d'analyse de risque, de gestion sur le terrain, etc. Au-delà de ces activités communes à tout pays protégeant son territoire des organismes nuisibles, la zone méditerranéenne doit faire face à un contexte géopolitique instable de la région.

Les crises et conflits affectent en effet la bonne exécution des activités d'inspection et de gestion des végétaux et produits végétaux. Les produits entrant sont ainsi susceptibles d'être contaminés, et les organismes nuisibles, sans gestion suivie sur le terrain, peuvent rapidement se disséminer. Dans de telles situations, les pertes de récoltes liées aux organismes nuisibles aggravent une productivité agricole déjà réduite par manque de main d'œuvre, de semences et d'intrants. C'est pour cette raison que dans le secteur de la protection animale, la FAO a conduit une vaste campagne de vaccination du cheptel à la frontière entre la Syrie et le Liban. Le risque de diffusion de maladies animale est en effet accru du fait du mouvement de plus de 1.5 millions de réfugiés se déplaçant entre la Syrie et le Liban et transportant avec eux moutons et chèvres[3]. Malgré ces difficultés, la zone poursuit ses activités phytosanitaires pour protéger son agriculture et son environnement et ainsi assurer sa sécurité alimentaire et un meilleur accès aux marchés.

[3] Voir http://www.fao.org/news/story/en/item/282808/icode/

L'existant en termes de capacités phytosanitaires

Le déploiement des outils de la Convention Internationale pour la Protection des Végétaux (CIPV) pour le renforcement des capacités phytosanitaires

Les organismes nuisibles (incluant les plantes exotiques envahissantes) représentent une cause majeure d'insécurité alimentaire et de dégradations environnementales. Au plan international, la Convention Internationale pour la Protection des Végétaux (CIPV) est un accord international auquel 182 pays adhèrent et qui a pour objectif de protéger les plantes sauvages et cultivées en prévenant l'introduction et la dissémination d'organismes nuisibles. La CIPV opère en élaborant, avec la participation de ses parties contractantes, des normes internationales[4]. Elle a également pour missions le partage d'informations au travers des obligations de notification nationales, ainsi que la mise en œuvre effective des normes et recommandations formulées. En matière de mise en œuvre, la CIPV a ainsi développé un riche programme d'activités de renforcement des capacités qui se traduit concrètement par les éléments listés ci-dessous :

– La collecte et la diffusion d'informations. Les informations officielles concernant le statut d'organismes nuisibles dans les pays doivent être reportées à la CIPV qui en assure la diffusion. Ceci se traduit par la publication d'une lettre d'information sur les obligations nationales de notifications. Par ailleurs, des questionnaires sont envoyés aux pays et restitués au travers du système de support et de révision de la mise en œuvre (*Implementation Review and Support System* en anglais, soit l'IRSS).

– La tenue d'ateliers régionaux afin que les parties contractantes puissent préparer des positions communes sur les normes internationales pour les mesures phytosanitaires en préparation.

– La tenue d'ateliers de formation sur divers sujets transversaux (comme par exemple la surveillance, ou sur des organismes nuisibles spécifiques).

– La mise à disposition de ressources techniques, élaborées par la CIPV[5], ou mises à disposition par d'autres institutions[6]. La CIPV a produit un manuel sur l'accès au marché, une formation virtuelle sur l'Analyse du Risque Phytosanitaire est également à la disposition des experts souhaitant la suivre, et de nombreux manuel sur le diagnostic, l'export, les relations avec les différents acteurs, etc. seront très prochainement disponibles.

[4] Les normes internationales pour les mesures phytosanitaires (NIMPs) adoptées à ce jour sont disponibles au lien suivant : https://www.ippc.int/fr/core-activities/standards-setting/ispms/
[5] Voir http://www.phytosanitary.info/ippc-technical-resources
[6] http://www.phytosanitary.info/contributed-resources

– La conduite de projets dans le cadre desquels un bilan des activités et compétences phytosanitaires est réalisé dans un pays au moyen d'une évaluation des capacités phytosanitaires (ECP). Une ECP est un outil interactif créé pour conduire une analyse du système phytosanitaire en place et pour aider l'Organisation Nationale de Protection des Végétaux (ONPV, institution reconnue par la CIPV pour mener les diverses activités de protection des plantes) à évaluer ses progrès au cours du temps dans la mise en œuvre de la CIPV et des normes internationales sur les mesures phytosanitaires. Cette ECP est effectuée de manière participative au travers de divers ateliers réunissant les acteurs locaux et elle demeure confidentielle. Cette évaluation donne lieu à l'élaboration d'une stratégie phytosanitaire, ainsi qu'à la révision de la législation phytosanitaire et à des propositions concernant l'organisation et les compétences en matière phytosanitaire.

  Dans la région méditerranéenne, une ECP a récemment été conduite en Territoire palestinien occupé dans le cadre d'un projet de la FAO (voir l'encadré 1). D'autres projets de ce type sont également en cours d'exécution dans la zone. Un projet de formation de facilitateurs d'ECP est également mené par la CIPV avec le soutien financier du *Standard for Trade and Development Facility* (STDF), et des candidats de la région méditerranéenne devraient d'ici 2016 être en mesure de conduire ces ECP dans leurs pays[7].

Des efforts régionaux coordonnés

La CIPV s'appuie, pour la mise en œuvre de ses objectifs sur des Organisation Régionales de Protection des Végétaux (ORPV). Ces ORPV sont chargées de coordonner les Organisations Nationales de Protection des Végétaux (ONPV) au plan régional. Chaque ORPV développe son programme d'activités, et un pays peut adhérer à plusieurs ORPV. Une ORPV ne se substitute en aucun cas aux ONPV, son rôle étant plutôt la coordination des activités phytosanitaires à l'échelle régionale et le partage d'informations. Dans la région méditerranéenne, 2 ORPV exercent des activités complémentaires.

1) L'Organisation Européenne et Méditerranéenne pour la Protection des Végétaux (EPPO) opère depuis 1951 et rassemble 50 pays membres sur le continent Européen ainsi qu'en Méditerranée, dont l'Algérie, Israël, la Tunisie, le Maroc et la Jordanie. L'OEPP concentre ses activités sur l'élaboration de normes régionales : des lignes directrices sur les mesures phytosanitaires, des mesures de gestion d'organismes nuisibles, des protocoles de diagnostics, ainsi que l'identification de menaces émergentes pour la région au travers d'analyses du risque phytosanitaire (voir les activités de l'OEPP à *www.eppo.org*).

Encadré 1

Renforcement des capacités phytosanitaires en Territoire palestinien occupé

Informations fournies par Shadi Darweech, directeur de la quarantaine végétale et des mesures phytosanitaires au sein de l'ONPV du Territoire palestinien occupé

Le Territoire palestinien occupé a fait une demande de renforcement de ses capacités phytosanitaires auprès de la CIPV en 2013. Cette requête s'est concrétisée par la conduite d'une Evaluation des Capacités Phytosanitaires dans ces territoires, dans le but d'élaborer un plan de travail national phytosanitaire.

Le projet a été conduit sur le terrain de mai 2014 à mars 2015 et coordonné par la CIPV. Les 13 modules de l'ECP ont été appliqués lors de 6 ateliers conduits de juin à octobre et réunissant et impliquant les acteurs pertinents pour le secteur de la protection des végétaux, et notamment le personnel de l'ONPV. Ces ateliers participatifs ont permis de faire un bilan des forces, des faiblesses, de leurs conséquences et des opportunités et d'élaborer un plan d'action national phytosanitaire. Des ateliers finaux ont été organisés en février 2014 afin de valider le plan d'action national phytosanitaire.

Cette ECP a mis en évidence, entre autre, que le statut politique du Territoire palestinien occupé, ainsi que le manque d'une législation unique portant protection des végétaux constituent des faiblesses. En revanche, la stratégie à l'export, les structures en place et le personnel, ainsi que la forte motivation du Territoire palestinien occupé à joindre les organisations internationales constituent des forces sur lesquelles s'appuyer pour améliorer ses capacités et sa situation phytosanitaires. Un plan de développement des capacités phytosanitaires a identifié la nécessité de produire les ressources suivantes d'ici à 2021 :

- une législation complète portant protection des végétaux et sa promulgation ;
- une stratégie claire de l'ONPV avec un budget ;
- une stratégie de mise en œuvre du diagnostic des organismes nuisibles ;
- un plan stratégique pour la surveillance et pour l'éradication ;
- un programme pour la mise en œuvre de l'analyse du risque phytosanitaire.

7 Une base de données des projets phytosanitaires est consultable sur: *http://www.phytosanitary.info/projects*.

2) La CIPV a soutenu la récente institution de l'Organisation pour la Protection des Végétaux au Proche-Orient (NEPPO), une organisation intergouvernementale régionale entrée en vigueur le 9 Janvier 2009. Douze pays participent activement aux activités de la NEPPO : l'Algérie, l'Egypte, l'Iraq, la Jordanie, la Libye, Malte, le Maroc, le Pakistan, le Soudan, le Sultanat d'Oman, la Syrie et la Tunisie, et 3 pays supplémentaires ont signé l'agrément mais ne l'ont pas encore ratifié : l'Iran, la Mauritanie et le Yémen. Chacun de ces 15 pays dispose d'une ONPV chargée des responsabilités définies par la CIPV dans son texte fondateur[8]. Ces missions consistent entre autres en la délivrance de certificats relatifs à la réglementation phytosanitaire pour les envois de végétaux, produits végétaux et autres articles réglementés ; la surveillance des végétaux sur le territoire ; l'inspection des envois de végétaux et produits végétaux faisant l'objet d'échanges internationaux, etc. *(voir encadré 2)*

Encadré 2

Activités de la NEPPO

La NEPPO facilite en premier lieu l'échange d'informations entre les pays de la zone, et s'attache également à accroître la participation des pays aux activités de la CIPV. Un atelier sur les bonnes pratiques a ainsi été organisé à Hammamet (en Tunisie) en mars 2014 sur les bonnes pratiques pour la participation aux réunions de la CIPV (voir *http://www.neppo.org/2014/03/03/participation-aux-reunions-de-ippc/*).

La NEPPO organise des ateliers afin de partager des informations sur des organismes nuisibles spécifiques menaçant la zone. La NEPPO s'est également dotée d'un site internet sur lequel figurent des informations sur les évènements organisés, les nouvelles phytosanitaires, et fournira à terme des informations techniques sur les organismes nuisibles d'intérêt pour la zone (champignons, bactéries, insectes, nématodes, virus, acariens, plantes, etc.).

La NEPPO s'attache de plus à renforcer les capacités de ses pays membres et à les accompagner dans les activités dévolues aux ONPV, tout particulièrement la surveillance, le contrôle phytosanitaire et la certification phytosanitaire. Un projet financé par le Royaume-Uni est également en cours et vise à effectuer des évaluations des capacités phytosanitaires rapides dans 6 pays de la zone NEPPO afin d'élaborer une stratégie phytosanitaire globale pour la zone. Ce projet s'attache aussi à former le personnel des ONPV en matière d'analyse de risque phytosanitaire.

[8] Voir https://www.ippc.int/static/media/files/publications/fr/2013/06/03/1034340690890_frippc_201304232117fr.pdf

Malgré ces efforts, des besoins en matière de partage d'information et de mutualisation des efforts se font sentir. Il serait stratégique de pouvoir y répondre de manière concrète grâce par exemple à une action synergique entre les pays et les Organisations Internationales opérant dans la région.

Quels besoins en matière phytosanitaire ?

Besoin d'un échange d'informations accru entre les pays de la zone NEPPO

Les organismes nuisibles ne connaissent pas de frontières, leurs mouvements sont accélérés par la globalisation et leurs impacts accentués par les changements climatiques et les pratiques agricoles intensives telles la monoculture qui déséquilibre les agro-écosystèmes. La base de tout système phytosanitaire consiste en l'obtention et l'échange d'information, et nécessite en particulier la mise en place à l'échelle de la région :

- d'un système de collecte et de traitement des informations concernant la présence et le statut d'organismes nuisibles (incluant les plantes exotiques envahissantes) efficace. La collecte d'informations de terrain s'effectue de plus en plus en impliquant activement différents publics sensibilisés : les opérateurs des ministères en premier lieu, mais également les chercheurs, les agriculteurs, et de plus en plus des citoyens motivés au travers des sciences citoyennes. Ce système intégré de collecte d'informations implique que les agents soient formés, que les données soient vérifiées puis stockées dans une base de données *ad hoc*.

- d'un système de diffusion et de communication rapide et en temps réel entre différents acteurs impliqués dans la collecte d'information, et entre les pays. Cet échange d'informations serait réalisé en premier lieu au niveau national puis entre pays afin de permettre la mise en œuvre de mesures phytosanitaires adéquates pour anticiper l'introduction d'un organisme nuisible nouvellement introduit dans la région. Les notifications sur le statut d'organismes nuisibles constituent une obligation des pays adhérant à la CIPV. Ces informations doivent ainsi être partagées officiellement avec la CIPV au travers de son portail (*www.ippc.int*).

Les activités de surveillance sont fondamentales dans toute la chaîne de décisions et d'opérations phytosanitaires. De manière plus globale, impliquer différents acteurs dans la collecte d'informations sur les organismes nuisibles incluant les plantes exotiques envahissantes requiert que leur attention ait été portée sur ce sujet de manière adéquate pour les motiver à contribuer. Dans la région NEPPO, mais c'est également vrai dans beaucoup de régions du monde, la compréhension de ce qu'est un organisme nuisible, de ses impacts et des activités conduites par les organisations nationales de protection des végétaux restent cantonnées aux professionnels du domaine et n'a pas encore percé auprès d'un public plus vaste.

Un réel effort pour savoir quels sont les outils et méthodes de divulgation qui fonctionnent pour communiquer sur les organismes nuisibles est nécessaire. La polémique et l'expression de messages contradictoires dont a fait l'objet le foyer de *Xylella fastidiosa* dans les Pouilles en Italie est éloquent sur le besoin de mieux informer la société civile. Ces activités d'information doivent être inscrites dans une stratégie phytosanitaire plus vaste, qui fait encore défaut à l'échelle de la région NEPPO.

Définir une stratégie phytosanitaire commune pour la région NEPPO

Certaines activités phytosanitaires, telles la surveillance et la gestion d'organismes nuisibles, ne sont pleinement efficaces que si elles sont mises en œuvre à une échelle régionale. D'autres activités doivent être conduites en commun afin d'optimiser les ressources entre les pays, c'est le cas de la conduite d'analyses de risque. Tous ces aspects doivent figurer dans une stratégie phytosanitaire commune, que les pays de la région NEPPO doivent élaborer conjointement. Cette stratégie phytosanitaire régionale, qui verra le jour dans le cadre du projet financé par le Royaume-Uni, pourra notamment s'attacher à :

- La mise en place d'un réseau de surveillance, dont les principaux problèmes phytosanitaires identifiés sont les mouches des fruits (Bactrocera zonata et B. dorsalis), le greening des agrumes (Liberibacter asiaticus) et ses vecteurs, le charançon rouge du palmier (Rhynchophorus ferrugineus) et le bayoud des palmiers ((Fusarium oxysporum. f.sp. albedinis). Ce réseau permettrait aux pays indemnes d'anticiper la dissémination de ces ravageurs ;

- La conduite d'analyse du risque phytosanitaire à l'échelle de la région NEPPO pour la mise en place d'un plan d'urgence pour les principaux organismes nuisibles identifiés ;

- La mise en place d'un groupe chargé de l'élaboration de normes régionales sur les mesures phytosanitaires (par exemple sur la gestion des palmiers) ;

- Une harmonisation sur les procédures d'inspection et le diagnostic, qui se traduirait en pratique par des formations communes et sur l'élaboration de normes régionales sur ces sujets ;

- L'harmonisation des législations phytosanitaires avec le texte de la CIPV ;

- La communication sur les risques phytosanitaires avérés et émergents.

Conclusions

Les menaces phytosanitaires actuelles et émergentes qui pèsent sur la région méditerranéenne représentent un risque bien réel et considérable dont les dommages se chiffrent en millions de dollars US, mais aussi en impacts sociaux et environnementaux. Les risques phytosanitaires demeurent encore trop peu connus des politiques, mais aussi de la société civile. Les sujets phytosanitaires doivent être portés à la connaissance du plus grand nombre de manière objective car les risques d'introduction et de dissémination d'organismes nuisibles (incluant les plantes exotiques envahissantes) sont accrus de part l'explosion des échanges commerciaux et le changement climatique.

La région méditerranéenne est particulièrement exposée et doit mutualiser les informations phytosanitaires disponibles. La région doit de plus se doter d'une stratégie phytosanitaire régionale concertée impliquant tous les pays de la zone et permettant une coordination de leurs activités. La NEPPO, en tant qu'ORPV reconnue par la CIPV, a un rôle clé à jouer dans la mise en œuvre et le renforcement des capacités phytosanitaires au Proche Orient. La FAO et la CIPV s'attachent de leur côté à fournir les outils les plus appropriés pour améliorer la situation phytosanitaire dans la région méditerranéenne et ainsi contribuer à l'éradication de la faim et de la pauvreté.

Remerciements

Nous tenons à exprimer nos remerciements à Monsieur Shadi Darweech qui nous a fourni des informations sur le projet d'évaluation des capacités phytosanitaires dans le Territoire occupé Palestinien, ainsi qu'à Orlando Sosa, Ana Peralta et Craig Fedchock de la CIPV pour leur support. Nous remercions également Céline Germain de la CIPV et Nora Ourabah Haddad du Bureau pour la communication, les partenariats et des activités de plaidoyer de la FAO pour leurs relectures attentives.

Bibliography / More information

- NIMP 5 (Norme Internationale pour les Mesures Phytosanitaires n° 5). Glossaire des termes phytosanitaires. Rome, CIPV, FAO. 42 p. https://www.ippc.int/static/media/files/publication/fr/2015/04/ISPM_05_Fr_2015-04-29_dUbb022.pdf

- FAO (2013) Nos priorités. Les objectifs stratégiques de la FAO. 16 p. http://www.fao.org/docrep/018/mi317f/mi317f.pdf

- Site Internet de la Convention Internationale pour la Protection des Végétaux : https://www.ippc.int/en/

- Site Internet sur les Ressources Phytosanitaires de la CIPV : http://www.phytosanitary.info/

- Site Internet de la NEPPO : http://www.neppo.org/

- Site Internet de l'OEPP : http://www.eppo.int/

Focus on…Euphresco: European Phytosanitary Research Coordination network

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Introduction

The five Mediterranean-climate regions of the world (southern and south-western Australia, central Chile, coastal California, Western Cape of South Africa and the Mediterranean basin) occupy less than 5% of Earth's surface yet harbour almost 20% of the total vascular plants[1]. The Mediterranean basin in particular is home to 25 000 plant species, of which 13 000 are endemic (i.e. they are found nowhere else on Earth) and it was identified by Myers and collaborators as a biodiversity hotspot experiencing exception loss of habitat[2]. The threats associated with climate change and the increase in global trade open new pathways for the introduction of invasive alien species and the need to tackle plant pests is more important than ever.

If the countries of the Mediterranean basin face similar problems in relation to agriculture and their ecosystem, these issues are still handled nationally while transnational cooperation will accelerate the development of solutions to protect the environment and support the economy[3].

This fragmentation is not limited to the Mediterranean basin, but is a character of the whole of Europe and is based on historical heritage. One solution to improve co-operation is the development of a European Research Area (ERA), an area where ideas, knowledge and people could circulate freely. A lot of work needs to be done to establish this ERA, but some progress has been made since the concept was endorsed at the Lisbon European Council (2000).

Euphresco ERA-NET

ERA-NET schemes have been developed to ease the opening of national and regional research programmes, to strengthen their coordination, and to support joint activities as joint calls for transnational research projects. Among the various ERA-NETs funded so far by the EU Framework Programmes, EUPHRESCO European Phytosanitary Research Coordination ERA-NET (2006-2014) aimed at underpinning European plant health policy and its implementation, sustaining European plant health science capability, optimising the use of limited resources and producing optimal research outputs. In a transition period for the economy (reduced availability of funds), for the phytosanitary field (lack of staff, development of new technologies that have to be mastered) and for the environment (number and complexity of plant pest problems increases every year), EUPHRESCO ERA-NET was seen as an opportunity to 'perform more with less'.

As a network of European (public or non-profit) organisations funding and/or managing national phytosanitary research programmes, Euphresco members have funded a number of research projects of interest for the Mediterranean basin.

[1] *Cowling R.M., Rundel P.W., Lamont B.B., Kalin Arroyo M., Arianoutsou M. Plant diversity in Mediterranean-climate regions. Trends Ecol Evol. 11(9): 362-6 (1996).*

[2] *Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A., Kent J. Biodiversity hotspots for conservation priorities. Nature 403(6772): 853-8 (2000).*

[3] *Mediterra 2008. The Future of Agriculture and Food in Mediterranean Countries* / International Centre for Advanced Mediterranean Agronomic Studies. – Paris: Presses de Sciences Po, 2008.

Tableau 1*
List of Research projects launched by Euphresco

Country	Organisation
Austria	Ministry of Agriculture and Forestry, Environment and Water Management
Belgium	Federal Public Service Health, Food Chain Safety and Environment
	Institute for Agricultural and Fisheries Research
	Walloon Agricultural Research Center
Bulgaria	Bulgarian Food Safety Agency
Denmark	Ministry of Food, Agriculture and Fisheries, Danish AgriFish Agency, Department of Plants
Estonia	Ministry of Agriculture
Finland	Ministry of Agriculture and Forestry
France	French Agency for Food, Environmental and Occupational Health & Safety
	Ministry of agriculture, agro-food and forestry, General directorate for food
	National Institute for Agricultural Research
Germany	Federal Ministry of Food and Agriculture
Greece	Benaki Phytopathological Institute
Hungary	Ministry of Agriculture
Ireland	Department of Agriculture, Food and the Marine
Italy	Agricultural Research Council
	Ministry of agricultural food and forestry policies
Latvia	Ministry of Agriculture
Lithuania	Ministry of Agriculture of the Republic of Lithuania
Netherlands	Ministry of Economic Affairs, Department of Agroknowledge
Portugal	National Institute for Agricultural and Veterinarian Research
Russian Federation	All-Russian Plant Quarantine Centre
Slovenia	Ministry of Agriculture, Forestry and Food
Spain	National Institute for Agricultural Research and Food Technology
Sweden	Swedish Board of Agriculture
Switzerland	Federal Office for Agriculture
United Kingdom	Department for Environment, Food and Rural Affairs
	Forestry Commission
	Science and Advice for Scottish Agriculture

** The full list of research projects funded so far can be found on the Euphresco website: http://www.euphresco.net/projects/portfolio*

The procedure through which research topics are selected for funding has been running for a number of years and it is now consolidated. Each member of Euphresco can propose topic suggestions as national priorities that can be supported by other Euphresco members. If a topic reaches the minimum level of trans-national interest (two funders from two different countries) it can be proposed to become an official Euphresco topic. The detailed topic description and the funding mechanism (non-competitive or competitive) for each topic are agreed by the funders behind each topic, and the funders are also involved in the selection of the proposals.

Research organisations in countries represented within Euphresco are eligible for funding. For those countries not yet in the network it is still possible to participate in research projects funded through Euphresco provided that the research activity they propose is in line with the topic objectives set-up by Euphresco funders and that they fund their own research.

Examples of the approximately fifty research projects funded include:

- The project 'Validation of diagnostic methods for the detection and identification of whitefly-transmitted viruses of regulatory or quarantine concern to the EU' (2008-2009) was funded through Euphresco. *Bemisia tabaci* is vector of 111 plant infecting viruses causing severe losses to the horticultural industries in the Mediterranean basin. The emergence of the polyphagous B biotype of *B. tabaci* has given whitefly-transmitted viruses a mode to infect new plant species. The project focussed on real-time and conventional PCR methods for the diagnosis of the following viruses: *Tomato infectious chlorosis virus* (TICV), *Tomato chlorosis virus* (ToCV), *Cucumber vein yellowing virus* (CVYV) and *Cucurbit yellow stunting disorder virus* (CYSDV). Trials were organised among the different laboratories involved in the project to blind-test samples of healthy and infected plant material. The project produced test validation data for the detection and identification of the above viruses which will benefit to National Plant Health Service laboratories and promoted the use of TaqMan real-time PCR as an efficient method for the diagnosis of the viruses.

- During the same period (2008-2009) the project 'Development and validation of innovative diagnostic tools for the detection of fire blight *Erwinia amylovora*' validated methods for strain level genotyping and source tracking of *Erwinia amylovora*, a quarantine bacterium in Europe which is responsible for a devastating disease of apple and pears. The EU-28 is a leading producer of fresh pome fruits and the pest represents then a serious threat to European economy. The development and validation of these methods allows distinction of *Erwinia amylovora* strains from different geographical regions in order to identify inoculum sources. Several genomic markers were identified and evaluated for their potential use in strain genotyping, including genomic rearrangements, Variable Number Tandem Repeat (VNTRs) and plasmid content. VNTRs and plasmid content were determined to have the highest potential for application in pathogen source tracking. High-throughput PCR tests based on the VNTR system and plasmid typing tests were developed and validated for source tracking. Newly available tests such as new PCR assay and real time PCR were reviewed with respect to their performance criteria. The final results of test performance study showed that Isolation, conventional PCR assays according

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Llop 1999[4], Taylor 2001[5], Stöger 2006[6] and Obradovic 2007[7] and real time PCR assay according Pirc 2009[8] with the tested DNA extraction protocols can be recommended for the analysis of asymptomatic and symptomatic plant material.

– More recently (2014-ongoing) the project 'IPM strategies against *Drosophila suzukii*' was funded to develop integrated control strategies to reduce the huge economic impact of this pest that since the first European record (Spain 2008) has spread through most of the Mediterranean and continues its colonisation towards north and east. Contrary to most of drosophilid flies that oviposit on overripe fruits, *D. suzukii* is able to lay eggs in fresh ripening fruits causing physical damage to the host fruits, that become soft and rot rapidly. Secondary pathogens infections via the oviposition wound can further increase the damage. Furthermore, a high variety of wild fruits are also hosts of the spotted-wing drosophila, thus acting as reservoirs from which the fly can infest cultivated fruits[9]. The current methodologies employed for the control of *D. suzukii* are mainly based on the use of insecticides; however, the range of insecticides is being progressively restricted. In this context, the development of Integrated Pest Management (IPM) solutions for the control of *D. suzukii* is of great importance to reduce the huge economic impact that this fly can potentially exert on European agriculture (damage produced by this pest species can be up to 80% crop loss). The project will improve the knowledge of the biology of the pest species and of the ecological factors that determine the abundance, dispersal and survivorship of field populations. Also, alternative plant protection products which are environmentally safer and with a different mode of action (entomopathogenic microorganisms and the insect growth regulators) to those employed currently will be evaluated. Easy to handle monitoring and trapping devices will be developed.

[4] *Llop, P., Caruso, P., Cubero, J., Morente, C., and López, M.M. A simple extraction procedure for efficient routine detection of pathogenic bacteria in plant material by polymerase chain reaction. Journal of Microbiological Methods 37: 23-31 (1999).*
[5] *Taylor, R.K., Guilford, P.J., Clark, R.G., Hale, C.N. and Forster, R.L.S. Detection of Erwinia amylovora in plant material using novel polymerase chain reaction (PCR) primers. New Zealand Journal of Crop and Horticultural Science 29: 35-43 (2001).*
[6] *Stöger, A., Schaffer J., Ruppitsch W. A Rapid and Sensitive Method for Direct Detection of Erwinia amylovora in Symptomatic and Asymptomatic Plant Tissues by Polymerase Chain Reaction. J. Phytopathology 154, 469–473 (2006).*
[7] *Obradovic D., Balaz J., Kevresan S. Detection of Erwinia amylovora by Novel Chromosomal Polymerase Chain Reaction Primers. Microbiology 76 (6), 748-756 (2007).*
[8] *Pirc, M., M. Ravnikar, J. Tomlinson, T. Dreo. Improved fireblight diagnostics using quantitative real time PCR detection of Erwinia amylovora chromosomal DNA. Plant Pathology, 58:872-881 (2009).*
[9] *Cini A, Ioriatti C & Anfora G. A review of the invasion of Drosophila suzukii in Europe and a draft research agenda for integrated pest management. Bulletin of Insectology 65(1):149-160 (2012).*

Euphresco durable and self-sustainable network

Since April 2014 Euphresco (www.euphresco.net) is a self-funded phytosanitary network in Europe supported by its members and accountable to them. Recently the network has been recognised by the Working Party of Chief Officers of Plant Health Services (COPHS) as a competent forum to identify phytosanitary research priorities and contacts with the European Commission (DG Research and Innovation) are established to discuss a long-term strategy for research coordination in the field of plant health. If the legal framework in which Euphresco operates has changed, the remit remains the same: to support activities towards transnational research coordination and funding.

Euphresco coordination and secretariat is hosted within the European and Mediterranean Plant Protection Organization (EPPO), an international organisation of 50 member countries which includes within its remit the facilitation of co-operation in research on plant pests. The privileged position of Euphresco coordination being hosted within EPPO has many advantages, among which an increased visibility of the network and preferential relationships with the national plant protection organisations in the EPPO region (which includes several countries of the Mediterranean basin).

Euphresco members set-up the objective to fund a number of research topics every year and they are currently working on the identification of the topics to fund in 2015. The bacteria *Xylella fastidiosa* and '*Candidatus* Liberibacter solanacearum', and the nematode *Meloidogyne* spp. are among the priorities identified by Euphresco members as requiring urgent actions.

In mid-October 2013 the National Plant Protection Organisation of Italy reported the first detection of *Xylella fastidiosa* in the Puglia region. A task force has been created in Italy to stop the spread of this new olive tree disease, which represent a very serious threat for the Mediterranean basin and for the larger EPPO region. Euphresco members will be funding a research project aiming at developing rapid and reliable methods for the identification of the bacterium from symptomatic and asymptomatic material. Better understanding of the pest's biology (vectors, host plants) could also help those designing control strategies and elaborating management strategies.

Since its addition to the EPPO Alert List in 2009 *Candidatus* L. solanacearum has been detected in several European countries in carrot crops (and to a lesser extent in celery). *Solanaceous* crops such as potatoes and tomatoes are the main plant hosts of the bacterium which is transmitted through psyllid *Bactericera cockerelli* vectors. Even if there does not seem to be a pathway for transmission from carrots to other plants, it is essential to ensure surveillance in order to prevent and limit the economic impact the pest could have on Mediterranean agriculture. In 2015 Euphresco members are funding a research project to identify transmission pathways, to elucidate the host plant-vectors interactions and to develop control strategies.

Because of its climatic conditions the Mediterranean basin is susceptible to the establishment of both sub-tropical and tropical invasive pests. As an example, the area of distribution of tropical *Meloidogyne* species is evolving towards the European region because of climate change. The nematodes are able to infect about 2000 plant species and are among the most economically damaging plant parasitic nematodes on horticultural and field crops. In 2015 Euphresco members will fund a topic aimed at mapping the distribution of tropical *Meloidogyne* species and at analysing pathways of introduction.

The Mediterranean countries currently represented within Euphresco are Spain, France, Italy, Slovenia, and Greece. As the network is looking for enlargement outside Europe, the possibility to involve organisations in North-Africa and the Middle East is very welcome; having more members advocating joint research to work on regional plant health problems will focus the attention of a wider audience on the Mediterranean plant health and could catalyse the development of solutions to safeguard the agriculture, the environment, and protect the economy.

Bibliography / More information

- Cowling R.M., Rundel P.W., Lamont B.B., Kalin Arroyo M., Arianoutsou M. Plant diversity in Mediterranean-climate regions. Trends Ecol Evol. 11(9): 362-6 (1996)
- EPPO. Plant Health Endangered - State of Emergency (Madeira, 2004-09): https://www.eppo.int/STANDARDS/position_papers/madeira.htm
- Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A., Kent J. Biodiversity hotspots for conservation priorities. Nature 403(6772): 853-8 (2000)
- Mediterra 2008. The Future of Agriculture and Food in Mediterranean Countries / International Centre for Advanced Mediterranean Agronomic Studies. – Paris:Presses de Sciences Po, 2008.

New Medit

Based in Italy, this journal is produced under the direction if the CIHEAM-Bari. Agro-food economy, rural systems and environmental issues are the main topics addressed.

Established in 1990, *New Medit* is a quarterly publication. This peer-reviewed journal is evaluated in the "Journal Citation Reports (JCR) Science Edition". The articles are referenced in the "Web of Science Core Collection".

Its peer recognition makes it even more attractive for researchers and scientists in the Mediterranean and elsewhere. Since 2014, the editorial board of *New Medit* has opted for the free access policy by making all articles available online.

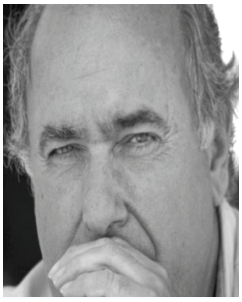
Economics, agriculture, and environment are the key words of the subjects dealt with in the review.

You can find all the articles published in the review since 1990 on the official website

newmedit.iamb.it

Aperçu des problématiques de gestion des espèces invasives en milieux aquatiques dans les régions méditerranéennes françaises

Alain Dutartre
Expert indépendant



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Chargé de mission « espèces exotiques envahissantes » et « espèces menacées »
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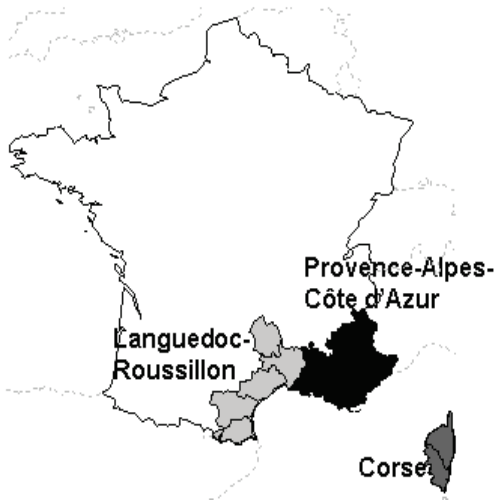
Introduction

Les trois régions du sud de la France situées en zone méditerranéenne, Provence-Alpes-Côte-d'Azur, Languedoc-Roussillon et Corse (Figure 1), sont confrontées à de multiples invasions biologiques touchant aussi bien les milieux terrestres qu'aquatiques. Les exemples sont nombreux, Ragondin, Canne de Provence, Tortue de Floride, Griffe de sorcière.

Figure 1
Régions méditerranéennes de la France



Les dynamiques régionales engagées pour gérer ces invasions depuis environ une décennie présentent chacune des caractéristiques organisationnelles spécifiques. Ces caractéristiques sont liées à divers paramètres portant à la fois sur les configurations écologiques des territoires, les cortèges de flore et de faune, des décisions politiques portant sur l'organisation et la mise en œuvre pratique de la gestion des espèces exotiques envahissantes (EEE), et des implications de gestionnaires locaux confrontés à ces espèces, convaincus de la nécessité d'une gestion adaptée. Elles ne sont donc pas tout à fait convergentes mais illustrent très bien la multiplicité des "histoires" des invasions biologiques et de leur ressenti à cette échelle régionale.

Cet article traite des milieux aquatiques continentaux particulièrement concernés, comme dans de nombreuses zones de la planète, par les introductions d'espèces et les invasions biologiques.

Réseaux d'acteurs, synthèse des connaissances et stratégies : des outils indispensables pour l'organisation de la gestion des EEE

En région Provence-Alpes-Côte d'Azur, l'Agence Régionale de Protection de l'Environnement[1], destinée à aider à la prise en compte de l'environnement pour le compte des pouvoirs publics et des collectivités territoriales, anime le Réseau Régional des Gestionnaires de Milieux Aquatiques[2], qui réunit l'ensemble des acteurs concernés par les milieux aquatiques. Il a pour objectif de développer "*une gestion globale, cohérente et concertée des milieux aquatiques inscrite dans le cadre du développement durable*".

Deux des journées techniques partenariales organisées par ce réseau ont été consacrées à la gestion des plantes envahissantes. La première, en 2010 en Camargue, a permis d'améliorer les échanges entre membres du réseau et de les familiariser avec un guide d'identification des principales espèces invasives aquatiques et de berges en Provence et Languedoc (ARPE PACA, 2009). Organisée par le Service Rivières et Milieux Aquatiques du Conseil Général du Var en 2012, la seconde journée a abordé les possibilités de gestion des renouées asiatiques et des jussies.

Une "*stratégie régionale relative aux espèces végétales exotiques envahissantes en Provence-Alpes-Côte d'Azur et son plan d'actions*" rédigée conjointement par les conservatoires botaniques nationaux alpin (CBNA) et méditerranéen (CBN Med) vient d'être récemment publiée (Terrin *et al.*, 2014)[3]. Ce volumineux rapport propose un état des lieux et une stratégie à l'échelle régionale.

Trois statuts ("exotique envahissante", "potentiellement envahissante", "autre") rassemblant sept catégories (de "majeure" à "absente") ont été attribués aux différentes plantes évaluées. Au total, 25 espèces sont considérées comme envahissantes majeures et 42 sont recensées comme envahissantes émergentes Le tableau 1 rassemble les taxons aquatiques, et leurs statuts, présents dans la liste générale.

Tableau 1
Espèces végétales exotiques envahissantes des milieux aquatiques et statuts proposés par la Stratégie régionale relative aux espèces végétales exotiques envahissantes en Provence-Alpes-Côte d'Azur

Espèce « exotique envahissante majeure »	Espèce « exotique envahissante modérée »	Espèce « exotique envahissante émergente »	Espèce « exotique envahissante potentielle »
Acer negundo *Baccharis halimifolia* *Ludwigia peploides* *Paspalum distichum*	*Azolla filiculoides*	*Alternanthera philoxeroides* *Egeria densa* *Elodea Canadensis* *Elodea nuttallii* *Ludwigia grandiflora* *Lagarosiphon major* *Lemna minuta* *Myriophyllum aquaticum* *Reynoutria sp.* *Salpichroa origanifolia*	*Pistia stratiotes* *Eichhornia crassipes* *Salvinia molesta* *Crassula helmsii* *Hydrocotyle ranunculoides*

Le plan d'actions de gestion proposé en région PACA comporte cinq axes (Amélioration et mutualisation des informations, limitation et gestion des introductions en milieux naturels et semi-naturels, limitation et gestion de certaines espèces en milieux fortement anthropisés, communication, formation et sensibilisation, et enfin gouvernance et animation), déclinés en dix-sept objectifs et cinquante-neuf actions.

L'évaluation financière globale de ce programme est de l'ordre de 1 à 1,5 million d'euros sur les cinq années envisagées (hors gestion des espèces, inventaires floristiques, recherche et formations). A notre connaissance, aucune stratégie régionale concernant la faune invasive n'est actuellement disponible en PACA.

En région Languedoc Roussillon, le réseau des gestionnaires d'espaces naturels protégés [4] a pour but "*d'améliorer les actions de protection et de gestion de ce patrimoine et d'en favoriser la découverte par le public*". Il rassemble services et établissements de l'Etat, collectivités, associations, etc., dont, en 2003, 44 structures gestionnaires d'espaces naturels protégés. Un des premiers numéros de la lettre d'information du réseau diffusée depuis 2008 comportait un dossier sur les espèces envahissantes (flore et faune).

En 2011, un atelier consacré à la thématique des EEE au sein des espaces naturels, organisé par le CBN Med et le Conservatoire d'Espaces Naturels de Languedoc-Roussillon (CEN LR), a permis d'établir un premier bilan de la situation à l'échelle régionale[5]. Une stratégie régionale de gestion des EEE a été mise en ligne en mai 2014[6].

[1] www.arpe-paca.org/
[2] www.rrgma-paca.org/
[3] *www.paca.developpement-durable.gouv.fr/strategie-especes-vegetales-exotiques-a8018.html*
[4] *www.enplr.org*
[5] *www.enplr.org/spip.php?article221*
[6] *www.languedoc-roussillon.developpement-durable.gouv.fr/strategie-regionale-especes-exotiques-a4679.html*

Les documents concernant la flore ont été élaborés par le CBN Med et ceux concernant la faune l'ont été par le CEN LR. Un document cadre commun détaille les quatre objectifs de cette stratégie : prévenir les introductions, détecter et identifier de nouvelles espèces en cours d'installation, gérer les espèces établies ou en cours d'expansion et restaurer les habitats remarquables. La proposition de stratégie concernant la flore (Mandon-Dalger, 2010) comporte quatre listes différentes d'espèces en termes d'évaluation de risques d'envahissement. La majorité des espèces inféodées aux milieux aquatiques se retrouve dans la « liste noire », c'est-à-dire considérées comme des espèces invasives avérées (voir tableau 2).

Tableau 2
Espèces végétales exotiques envahissantes des milieux aquatiques, et leurs statuts, en région Languedoc-Roussillon
(Stratégie régionale relative aux espèces végétales exotiques envahissantes en Languedoc-Roussillon)

Liste noire (espèces invasives avérées)	**Liste grise** (espèces dont l'évaluation ne peut être réalisée mais déjà identifiées comme invasives dans des territoires proches ou au climat similaire)	**Liste d'observation** (espèces semblant présenter un risque moyen)
Acer negundo *Arundo donax* *Azolla filliculoides* *Baccharis halimifolia* *Egeria densa* *Elodea canadensis* *Elodea nuttallii* *Fallopia japonica* *Heracleum mantegazziannum* *Impatiens glandulifera* *Lagarosiphon major* *Lemna minuta* *Ludwigia sp.* *Myriophyllum aquaticum* *Paspalum disticum* *Reynoutria x bohemica*	*Eichhornia crassipes* *Impatiens parviflora* *Pistia stratiotes* *Sagittaria latifolia* *Salpichroa organifolia* *Solidago sp.*	*Impatiens balfourii*

Source : http://www.invmed.fr

N.B : une liste « blanche » correspond à des espèces présentant de faibles risques n'était pas disponible (en actualisation sur le site) lors de notre consultation.

La stratégie concernant la faune comporte deux documents, le premier présentant l'état des lieux, le second un plan d'action. Dans l'état des lieux (réalisé en 2009), 15 espèces animales exotiques ont été identifiées comme invasives : parmi les espèces considérées comme prioritaires figurent le ragondin (*Myocastor coypus*), le ver cascail (*Ficopomatus enigmaticus)*, un ver polychète, et l'ibis sacré (*Threskiornis aethiopicus*). Un autre oiseau, l'érismature rousse (*Oxyura jamaicensis*) est identifié comme présentant un fort potentiel d'invasion dans la région. Organisé en quatre axes (collecter et gérer l'information, informer et sensibiliser, accompagner les plans de gestion et améliorer les connaissances), le plan d'action est décliné en 10 actions concernant diverses espèces.

L'office de l'environnement de la Corse[7], établissement public créé par la collectivité territoriale de Corse, a pour objectif de gérer et mettre en valeur le patrimoine naturel de l'île. Ses missions concernent la protection et la gestion des espaces et des espèces, la lutte contre les pollutions et les nuisances, la sensibilisation et l'éducation à l'environnement, etc.

Le Conservatoire Botanique National de Corse[8] (CBN Corse) est l'un des services de l'office. Dans le cadre d'un programme régional sur les espèces invasives Le CBN Corse a élaboré une première liste d'espèces exotiques présentes, considérées comme envahissantes avérées et potentielles (dernière mise à jour consultée, juin 2013). Le tableau 3 présente les espèces aquatiques de cette liste.

Tableau 3
Espèces végétales exotiques envahissantes des milieux aquatiques, et statuts, listés par le CBN Corse

Espèces invasives avérées	**Espèces potentiellement envahissantes, à surveiller**
Arundo donax *Azolla filliculoides* *Cotula coronopifolia* *Ludwigia peploides ** *Paspalum. disticum* *Pistia stratiotes ** *Reynoutria sp.* *Robinia pseudoacacia* *Salpichroa origanifolia* *Salvinia molesta **	*Acer negundo* *Eichhornia crassipes* *Impatiens balfourii* *Solidago canadensis*

(* Dans la liste, espèces suivies d'une indication "arrachage")

Source : http://cbnc.oec.fr/catalog_repository/uploads/7/ClassementInvasives.pdf)

Parmi les espèces évaluées, les cas de *Pistia stratiotes*, *Eichhornia crassipes* et *Salvinia molesta* devraient être examinés avec une attention particulière. Ces plantes flottantes sont capables de développements rapides et importants sur les milieux stagnants ou faiblement courants. Elles sont jusqu'à présent observées seulement de manière ponctuelle dans le temps et les sites mais les dommages qu'elles créent dans les milieux colonisés de manière permanente dans les zones tropicales de la planète sont bien connus. Une dynamique de colonisation du sud de l'Europe par *E. crassipes* (jacinthe d'eau) est débutée depuis quelques années et cette espèce est déjà observée en Corse. *Salvinia molesta* a également fait l'objet d'un récent arrachage manuel dans le sud de la Corse. Concernant la faune invasive, à notre connaissance, il n'existe pas encore d'état des lieux et de stratégie pour la Corse.

[7] *www.oec.fr*
[8] *http://cbnc.oec.fr*

Quelle gestion sur le terrain ?

La plupart des démarches concrètes de gestion des EEE engagées jusqu'à récemment sur le territoire métropolitain (et les régions méditerranéennes ne font pas exception) l'ont été par des gestionnaires confrontés à des difficultés locales et contraints de développer des démarches propres s'appuyant sur leurs ressources et matériel.

Depuis plusieurs années, l'émergence d'une approche organisationnelle de la gestion des EEE a toutefois permis d'engager des réflexions plus larges sur ces démarches. Les régions méditerranéennes de métropole ont ainsi mis en application une approche constituée de trois grandes étapes :

1) Echanger et constituer un réseau d'acteurs concernés par les EEE ;

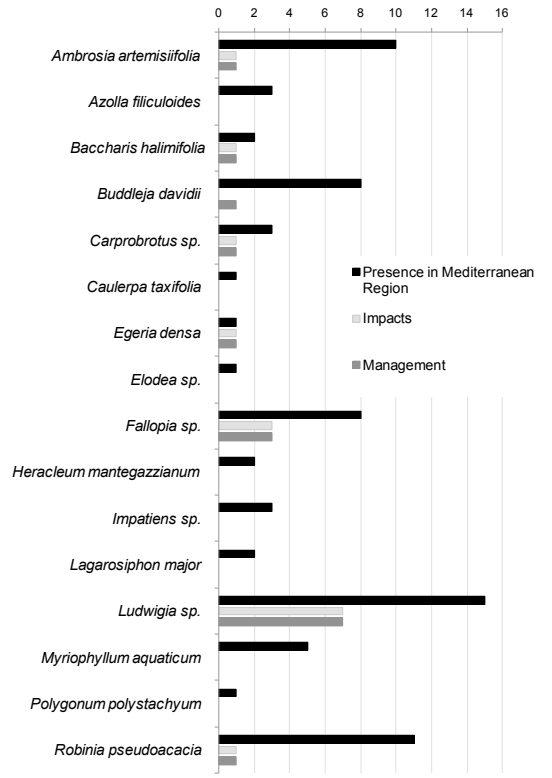
2) Réaliser un état des lieux sur la flore et la faune EEE (avec production de listes d'espèces adaptées au contexte et aux enjeux) ;

3) Proposer une stratégie et un plan d'action.

Ces deux démarches complémentaires de gestion (démarche de terrain et démarche organisationnelle) facilitent la mise en œuvre des stratégies régionales. La pratique de terrain permet ainsi d'alimenter la réflexion et l'approche organisationnelle permet de fournir des cadres généraux de positionnement. Les listes d'espèces, les documents stratégiques et des plans d'action sont autant d'outils permettant d'appuyer le gestionnaire dans sa démarche de gestion locale. En région méditerranéenne, les interventions de gestion sont nombreuses et ont souvent été mises en place avant l'émergence de stratégies générales d'organisation.

Selon l'enquête conduite en 2010 par le groupe de travail national « Invasions biologiques en milieux aquatiques » (IBMA)[9] sur les pratiques de gestion en métropole, 10 % des réponses obtenues, d'après une liste prédéterminée d'espèces, étaient issues des régions méditerranéennes (Mazaubert, Dutartre, 2010). L'analyse de ces réponses montrait que les signalements d'espèces n'étaient pas toujours accompagnés d'informations détaillées sur les impacts estimés de ces espèces et leur gestion (Figure 2) mais que dans les cas où des impacts étaient identifiés, les espèces faisaient l'objet d'interventions de gestion.

Figure 2
Nombre d'identifications d'espèces végétales invasives et de réponses donnant des précisions sur les impacts et les interventions de gestion



Source : (Mazaubert et al., 2010)

Une assez forte convergence entre ces résultats et l'ensemble des données obtenues sur la métropole restait visible, dont des efforts particuliers de gestion concernant les jussies (*Ludwigia* sp) et les renouées asiatiques (*Fallopia* sp). Les impacts négatifs des espèces les plus fréquemment cités étaient des modifications des écoulements, très compréhensibles en climat méditerranéen, et près des trois quarts des réponses sur les modalités de gestion se référaient à des interventions manuelles ou mécaniques.

Une des difficultés rencontrées par les acteurs lors du déploiement de stratégies est que la concordance entre les évaluations de risques, les plans d'action et la mise en œuvre concrète d'interventions est loin d'être évidente. Une espèce évaluée comme invasive avérée peut en effet être très peu présente sur le territoire concerné et donc ne pas faire l'objet d'interventions ou, au contraire, une espèce considérée comme seulement à surveiller peut localement poser des difficultés telles que le gestionnaire concerné peut être contraint d'intervenir.

[9] *www.gt-ibma.eu/*

C'est pourquoi il est indispensable d'intégrer les deux approches sans les hiérarchiser a priori pour faire évoluer la stratégie au fil du temps. De même, la compilation de données sur les interventions concrètes est une nécessité pour contribuer à une évaluation correcte des enjeux généraux de la gestion des EEE. C'est d'ailleurs un des objectifs du groupe IBMA qui propose des fiches d'exemples concrets de gestion, rédigées avec les gestionnaires. Concernant les régions méditerranéennes, cinq exemples sont disponibles : un sur les jussies, les renouées et l'Ibis sacré, et deux sur la Tortue de Floride[10]. Les échanges et la concertation entre acteurs institutionnels (état, région) et gestionnaires ont permis d'intégrer pleinement les interventions concrètes dans l'approche régionale, comme en témoignent les deux exemples de gestion ci-dessous.

Gestion de la Tortue de Floride dans le département de l'Hérault, Languedoc-Roussillon

Sur le site Natura 2000 « Etang de l'Or », les populations de Cistude d'Europe (*Emys orbicularis*), espèce protégée faisant l'objet d'un plan national d'action, sont menacées par une colonisation importante des milieux par la Tortue de Floride (*Trachemys scripta elegans*). Depuis 2009, puis dans le cadre du programme Life + Lag'Nature, le syndicat mixte du bassin de l'Or mène des opérations de piégeage pour réguler cette colonisation[11]. La première technique de piégeage n'a pas été concluante (faibles captures, temps passé élevé). A partir de 2012, un nouveau modèle de piège, très performant, dénommé « cage-fesquet », a été déployé à grande échelle et a permis de fortement multiplier les captures, sans augmenter le temps de travail. Les résultats positifs de cette expérience de gestion et des détails sur la conception de la « cage-fesquet » ont été diffusés à l'échelle nationale, notamment par le biais du groupe de travail IBMA, afin que cette pratique de gestion puisse être connue de tous les gestionnaires d'espaces naturels[12]. L'information a été relayée jusqu'en Nouvelle-Calédonie où la Tortue de Floride est également introduite. Des campagnes de piégeage sont prévues jusqu'en 2018 sur l'Etang de l'Or.

Gestion de la jussie à petites fleurs (Ludwigia peploides) en Corse

La première observation de jussie en Corse date de juin 2007, dans les bassins de lagunage de l'aéroport de Figari, en Corse du Sud. A la demande du CBN de Corse, une expertise réalisée avec l'aide du Cemagref (devenu Irstea) a permis de préciser les enjeux de la colonisation du milieu par la jussie. En effet, sa présence a également été notée dans les ruisseaux et prairies connexes, présentant ainsi des risques pour les zones humides en aval, considérées comme des milieux patrimoniaux importants. Pour limiter ces risques, une première journée d'arrachage a été menée par le CBN Corse, avec la participation de 15 bénévoles.

En novembre 2007, une visite et expertise de terrain ont été réalisées avec l'ensemble des parties prenantes (Dutartre, 2008). Des préconisations de gestion ont donc été formulées en fonction des milieux touchés par la colonisation (lagunes, ruisseaux et prairies), avec des techniques et des objectifs les plus adaptés au contexte, ainsi que la mise en place d'une surveillance régulière sur les sites. Depuis 2007, près d'une dizaine de journées d'arrachage ont été organisées par le CBN en mobilisant à chaque fois des organismes comme le lycée agricole de Sartène, le Parc Marin International des Bouches de Bonifacio, l'Université de Corse, etc. Ces interventions ont permis de stabiliser les populations de jussie. Depuis, des expertises et propositions de modalités de gestion ont été réalisées suivant ce modèle organisationnel pour d'autres espèces, comme le Séneçon du Cap, la Jacinthe d'eau ou, plus récemment, l'Azolle fausse-fougère et des échanges ont eu lieu entre les différentes parties prenantes, afin de définir les enjeux sur les sites et les meilleures options de gestion à envisager. Des documents de sensibilisation et d'information (fiches descriptives des espèces, fiches d'observation) ont été réalisés et mis à disposition sur le site du CBN Corse[13].

Conclusion

Les milieux aquatiques d'eaux douces des régions méditerranéennes françaises sont particulièrement concernés par les invasions biologiques. Pour tenter de répondre aux problématiques de gestion, les acteurs locaux se sont donc organisés. De nombreuses améliorations ont été réalisées dans ce domaine : diagnostics et états des lieux sur les espèces exotiques envahissantes, mise en réseaux d'experts et de personnes ressources, structures de gestion identifiées, stratégies pluri-acteurs, interventions de gestion…

Pour autant, les défis restent nombreux : sensibilisation accrue des responsables politiques, des décideurs et de la population, consensus sur la nécessité d'agir, meilleure adhésion des acteurs socio-économiques, mise en place de moyens financiers dédiés et de soutiens aux projets locaux, une réglementation adaptée avec des moyens pour sa mise en œuvre, pour n'en citer que quelques-uns.

Depuis le 1er janvier 2015, l'Europe est dotée d'un règlement relatif à la prévention et à la gestion de l'introduction et de la propagation des espèces exotiques envahissantes qui impose à tous les Etats membres la mise en œuvre d'une politique publique d'envergure pour traiter le problème.

[10] *http://www.gt-ibma.eu/fiches-exemples/*
[11] *www.gt-ibma.eu/wp-content/uploads/2012/05/131125_Trach%C3%A9myde_LAG-Nature.pdf*
[12] *www.gt-ibma.eu/wp-content/uploads/2014/05/Lettreinfo_d%C3%A9cembre_VF.pdf*
[13] *http://cbnc.oec.fr/Plantes_invasives__Le_Programme_Regional_page_88_1,199.htm*

Un des axes de ce règlement traite de la coopération régionale. Une politique active de coopération régionale entre les pays méditerranéens sur ce sujet est souhaitable pour améliorer les échanges d'informations entre les pays sur les espèces problématiques et les expériences de gestion, favoriser la construction de réseaux d'échanges, et mobiliser des moyens plus importants pour entreprendre des actions communes, par exemple en matière de biosécurité ou d'intervention de gestion sur des espèces prioritaires. Des organismes de coopération régionale existent déjà comme l'OEPP qui s'intéresse de plus en plus en plantes envahissantes et pourraient apporter une aide importante.

Enfin, dans les pays du bassin méditerranéen, le changement climatique devrait, selon les prévisions, se traduire par une augmentation des températures, une diminution des précipitations, et des évènements extrêmes plus fréquents. Ces perturbations affecteront directement les écosystèmes aquatiques d'eau douce, les espèces, indigènes et introduites, qu'ils abritent. Les gestionnaires d'espaces mais aussi les décideurs devront donc élaborer dans le futur de nouvelles stratégies de gestion des EEE intégrant le changement climatique et ses interactions avec les écosystèmes, les espèces et les activités anthropiques.

Bibliography / More information

- ARPE PACA. 2009. Plantes envahissantes. Guide d'identification des principales espèces aquatiques et de berges en Provence et Languedoc. Réseau Régional des Gestionnaires de Milieux Aquatiques Provence-Alpes-Côte d'Azur. 113 p.
- CBNMED, CEN-LR. 2010. Stratégie régionale relative aux espèces exotiques envahissantes (EEE) en Languedoc-Roussillon : présentation générale, DREAL LR & Région LR, 6 p.
- Dutartre A., 2008. Expertise sur le développement de Ludwigia peploides (jussie) à proximité de Figari (Corse du Sud) : visite de terrain des 29 et 30 novembre 2007 : évaluation de la situation et propositions de gestion. Cemagref, Unité de Recherche REQE, rapport, 24 p.
- Mandon-Dalger I., 2010. Éléments de réflexion et d'argumentation pour la mise en place d'une stratégie régionale de lutte contre les espèces végétales exotiques envahissantes en région méditerranéenne française continentale. Rapport CBNMED, 95 p.
- Mazaubert E., Dutartre A., 2010. Enquête sur les espèces exotiques envahissantes en milieux aquatiques en métropole et leur gestion. *Réalisation, première analyse et synthèse des résultats.* Partenariat Onema Cemagref, 2009. Rapport, 80 p.
- Mazaubert E., Dutartre A., Poulet N., 2010. Invasive aquatic plants in the French Mediterranean area. (316-324). In "Proceedings 2nd International Workshop on Invasive Plants in the Mediterranean Type Regions of the World, Trabzon, Turkey", 445 p.
- Terrin E., Diadema K., Fort N., 2014. Stratégie régionale relative aux espèces végétales exotiques envahissantes en Provence-Alpes-Côte d'Azur et son plan d'actions. CBNA, CBNMED. 454 p.

Participation of CIHEAM at the G20 Ministerial meeting on Agriculture

Istanbul, 7th-8th May 2015

As the G20 Chair in 2015, Turkey focuses its efforts on ensuring inclusive and robust growth through collective action, formulated as the three I's of the Turkish Presidency: Inclusiveness, Implementation, and Investment for Growth.

Turkish authorities have decided to place the challenges of food and nutrition security among the main priorities of its G20 Presidency, highlighting in particular the issue of Food Losses and Waste (FLW).

The Turkish Minister of Food, Agriculture and Livestock, H.E. Mehmet Mehdi Eker, invited the CIHEAM to take part in the meeting of Istanbul. As founding member of our Organisation in 1962, Turkey has always supported the CIHEAM in its actions aimed at reinforcing Mediterranean cooperation in agriculture, food and rural affairs.

Cosimo Lacirignola, Secretary General of the CIHEAM participated in the Ministerial meeting. He stressed the "*very sensitive issue of Food Waste and Losses in the Mediterranean countries that should be addressed through a three-fold approach: the need to reduce the waste of natural resources, the need to reduce the waste of food products, and the need to stop the waste of knowledge and traditional know-how*". To conclude his speech, the Secretary General called for greater cooperation with all G20 Member countries and international organisations "*because the Mediterranean Future certainly depends on better food security*".

Interview

The issue of *Xylella Fastidiosa* in Italy

General Giuseppe Silletti
Regional Commander of the State Forestry Corp, Puglia, Italy
Commissioner for the emergency "Xylella fastidiosa"

Dear 'Generale', let's start with your home region Puglia and olive growing

Puglia is the region which has the greatest number of olive trees in the world, over 60 million. More than half of these are hundreds of years old, and are not only beautiful but are our traditional landscape and witnesses to the successive Norman, Aragonese, Spanish and Piedmontese dominations. The expanse of ancient olive trees is a complex system in which history, nature and agriculture have interacted harmoniously over the millennia.

The principal and most widespread varieties of olive trees in Puglia can be considered autochthonous due to their specific biological adaptation over time. All varieties of olive tree have developed peculiar characteristics in relationship to the soil, climate and cultivation methods, and these characteristics originate from selection of the most vigorous trees, those which are most resistant to pests and which produce the most oil.

Olive growing in Puglia is prevalently directed towards oil production; this is very closely connected with the conditions of local olive cultivation and is one of the most interesting and important areas of Puglia's agro-food sector. Puglia produces approximately 250,000 tonnes of olive oil per year, of which around 40% is extra virgin oil; the region accounts for about 13% of world olive production and is the world leader in terms of volume.

There are about 190,000 olive farms in Puglia, making it the Italian region with the greatest number of olive farms and oil producers (188,554), second only to Sardinia in the number of farms producing table olives (1.943). Puglia accounts for 25% of Italy's olive farms.

Is production homogeneous across the Region?

Not at all. Olive-growing in Puglia is very heterogeneous, both in terms of the different production areas, and in terms of different types of farm. Two distinct kinds of olive cultivation exist in the region: one in the northern area, which includes the provinces of Bari, Barletta-Andria-Trani and Foggia, and the other in the Salento. The differences regard structure and productivity. In the province of Bari, the prestigious varieties, like Coratina and Cima di Bitonto, are widespread and production systems aim to obtain high quality oil. On the other hand, the traditional Cellina di Nardò variety is widespread in the Salento area, where it is difficult and expensive to produce quality oil. The quantity of lamp oil produced in the Salento is relatively high.

The farms themselves also differ greatly: 64% have a surface area of only 2 hectares, 27% between 2 and 10 hectares, and 9% over 10 hectares. Economic results are therefore different, as they depend on crop productivity and the size of the farm. According to studies of farm accounts by ISMEA, the smaller farms operating in marginal areas have the lowest levels of profitability (Salento, Gargano and Subappennine Daunia), whereas farms in the province of Bari have the highest levels.

This was the situation until 2013…

Yes. In summer 2013 the first signs of Olive Quick Decline Syndrome (OQDS) appeared in the Gallipoli area (Lecce). The Plant Health Observatory and CNR researchers from Bari went to work immediately, identifying the cause of the syndrome as the bacterium known as *Xylella fastidiosa*, spp.*pauca,* strain *CoDiRO*. This is a quarantine bacterium on the EPPO (European and Mediterranean Plant Protection Organization) A1 list.

Between the end of 2013 and the first months of 2014, the Regional Plant Protection Service (RPPS) monitored the entire Region by taking and analysing over 16,000 plant samples: subsequently, the RPS identified the areas infected by *Xylella* (Decision 157 of 18.04.2014), and communicated its findings to the Ministry and European Commission. The scenario depicted had an enormous impact and immediately generated predictions of a particularly critical situation. Further monitoring in summer 2014 showed that infection had spread across the whole province of Lecce, and the symptoms observed clearly showed that this was a very serious epidemic. In different areas of Lecce province, many olive trees had symptoms attributable to *Xylella fastidiosa,* and laboratory tests confirmed this diagnosis.

In late July and late August, the Region met twice with the Minister and the Directors of the Ministry of Agriculture, Food and Forestry Policies; it stressed the dramatic nature of the emergency, and the increasing extent of infection, and asked to adopt emergency measures for the containment of the bacterium in Lecce province and across the whole of Puglia. It was stressed that the epidemic had all the characteristics of an emergency, and that all available means were required in order to prevent this quarantine pathogen from spreading further, thereby endangering olive cultivation not just in Puglia but also creating risks for olive production in Italy and the world.

Since then, various emergency measures have been implemented, both with regard to territorial management, and also in response to numerous requests from the European Commission. The Italian Council of Ministers declared a state of emergency (on the 10 of February 2015) due to the spread of *Xylella* in Puglia. This was followed immediately by an Ordinance from the head of the Civil Protection body appointing a Commissioner to deal with the emergency (OCPDC 225 of February 11th 2015).

And what are the duties of the Commissioner?

According to the Ordinance, as Commissioner I was required to publish a plan providing for the rapidest implementation of the mandatory control measures for quarantine pathogens. Subsequently, the plan was adapted several times to provide for more precise and more accurate actions, based on the results of monitoring, which showed daily changes in the limits of the infection area. For example, when the Task Force met in Brussels recently at the EU Standing Committee on Plant Health, it emerged that the 1 km Eradication Zone was not adequate for preventing the spread of the bacterium, therefore it was decided to widen the Eradication Zone to 15 km.

But was an Official Action Plan eventually approved?

Yes. The latest Action Plan was approved on 18th March and will remain in force throughout 2015. The Plan takes account of all the measures listed in Ministerial Decree no. 2777 (26.09.2014) Annex III, Section 2; all quarantine measures, such as the elimination of infected plants, will be taken in order to reduce possible pathogen inoculum. For the same reason all possible host species must be eliminated from the infected areas and from the buffer zone, and efforts must be made to contain the vector insect population.

Can you tell us what needs to be done about the insect vector?

In Puglia, the only confirmed vector of this bacterium is *Philaenus spumarius* (also known as "meadow spittlebug"). However, it may not be the only one, and for this reason research bodies are still monitoring the infected areas by collecting the greatest possible number of insects.

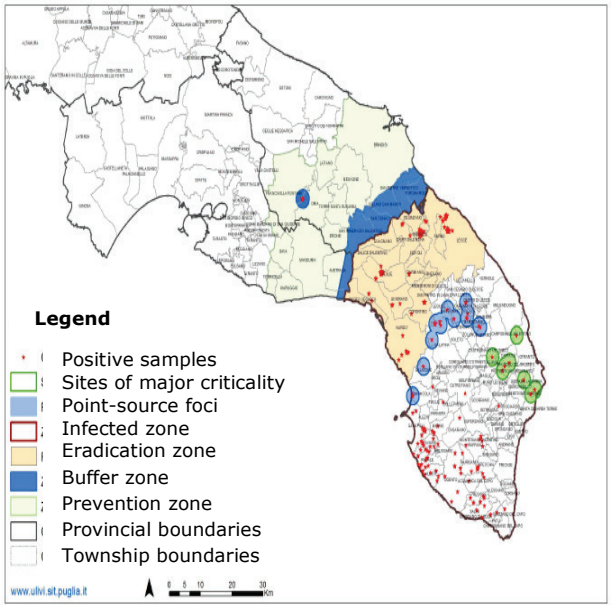
Philaenus spumarius could have an important epidemiological role in spreading the disease, both because of its high population density observed in the Salento and because it is widely polyphagous. This insect is believed to have only one generation per year, developing mainly from spring to autumn, with overwintering eggs. Its biological cycle starts in April when nymphs hatch from the eggs. The nymphs live on the stems of herbaceous vegetation, and cover themselves in liquid foam to maintain their correct moisture level and protect from their natural enemies.

Once they have reached the adult stage, they fly onto the aerial parts of trees and feed on xylem liquid by piercing the leaf vessels with their stylets. Our objective is to reduce the number of nymphs as much as possible, and this requires eradicating all wild herbaceous plants in spring. This can be done mechanically (mowing or harrowing) where possible, or else by burning, using string trimmers or applying insecticides registered for use against phytophagous insects which are effective against the juvenile stages. It is also important not to underestimate the control of the adult stages; this is the most dangerous stage of this insect because as it moves from one tree to another it may spread the bacterium even further. Therefore, phytosanitary treatments must be applied in autumn to the canopies of olive trees and other fruit trees in the affected areas.

Is the action protocol to be applied in the entire zone affected by Olive quick decline syndrome?

The areas infected by *Xylella fastidiosa* have been sub-divided into 4 zones: infected, eradication, buffer and prevention zones (Figure 1). All the measures identified provide for actions in all these zones, in the point-source outbreak and in those with greater criticality; they also include treatments in the plant nurseries, in the remaining infected area, and cross-cutting actions.

Figure 1
The areas defined for *Xylella fastidiosa*, according to Decision no. 54 (March 13th 2015)



Looking at the attached map (figure 1) and starting from the North, the first zone is the Prevention Strip. What kinds of actions are planned in this zone?

In this zone, treatments will target the vectors on weeds (in March and April), and adult vectors on olive and fruit trees in spring-summer and in autumn.

What about the buffer zone?

All host plants along the roads, ditches, canals, green areas etc. must be removed, shredded and disposed of, in order to prevent them from acting as vehicles of further transmission (in March and April). In addition, phytosanitary treatments will target both the vectors on weeds and adult vectors on olive and fruit trees.

Then there is the infected zone, further sub-divided into 4 areas. What does the action plan envisage here?

The infected zone includes the entire province of Lecce, and within this area we have distinguished 4 areas according to their criticalities. We can begin with the eradication zone, the area south of the 15-kilometre buffer zone. All the interventions of the buffer zone will also be carried out in the eradication zone; in addition, all infected plants -identified by laboratory tests and by symptoms attributable to *Xylella fastidiosa* - will be eliminated, together with plants identified as probably infected.

Eradication has begun immediately, starting from the centre of infection identified at Oria (Brindisi), then spreading to those in the eradication zone and to the remaining point-source outbreak of infection and those with greatest criticality.

Already last year the Regional Plant Protection Service imposed a ban on the movement of *X. Fastidiosa* host plants by plant nurseries in the infected zone. Now it has become necessary to destroy these plants by shredding or controlled burning in loco. The owner or manager of the nursery must do this by the end of April.

Apart from the destruction of all host plants along roads, ditches, canals, green areas etc., and all the other operations will also be carried out in the other areas within the infected zone.*

** Interview conducted in April 2015 by Stefania Lapedota from CIHEAM-Bari.*

Next CIHEAM Ministerial Meeting in Portugal

The 11th meeting of the Ministers of Agriculture of the 13 Member countries of CIHEAM is being prepared. It will take place in Cascais on September 22 and 23, 2015, at the invitation of the Portuguese Authorities. It will focus on the theme "Better Mediterranean agriculture and food for better live", addressing the need to implement applied agricultural research models based on Mediterranean networking and partnership.

As expressed by the Portuguese Minister of Agriculture and Sea, Mrs Assunção Cristas, 2015 is very rich in international events linked to the agricultural, food, fisheries and rural challenges. The Expo Milan 2015, the Blue Week in Lisbon, the Climate Conference in Paris or the definition of the agenda post-2015 will be at the core of the 2015 Year. Moreover, 2015 is the 20th Anniversary of the Barcelona Declaration and the Euro-Mediterranean Partnership.

In this perspective, the 11th meeting of the Ministers of Agriculture of CIHEAM's member countries could be an opportunity to reaffirm the Mediterranean issues within the global agenda for development and to reinforce the place of food security for a better Euro-Mediterranean cooperation.

The presence of *Xylella fastidiosa* in Apulia region (Southern Italy) poses a serious threat to the whole Euro-Mediterranean region

Michele Digiaro
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Background

That is now a fact! The main causal agent which is devastating the olive groves of Apulia is a strain of the bacterium *Xylella fastidiosa* (Xf) subspecies *pauca,* named "Codiro" (acronym of "Complesso del Disseccamento Rapido dell'Olivo" that means "olive quick decline syndrome", OQDS). Koch's postulates are expected to be fulfilled soon and their completion will dispel any doubt about the causal relationship between the bacterium and OQDS. However, the close association of *X. fastidiosa* with symptomatic olive trees seems to leave little doubt about the involvement of this pathogen in the disease aetiology. The severe damage caused by this bacterium on the olive crop represents an unprecedented exceptional situation which must be faced adopting a different approach compared to the strategies already applied in other countries. However, other infectious agents, in particular some fungi of the genera *Phaeoacremonium* and *Phaeomoniella*, commonly found together with *X. fastidiosa* in the OQDS-infected trees of Apulia, are supposed to play an important synergistic role in the severity of symptoms.

At present, the disease is ravaging an olive growing area of *ca.* 90,000 hectares in the Salento peninsula (the province of Lecce), the boot-heel of Italy bordering the Ionian and the Adriatic seas, but concern remains that it could spread further through its natural vectors across Apulia, the most important Italy's olive producing region, with a total surface area of about 380,000 hectares (32% of the area under olive trees in Italy).

Following the application of traditional serological (ELISA) and molecular (PCR) detection techniques, *X. fastidiosa* was identified as a possible agent of the disease in September 2013 (Saponari *et al.*, 2013), although OQDS-like symptoms had already been reported some years earlier. Genome sequencing allowed then for the final and detailed characterization of the pathogen. At first, only a few characterizing genes of the bacterium were sequenced through Multilocus sequence typing (MLST) (Elbeaino *et al.*, 2014); subsequently, the entire genome was determined by "deep sequencing" (Giampetruzzi *et al.*, 2015). As a result, the Apulian isolate came to be one of the few *X. fastidiosa* isolates fully sequenced in the world. Molecular characterization provided a step forward in determining more clearly the pathogen identity, exploring its biological characteristics and suggesting hypotheses on its geographical origin.

Origins and Consequences

As indicated before, the Apulian strain of *X. fastidiosa* displays some genetic traits which relate it to the isolates of subspecies *pauca*, also including the causal agent of "Citrus variegated chlorosis" in South America. More precisely, it exhibits a very high level of genetic identity with an isolate of *X. fastidiosa* from Costa Rica, known to affect oleander, mango, coffee and other ornamental species, but not the olive tree which is not grown in this country. It is highly probable that the Apulian isolate originates from Central America because the European countries annually import from Costa Rica millions of ornamental plants belonging to several species, which rarely undergo appropriate phytosanitary inspections at the point of entry into the EU. The recent interceptions of *X. fastidiosa*, by the Dutch, French, German and Italian Customs and in a number of nurseries, on ornamental coffee plants imported from Costa Rica and Honduras provide further evidence in support of this hypothesis.

The very first records indicated that the olive tree was the preferred host of *Xf*-Codiro strain; furthermore, numerous other plant species were found to be vulnerable to this polyphagous bacterium. The list of the susceptible hosts, still provisional, already includes a number of cultivated, ornamental and wild species, i.e. almond (*Prunus dulcis*), cherry (*P. avium*), oleander (*Nerium oleander*), myrtle (*Myrtus communis*), rosemary (*Rosmarinus officinalis*), September bush (*Polygala myrtifolia*), coastal rosemary (*Westringia fruticosa*), periwinkle (*Vinca minor* and *Chatarantus roseus*), genista (*Spartium junceum*), golden wattle (*Acacia saligna*), Mediterranean buckthorn (*Rhamnus alaternus*), etc. Hopefully, the susceptibility of grapevine and *Citrus* spp. to *Xf*-Codiro strain in nature might be excluded, because not a single plant in these species has tested positive to the bacterium in severely infected areas. However, a final conclusion can only be reached once the results of the infectivity tests are made available.

Expansion and eradication strategy

The rapid spread of the bacterium in Apulia is undoubtedly facilitated by the abundance of its vector, the meadow spittlebug *Philaenus spumarius,* in the infected areas where research evidence immediately demonstrated high transmission efficiency (Saponari *et al*., 2014). At least two more species, *Neophilaenus campestris* and *Euscelis lineolatus,* proved to be capable of harbouring the bacterium, although there is no conclusive data so far that they can transmit the infection (Elbeaino *et a*l., 2014).

In a very short time the pathogen has invaded several thousands of hectares of olive trees in Apulia, expanding its range throughout an area that includes almost the whole province of Lecce and some isolated outbreaks in the province of Brindisi.

The presence of the pathogen in infected trees can be detected by different diagnostic tools. Technical protocols based on ELISA and conventional PCR, already utilized for the detection of *X. fastidiosa* in other plant species and countries, were applied to olive samples and compared and validated via an interlaboratory ring-test, during which both procedures proved to be equally effective. Considering its lower cost, in addition to its simplicity, ELISA was the preferred method for a large-scale monitoring programme in Apulia, which preliminarily involved about 20,000 plants, mainly olives but also other host species. The more sensitive PCR technique was instead used exclusively for confirmation tests and for doubtful cases.

Based on the large number of samples tested in Apulia, the distribution map of *X. fastidiosa* within the region was designed with a certain level of precision. For this purpose and to improve the planning of monitoring activities, the support of multimedia systems and tools was crucial. The whole regional area was subdivided into grids of about 10 km^2, the OQDS-suspected trees were identified by photointerpretation of high resolution aerial images, sampled plants were geo-referenced, the collected data were acquired through a field application (XylApp) and sent to a central server (XylWeb) for their rapid storage and analysis. At present, the area of expansion of the bacterium seems to be restricted to the southern part of the Salento peninsula. Given the current state of affairs, efforts are mainly aimed at protecting the area to prevent further spread of the disease northwards.

After completing the monitoring activities in the whole region of Apulia, which represented the first step taken when the pathogen was identified, a multidisciplinary strategic approach was adopted to contain the spread of *X. fastidiosa*, including a set of regulatory measures (at regional and subsequently, at national level) which led to the enactment of a law for the mandatory control of the bacterium (D.M. n. 2777 of 26/09/2014), the appointment of a Commissioner to deal with "*Xylella fastidiosa* emergency", the establishment of a national scientific committee to oversee all control initiatives and research activities, the earmarking of special funds to cover the cost of control.

Salento, Target area of the Action Plan

Salento is the target area of the action plan supervised by the Commissioner and has been divided into different zones, according to whether the pathogen has been found or not. The action plan encompasses the mandatory measures aimed at strengthening surveillance, removing the infection sources and controlling the vector. Considering the extent of this plague, which is now inflicting damages to a very wide area of Apulia, attempts at the total eradication are no more a feasible option. Indeed, there is no record of successful eradication anywhere in the world. As a result, to stop the spread of this invasive disease, a coast-to-coast "eradication zone" (a strip about 30 Km large and 50 km long), running from the Adriatic Sea to the Ionian Sea, has been set up in the northernmost part of the outbreak area.

At the same time, to prevent the bacterium from expanding northwards, a surrounding 2-4 Km wide "buffer zone" has been carved and a further 30 Km "prevention zone", next to the buffer zone, has also been established. In these areas (eradication, buffer and prevention zones), up-rooting concerned not only the infected olive trees and plants around in a radius of 100 meters, but also all ornamental and wild plants known to host *X. fastidiosa*. Vector control has become mandatory and it is based on an integrated management approach. Cultural practices (ploughing, harrowing, removal of shrubs and bushes), physical methods (weed flaming in places which are otherwise inaccessible), biological and chemical control measures are combined to fight against all life stages of the vector while always trying and preserving the environment. In addition, other actions are to be carried out such as cleaning canals, ditches, roads and public areas.

Furthermore, plant nurseries are submitted to regulatory restrictions concerning the production of *Xf*-host plants and also of potentially susceptible hosts, for prevention purposes. These restrictions include the total prohibition of plant movement outside the outbreak area, the production and trade of plant material in compliance with specific plant health requirements and even, plant growing under the screenhouse, if necessary, laboratory testing of plant material intended for export and chemical treatments of plant material.

However, drastic action would not be enough unless information campaigns are launched targeting practically the whole civil society to increase education and awareness about eradication measures, prohibition of infected plant movement and risk of disease spread by human assistance.

Apart from containment measures, only scientific research can provide effective solutions to this emergency, which represents an exceptional case worldwide. Hence, much research effort is required not only at local level, but also at national and EU levels, because *X. fastidiosa* is likely to become a global threat. Despite the severity of this problem, to date no concrete financial support has been provided to research on this important issue, except for few funds allocated by the Apulian authorities. In fact, current research is carried out thanks to the commitment of local highly motivated researchers who are aware of the serious situation in Apulia and are putting their expertise at the service the community. Today, a number of avenues are being explored to fight against the bacterium survival or limit its ability to reproduce inside the plant, identify and/or develop plant resistance/tolerance (especially, genetic), develop advanced techniques for quick and effective detection of the pathogen in a given area, improve control of insect vectors, possibly through environmentally friendly methods.

Concluding remarks

Once again, the *X. fastidiosa* crisis in Apulia has shown the fragility of agro-ecological systems, when plant invasive harmful organisms are brought into new vulnerable regions. Unfortunately, in the recent years undesirable organisms have been more and more frequently introduced into the EU countries like the red palm weevil (*Rhynchophorus ferrugineus*), the spotted wing drosophila (*Drosophyla suzukii*), the Asian chestnut gall wasp (*Dryocosmus kuriphilus*), the tomato leaf miner (*Tuta absoluta*), the citrus longhorned beetle (*Anoplophora chinensis*), the bacterial canker of kiwifruit (*Pseudomonas syringae pv. actinidiae*), etc.

As a result, we urgently need a more effective quarantine system, due to the increasing movement of commodities and people across boundaries, which is leading to the globalization of plant disease problems. Strengthening the inspection services at points of entry/exit would be desirable, in terms of both personnel and equipment, especially as regards the use of appropriate diagnostic tools for early detection. Of utmost importance is also focusing on the main pathways through which these organisms can be brought into new areas. As it has occurred with the introduction of *Xylella fastidiosa* into the EU, ornamental plant species, more often not regulated by the law, are the main carriers of most undesirable pests. However, apart from improved knowledge of stakeholders, the civil society as a whole should gain a better understanding of the phytosanitary risks posed by the transport of plant products when travelling.

Bibliography / More information

- Elbeaino T., Valentini F., Abou Kubaa R., Moubarak P, Yaseen T., Digiaro M., 2014. Multilocus sequence typing of *Xylella fastidiosa* isolated from olive affected by "olive quick decline syndrome" in Italy. Phytopathologia mediterranea 53 (3), 533-542.

- Elbeaino T., Yaseen T., Valentini F., Ben Moussa I.E., Mazzoni V., D'onghia A.M.. 2014. Identification of three potential insect vectors of *Xylella fastidiosa* in southern Italy. Phytopathologia Mediterranea, 53(2), 328-332.

- Giampetruzzi A., Chiumenti M., Saponari M., Donvito G., Italiano A., Loconsole G., Boscia D., Cariddi C., Martelli G.P., Saldarelli P., 2015. Draft Genome Sequence of the *Xylella fastidiosa* CoDiRO Strain. Genome Announcements 3(1):e01538-14. doi: 10.1128/genomeA.01538-14.

- Saponari M., Boscia D., Nigro F. and Martelli G.P.. 2013. Identification of DNA sequences related to *Xylella fastidiosa* in oleander, almond and olive trees exhibiting leaf scorch symptoms in Apulia (southern Italy). Journal of Plant Pathology 95 (3), 668.

- Saponari M., Loconsole G., Cornara D., Yokomi R.K., de Stradis A., Boscia D., Bosco D., Martelli G.P., Krugner R., Porcelli F., 2014. Infectivity and transmission of *Xylella fastidiosa* by Philaenus spumarius l. (Hemiptera: Aphrophoridae) in Apulia, Italy. Journal of Economic Entomology, 107 (4), 1316-1319.

Mediterranean farmers face *Xylella fastidiosa*

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As President of ASAJA Cordoba, a young farmers' association in the province of Cordoba, southern Spain, with nearly 350,000 ha of olive groves, I am very concerned about the effects of the bacterium *Xylella fastidiosa* even though, as far as we know, it has not yet entered our country. For this reason we organized the first International Conference on *Xylella fastidiosa* in Cordoba, at the County Council Assembly Hall, with the help of experts such as Rafael Jiménez, professor in Plant Pathology, and Blanca Landa, researcher, both from the CSIC (Spanish National Research Council in Cordoba) and acquainted with the bacterium. We also had the collaboration of the association representing olive growing municipalities, the University and Sygenta, GEA Westfalia Separator Ibérica and Caja Rural del Sur, always in close contact with farmers. We set to work on organizing a meeting where expert researchers and the administration (both national and regional) would be present. Although we did not originally count on the participation of European representatives, as they do not usually attend conferences on specific issues, this time, a Member of the European Parliament, Esther Herranz, attended the conference. The participation of two Italian experts was also fundamental as they gave a perfect illustration of the situation their country is undergoing.

In our region of Andalusia, the olive grove is the most representative agricultural system and not only does it have economic, social and environmental importance but it is also of cultural and territorial interest. Andalusia has more than 1.5 million hectares of olive groves which account for nearly one fourth of all Andalusian agricultural production, 30% of farm labour and 30% of Europe's total olive growing surface area. Besides, it forms part of an agro-business fabric that generates products that make us leaders on a global scale.

According to data from Act 5/2011 of 6 October on the Andalusian Olive Grove, it is the main activity in more than three hundred Andalusian villages, providing a living for more than two hundred and fifty thousand olive farming families, generating more than twenty-two million days' wages per year. Likewise, the Act considers that the Andalusian olive grove provides fundamental environmental goods and services that are not sufficiently paid for by the market, such as their role in fixing CO_2 or in combating erosion or their contribution to biodiversity. The weather in our region is predominantly dry with sudden rain events and the olive groves and the vegetation between trees play a fundamental role in preserving soils on the steep slopes in the area.

It goes without saying that we care a great deal about olive groves and we are equally concerned about their preservation. For these reasons we did not hesitate to organize a conference whose main objective was to learn more about the pathogen and its potential spread, to hear about the problem experienced in the South of Italy, and to press policy makers from the Administration at all levels –but mainly in Europe– to take action. Unfortunately, I must say that so far the European Union has not paid this problem the necessary attention.

Apparently the bacterium reached the Italian region of Apulia in 2008, although it was actually reported in 2013, probably introduced by ornamental coffee plants imported from Costa Rica through the Netherlands. Now thousands of hectares have been uprooted in Apulia forming a phytosanitary cordon of more than 250,000 hectares. As regards the pathogen, there are officially known subspecies, but a great deal of recombination has taken place generating new subspecies. This means that the occurrence of *Xylella fastidiosa* in one region does not mean that greater damage may not be caused in the future or that new, more virulent, variants of the bacterium may be found or variants that are pathogenic to new crops, as the researcher Blanca Landa explained in her presentation.

According to the EFSA report, more than 300 hosts are known but not all of them are susceptible. Some infections are asymptomatic and every year new hosts are discovered. Likewise, there are many vectors and more are reported every year, and furthermore there are no efficient control methods. The diseases caused by *Xylella fastidiosa* include, for instance, Pierce disease in Californian (USA) vineyards (PD) (Pierce, 1981), and *Clorosis variegada* in citrus in South America, Brazil, Argentina in the 1980s (Rosetti *et al.*, 1990) also affecting almond, cherry and olive species, among others.

By way of example, Blanca Landa reported at the conference that Pierce disease is costing California 104 million dollars each year and in other countries, *Xylella fastidiosa* has already been causing large losses for some time.The bacterium isolated in Italy is *Xylella fastiosa* subspecies *pauca*. It blocks the xyllem vessels resulting in necrotic branches, leaves and fruits, until the tree finally dies.

Most of the speakers agreed that as a consequence of trade globalization plants are now imported from many countries without taking into account the phytosanitary risks, and the situation remains unchanged even though we now know the damages caused by the bacterium in Italy. In his presentation at the conference, Rafael Jiménez drew attention to a declaration written by a group of more than 70 forest pathology expert scientists (representing 17 countries) who had attended the IUFRO1 International meeting in April 2011 at the Monasterio de Montesclaros, Cantabria (Spain) and which read as follows: "*As scientists with considerable experience in the study of forest pathologies, we would like to say that the indiscriminate transport of plant material is greatly increasing the number of forest diseases on a global scale. This evidence is based on the large number of exotic species and pests recently introduced in forests and forest plantations throughout the world, an unprecedented phenomenon in the history of humankind. For this reason, we therefore propose to introduce a progressive ban on all trade of plants and plant material that do not give rise to important economic benefit and may pose a risk to forest ecosystems*". Researchers at the conference made it clear that prevention measures are absolutely essential and that imports of host plants should be avoided. There are still host plants whose entry is not restricted.

To date, institutions have not paid attention to the experts and the conclusions of the conference highlight the need to take urgent measures. Milagros López, expert bacteriologist from the IVIA (Valencian Institute of Agricultural Research), concludes, among other things, that the presence of *Xylella fastidiosa* in Italy is a risk for Spanish olive groves, and that it should be borne in mind that the different subspecies of this bacterium also affect many species and ornamental fruit trees. The fact that the strain may have entered Italy through imports is an example that should be avoided. Preventive measures are essential: avoid imports of plant material with host plants and allow only those that are strictly necessary; analyse imports from Italy, North America and South America; and notify health authorities in case of any suspicious symptoms.

Rafael Jiménez stressed the importance of research, emphasizing how slowly actions were being taken to prevent the establishment and spread of the disease. He spoke about the changes in plant health scenarios, emerging and re-emerging diseases and their direct link to the increase in international and free trade of plant material, and also highlighted the importance of specialized training. Regarding control measures, researcher Blanca Landa discussed problems in ornamental plants coming from abroad and pointed out that border controls were fundamental to prevent the entry of the disease, since once it is established eradication is not effective.

She alluded to some control measures with chemical treatments to decrease vectors, and highlighted the current problem, as there are fewer and fewer permitted active substances. She concluded that what is known about this pathogen is thanks to the international cooperation of many researchers and to public and private funds invested in research, and added that there is more chance of solving a problem if it can be anticipated. Insecticide treatments are important in order to control the problem even in the nursery, however many essential insecticides are banned in Europe. Another important outstanding issue in the area is to sample in order to determine which insects are present.

Donato Boscia and Antonio Guario acquainted us with the problem faced by olive growers in Italy. They informed us of the measures that are being taken, the efforts made by the farmers and of the tragedies suffered. It was impossible not to identify with their plight and we conveyed many messages of support to them during the conference. Juan Antonio Navas, from the Spanish National Research Council (CSIC), described an uncertain but probable future, with an exposé of the future scenario based on available data. Bacteria could enter via plant material or insect vectors, both possibilities of which have been studied. Concerning the plant material, due to the large number of host plants and volume of international trade, the bacteria can survive and easily go undetected. The risk of entry via vectors is moderate.

As well as the potential routes of entry, climatic conditions in most of Spain are favourable for this bacterium. The climatic risk map of Europe coincides with that of the European olive grove map, in other words, the favourable climatic conditions for the bacterium coincide with the olive growing regions. Unfortunately the results obtained from the models describing the probability of *Xylella fastidiosa* being introduced into Spain are disheartening, and its appearance in our country is very probable, through plant material imported from countries that are not free from the bacterium given the large amount of host plants, many of which are asymptomatic.

A Round Table was held during the conference to discuss different approaches and measures taken by the Spanish Ministry of Agriculture and the Regional Government of Andalusia. The first was taken at European level to press for the adoption of measures and at the same time a bacteria detection scheme was set up in the region by the Regional Government establishing controls in authorized nurseries. However, unfortunately large retailers, street markets, etc. are not subject to control. The Member of the European Parliament Esther Herranz has worked in close collaboration with the young farmers' association ASAJA Cordoba, and has been willing at all times to work from the European Parliament's Committee on Agriculture. She enabled us to put the following parliamentary question to the Commission of the European Union in October 2014: "*What protection measures and short- and medium-term plans will be undertaken by the Commission to protect the rest of the countries of the European Union from the risk of contamination by this bacterium?*"

Recently, six months after an unconvincing answer, the EP's Committee on Agriculture put forward the following questions for debate in Parliament: "*What research and analysis is the Commission pursuing in order to find a definitive solution to the problem and avert the possible spread to other EU regions? Considering the huge losses to date experienced by growers, how will the Commission compensate for the additional costs borne by growers if tree destruction is used as a measure to eradicate the disease? This again shows the need to implement phytosanitary controls of imports into the EU to prevent entry of material infected by Xylella or other dangerous organisms like "black spot. Thus, is the Commission ready to take the necessary actions to prevent import of infected material into the EU by reinforcing conditions for imports from third countries, and if needed limit imports into the EU to plants originating from pest-free production sites which are surveyed and controlled?*"

On 27 April 2015, shortly before the debate, the Standing Committee on Plants, Animals, Food and Feed (PAFF) convened and approved a Decision to adopt new measures to prevent the entry and spread of the bacterium *Xylella fastidiosa* throughout the EU. This decision will strengthen the safety cordons surrounding the infected zones, increasing the number of protected kilometres. There will be restrictions on imports and the movement of plant material will be limited within the EU, increasing the list of hosts in line with the EFSA list (extended list), as well as a ban on entry of coffee plants from Honduras and Costa Rica and information provided on plants that have already been introduced into the EU, etc. Urgent research is still pending. Immediate backing is needed, as well as the convening of experts to study the bacterium and possible solutions. In order to do so it is necessary to support research. Another issue to be resolved is the closure of borders of countries not free from the bacterium.

Furthermore, compensation still has to be paid to the farmers as it is no fault of theirs that the disease affecting their olive groves is incurable, and have to uproot their olive trees immediately so as to stop the disease from spreading. Many of the trees are destroyed before the administration can approve research projects. Therefore we wonder if a solution will ever be reached, and if destruction of the olive groves could have been avoided.

I have made an effort to summarize the present situation in Europe. We still quake when our association receives a call from a farmer to tell us that ornamental coffee plants are on sale in a superstore in Cordoba; these are large retailers located in towns that rely almost entirely on olive production and where at least 80 per cent of the population make their living from the olive groves. This is a matter of great concern as we are at the mercy of uncontrolled entry of plant material until imports of all host plants are banned.

Last year ASAJA CORDOBA entrusted a report to Miguel García, University lecturer in International Public Law, European Union Law and International Environmental Protection, due to the lack of action taken by the EU institutions concerning "black spot" in citrus. Twenty years after the problem was detected, in a context of over 900 seizures in the period 1999-2013 and an official Scientific Opinion from the European Authority for Food Safety in February 2014 concluding that there was a risk of entry and spread, and that the measures adopted were insufficient to prevent it, the *statu quo* of the European Commission is inacceptable. Therefore, and for many other reasons, the report concludes that "No action, incomplete or insufficient action or the adoption of ineffective measures given the obligation of the Community institutions, means a direct infringement of the substantive provisions of the Treaty of the European Union and the Treaty of the Functioning of the European Union, therefore, should the unfortunate case arise and the disease be introduced, implanted and spread, the damage caused by the inexplicable permissive behaviour of the Community institutions, especially the Commission, would more than justify litigation by the citrus growers and other affected parties, taking action for contractual liability against said institutions, claiming the corresponding compensation for damages".

For once and for all the EU should put a stop to the entry of plant material from countries with the bacterium, not only from Honduras and Costa Rica. This Decision, once again, disregards the continuous statements of the experts in the EFSA reports. Untold damage would be inflicted both in direct economic terms and in social terms, as it is impossible to contemplate earning a living in the rural environment without the olive groves, to say nothing of the incalculable environmental damage. Unless immediate action is taken about this situation, it will be necessary to demand an explanation from the EU as to *why* no action has been taken.

All the communications of the International Conference can be consulted in www.asajacordoba.es

Contribution of CIHEAM-Bari for the early surveillance of *Xylella fastidiosa* and its vectors on olive trees in Italy

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Introduction

The Mediterranean area is home to a wide biodiversity of plant species which must be protected for social, economic and environmental reasons. A sustainable protection strategy is therefore more essential than ever in order to protect the whole region from phytosanitary threats and genetic erosion.

For about 30 years, CIHEAM-Bari has made great efforts in the monitoring and control of harmful organisms in Italy (Apulia region) and in several Mediterranean countries, especially those of quarantine importance in order to prevent their entrance, establishment or spread (i.e. *Citrus tristeza virus, Plum pox virus, Erwinia amylovora*, etc.). To this aim, Bari Institute has promoted the use of 'healthy' propagating material, the establishment of pest surveillance programmes and application of eco-sustainable control methods. In the framework of Plant Protection Master of Science and cooperation programmes, numerous students have been trained and several research activities are carried out on phytosanitary problems affecting mainly Mediterranean fruit crops. Most of the results are transferred to the Mediterranean countries following the CIHEAM mission. CIHEAM-Bari is recognized by the Italian Ministry of Agriculture as a quarantine centre and its laboratory is accredited for the maintenance and manipulation of several pathogens.

To combat these phytosanitary threats the Institute has developed innovative solutions in early pathogen surveillance on regional scale such as efficient sampling methods, rapid diagnostic tools and predictive maps of the infection. In particular, about *Xylella fastidiosa* (*Xf*), a quarantine pest reported for the first time in Europe and in the Mediterranean area only in 2013, CIHEAM-Bari has played a pivotal role in research, training and support to the Apulian Plant Protection Service (PPS) in the bacterium monitoring.

X. fastidiosa, a gram-negative plant pathogenic bacterium is a regulated quarantine pest, whose introduction and spread into EU Member States is banned. Four subspecies of the bacterium have been described: ssp. *fastidiosa* (the agent of Pierce's disease of grapevine in California), ssp. *pauca* (the agent of Citrus variegated chlorosis in Brazil), ssp. multiplex and ssp. sandyi, each showing a high degree of host specificity.

X. fastidiosa ssp. pauca strain CoDiRO (Complex of rapid olive decline) is the bacterium which was first reported under field conditions from the province of Lecce (Apulia region, southeastern Italy), in association with a devastating disease of olive known as "olive quick decline syndrome" (OQDS). OQDS symptoms consist of leaf scorch and desiccation of scattered terminal shoots, which rapidly expand to the rest of the canopy, and result in the collapse and death of the tree. This pathogen was found to be transmitted by a xylem fluid-feeding insect vector, the polyphagous meadow spittlebug *Philaenus spumarius* (L.) (Hemiptera: Aphrophoridae), while *Neophilaenus campestris Fallén* (Aphrophoridae) and *Euscelis lineolatus Brullé* (Cicadellidae) were reported to be additional potential vectors. Apart from olive, other host species of the bacterium have been identified, most of which are ornamentals or belongs to the typical Mediterranean bush.

Upon the request of the Apulian PPS, a monitoring campaign was immediately organized in the region to assess the distribution of the pathogen and its putative vector, and to limit further dissemination of the bacterium. CIHEAM-Bari is one of the laboratories where samples are officially tested and research conducted on this newly introduced pathogen. Moreover, CIHEAM-Bari launched different research lines on *Xf* soon after its first report in 2013, mainly in the framework of the CIHEAM Master of Science programme in Integrated Pest Management, which is focused on (i) pathogen isolation and characterization; (ii) improvement of pathogen detection tools; (iii) identification of potential insect vectors/spies; (iv) evaluation of different control methods for pathogen and vector; (v) development of pathogen surveillance tools by remote sensing and information technologies. Results already achieved and presented at national and international scientific events or published in scientific journals were also put at disposal of the Apulian PPS for the implementation of *Xf* monitoring programme.

In particular, an efficient and innovative surveillance system of *Xf*, integrating advanced tools of territorial analyses and diagnosis methods of the bacterium in plant material and in the spy insects was designed and developed by CIHEAM-Bari (D'Onghia et *al.*, 2014 Fig. 1). This system, part of which is already officially applied in Apulia, is composed of a central web server (XylWeb) in which data from processed high resolution aerial images (Photointerpretation of OQDS trees), field smart application on android device (XylApp) and on-site rapid diagnostic assays (DTBIA and real time LAMP) converges (Fig. 1).

The spy insects approach (Elbeaino et *al.*, 2014)

An effective approach included in the innovative surveillance programme for *Xf* is the use of *spy insects* as bioindicators to assess the presence of the bacterium in areas which are considered free because of the absence of specific OQDS symptoms.

The *spy insect* is able to harbor the pathogen by feeding from infected plants; therefore it can be used as a sample, instead of the plant material, for testing the presence of the pathogen in a specific area. Apart from *P. spumarius*, which is also vectoring the bacterium, *N. campestris* and *E. lineolatus* proved to be *spy insects* by harboring *Xf*. This approach is very important in order to define an area as *Xf*-free, and to detect the pathogen before symptoms develop. However, it is very hard to assess the presence of the pathogen in asymptomatic trees due to the uneven distribution of the bacterium inside the host plant.

Photointerpretation of aerial images (Gualano *et al.*, 2014)

The availability of remote and proximal sensing instruments suitable for running in stand-alone or web-based GIS platforms has led CIHEAM-Bari to a significant progress in the large scale surveillance of infections related to pathogens of quarantine importance (i.e. *Citrus tristeza virus*). As for *Xf*, the photointerpretation technique was developed to recognize and classify the canopy with leaf scorching and desiccation as OQDS-suspected plants in GIS environment and used in the official large-scale monitoring of the bacterium. For this purpose, high resolution aerial images were used by processing visible (VIS) and near infrared (NIR) data for a rapid identification of appropriate photo-types, morphologically suitable for detecting the OQDS alteration. The identified OQDS- suspected trees are geo-localized for field inspections, sampling and testing. This approach is very innovative for a precise field monitoring, thus reducing time and costs. Moreover, this tool also provides a quantitative and spatial analysis of the occurrence of OQDS trees in different areas.

XylApp (Santoro *et al.*, 2014)

The smart application named XylApp has been designed for Android devices in order to optimize, rationalize and make sampling, geo-localization of the investigated sites and samples, data storing and transmission to the central server XylWeb easier. This application is composed of five independent modules: "*Sampling*" which allows to acquire sample data taken from the field without map support; "*Browse and sampling*" to acquire sample data from the field with the map support using the regional cartographic grid; "*Find*" to pinpoint one or more targets through geographic coordinates; "*Archives*" to (i) store field data in a directory, (ii) send them to a remote database, (iii) generate a report in Excel format, (iv) edit and/or delete single samples; "*Vademecum*" which provides a valuable guide with the main knowledge about host species, symptoms, insect spy/vector, equipment, etc.. In the official Apulian monitoring of *Xf*, XylApp is provided free of charge to the plant protection agents who have been trained for the use of this application in the field with a great success for the programme.

Rapid pathogen detection techniques (Djelouah *et al.*, 2014; Yaseen *et al.*, 2015)

Several detection methods, including tests such enzyme-linked immunosorbent assay (ELISA), immunofluorescence, Polymerase chain reaction (PCR)-based and Loop mediated Loop-mediated Isothermal Amplification (LAMP) assays, have been used over the years to detect *Xf* in grapevine, citrus, almond and other hosts.

Soon after the first findings of *Xf* in Apulia, no information was available on the strain or genotype infecting olive trees, nor procedures for the identification of the bacterium in locally grown olive cultivar tissues. Thus, the validation of ELISA and PCR protocols was necessary even before a large scale monitoring program for *Xf* detection in Apulia. The CIHEAM-Bari laboratory was part of a ring-test with other accredited laboratories and ELISA was identified as the official diagnostic assay in large-scale monitoring whereas PCR as a method for the confirmation of ELISA positive/doubtful samples in new infected areas.

In order to reduce time and costs for testing, and to avoid the high risk associated with the movement of the infected plant material to 'pathogen-free' areas, in which most of the laboratories are located, CIHEAM-Bari has developed the protocols of two diagnostic methods for the rapid and reliable on-site detection of *Xf* in plant material and in *spy insects*: the direct tissue blot immunoassay (DTBIA) and the real time - loop-mediated isothermal amplification (LAMP) technique. Both techniques are user-friendly, fast and do not require sophisticated equipment or highly skilled operators.

DTBIA or tissue print–ELISA is an accurate serological test whose sensitivity equals that of ELISA; it requires just the imprint of the sample in the field (usually young twigs or stem explants) directly on the nitrocellulose membrane. Printed membranes are processed in the laboratory and a violet color of the prints indicates the positive samples.

An alternative assay to conventional PCR is LAMP, which occurs at isothermal conditions with the use of four specially designed primers, providing a greater level of specificity compared to PCR. The protocol developed by CIHEAM-Bari was applied on-site for the detection of *Xf* through the use of a Smart-DARTTM unit (Diagenetix), a portable device equipped with D&A software that can process six samples each time. The real-time LAMP showed remarkable results in detecting *Xf* mainly from *spy insects*.

XylWeb (D'Onghia *et al.*, 2014)

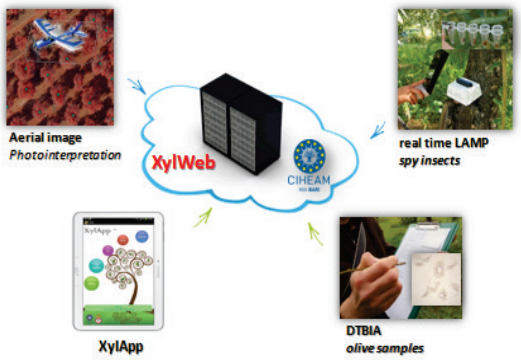
XylWeb is a web server designed and developed by CIHEAM-Bari for the collection, storage and management of the monitoring data flow for *Xf*. This software represents the core of this innovative surveillance system for *Xf* in which all data from the photointerpretation of aerial images, from the field acquisition by XylApp and from pathogen analyses in the laboratory or in the field (DTBIA and real time LAMP) merge by remote transmission.

XylWeb allows data traceability and real time analyses for producing reports and other papers. Its implementation with the regional cartography provides a clear map on the distribution of the samples, infected plants, etc. in order to support the Plant Protection Service in regional decisions for the containment of the infection.

Conclusion

The innovative surveillance system designed for *Xf* is multi-disciplinary, multi-data, multi-functional and multi-actors (Fig.1). Its application, although it is still in progress, is successful for the rapid and continuous monitoring of the pathogen at regional level. This system provides a precise identification of the suspected infected sites to be monitored, the accurate field data acquisition, the rapid onsite pathogen detection avoiding the risk of dissemination of *Xf* and relative vector to "pathogen-free" areas. It represents a valid tool for the Plant Protection Service to locate and properly size the expansion of the infection, and put in place the measures needed to counteract it. Such a model, which integrates different types of techniques and data, could become a permanent system for the surveillance of *Xf* and other invasive harmful pathogens and pests, which may threat the European and Mediterranean countries.

Figure 1
The CIHEAM-MAIB innovative surveillance system for Xylella fastidiosa: multidata, multidisciplinary, multifunctional, multiactors



Bibliography / More information

- Elbeaino T., Yaseen T., Valentini F., Ben Moussa I., Mazzoni V., D'Onghia A.M (2014). Identification of three potential insect vectors of *Xylella fastidiosa* in southern Italy. Phytopathologia Mediterranea 53(2), 328-332.

- Djelouah K., Frasheri D., Valentini F., D'Onghia A.M., Digiaro M. (2014). Direct tissue blot immunoassay for detection of *Xylella fastidiosa* in olive trees. Phytopathologia Mediterranea 53, 3, 207–212.

- D'Onghia A.M., Santoro F., Yaseen T., Djelouah K., Guario A., Percoco A., Valentini F. (2014). An innovative monitoring model of *Xylella fastidiosa* in Apulia region, Italy. Proceedings of the International Symposium of the European Outbreak of *Xylella fastidiosa* in Olive, Gallipoli, Locorotondo, Italy (October 2014), 33.

- Gualano S., Tarantino E., Santoro F., Valentini F., Dongiovanni N., D'Onghia A.M. (2014). Analisi assistita da immagini aeree ad elevata risoluzione geometrica per il riconoscimento del CoDiRO associato al batterio *Xylella fastidiosa* in Apulia. Proceedings of the 'Federazione Italiana delle Associazioni Scientifiche per le Informazioni Territoriali e Ambientali (ASITA)' (October, 2014), 651-658.

- Santoro F., Favia G., Valentini F., Gualano S., Guario A., Percoco A., D'Onghia A.M. (2014). Development of an information acquisition system for the field monitoring of *Xylella fastidiosa*. Proceedings of the International Symposium of the European Outbreak of *Xylella fastidiosa* in Olive, Gallipoli, Locorotondo, Italy (October 2014), 48.

- Yaseen T., Drago S., Valentini F., Elbeaino T., Digiaro M., D'Onghia A.M. (2015). On-site detection of *Xylella fastidiosa* in olive trees (*Olea europaea L.*) and insects using the real-time loop-mediated isothermal amplification method. Phytopathologia Mediterranea (in press).

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Assessing the risk posed to plant health by *Xylella fastidiosa* in the European Union

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The plant pathogenic bacterium *Xylella fastidiosa* Wells et al., 1987 was detected in olive trees in Lecce province in Apulia, Italy, in October 2013, being this its first outbreak under field conditions in the European Union. Following a request by the European Commission, in November 2013 the European Food Safety Authority (EFSA) published a Statement reviewing the host plants range and the vectors of this pathogen, its pathways for entry and spread, as well as the options available to reduce the risk it poses (EFSA, 2013).

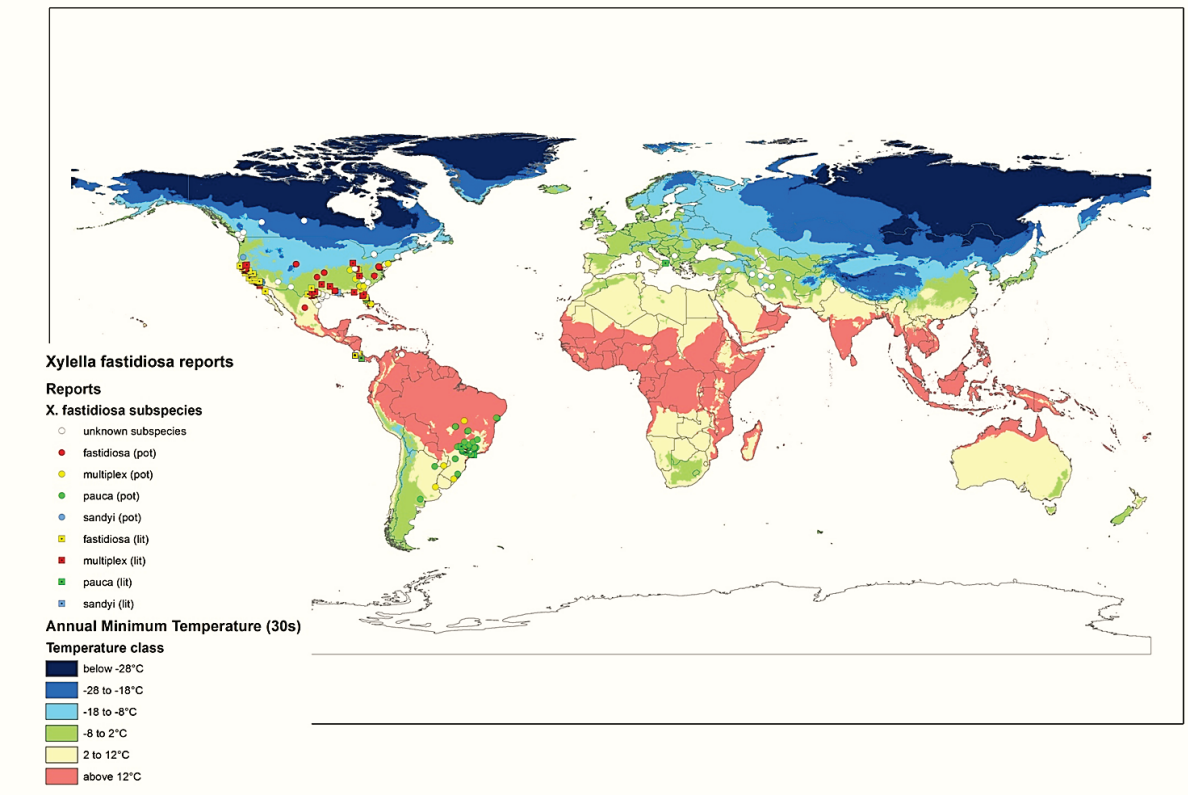
This was followed in January 2015 by a comprehensive assessment of the risks to plant health of *X. fastidiosa* for the EU and by a systematic identification and evaluation of risk reduction options (EFSA PLH Panel, 2015). In spring 2015, EFSA has published a searchable electronic list of host plants of *X. fastidiosa* (EFSA, 2015a) and has also further discussed studies on the quick olive decline syndrome (EFSA, 2015b). This paper presents a summary of the main findings of these assessments.

The pathogen *Xylella fastidiosa*

X. fastidiosa is a gammaproteobacterium in the family Xanthomonadaceae causing many important plant diseases such as Pierce's disease of grapevine, phony peach disease, plum leaf scald as well as almond, elm, oak, American sycamore, mulberry and maple leaf scorch, and citrus variegated chlorosis disease. The genus *Xylella* consists of only one species, *X. fastidiosa.* The current distributions of *X. fastidiosa* and its main subspecies are presented in Figure 1, which shows that *X. fastidiosa* has been reported over a large range of climatic environments.

Figure 1
World map of annual minimum temperatures from WorldClim database (http://www.worldclim.org) and *Xylella fastidiosa* subspecies distribution.

Temperature classes were chosen based on annual minimum temperatures of northern records of X. fastidiosa.
Reports of X. fastidiosa from an EFSA literature search database: (lit) indicates reports where the subspecies was assigned in the original paper; (pot) indicates reports for which a potential subspecies was assigned by the Panel.



However, there is a lack of data regarding its overwintering capacity and the range of temperatures within which the different subspecies of the bacteria can thrive. *X. fastidiosa* colonises the xylem vessel network of plants, where it can move up- and downstream, restricting water movement in the xylem. High frequencies of blocked xylem vessels are associated with development of disease symptoms based on plant physiological responses to water stress (Figure 2).

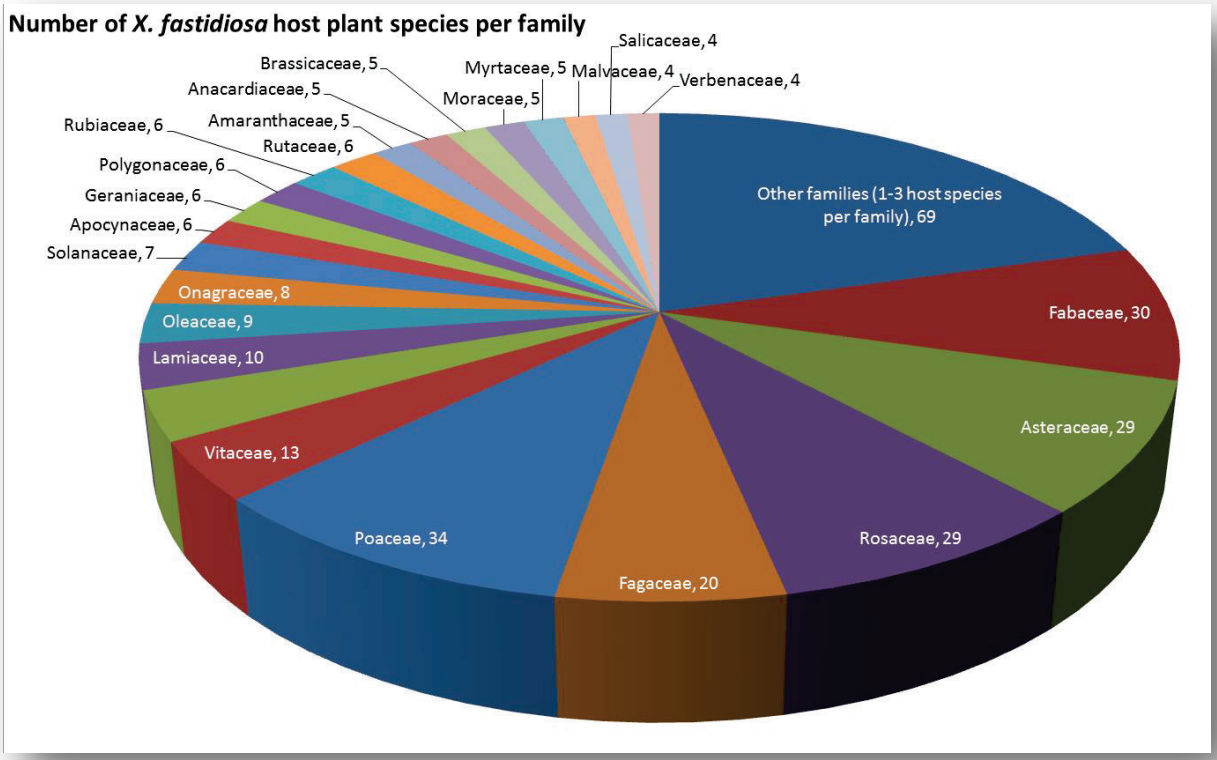
Figure 2
***Xylella fastidiosa* symptoms on various host plant species.**
(A) Olive trees (B) Oleander (C) Almond leaf scorch disease (D) Cherry (E) *Polygala myrtifolia* (F) *Acacia saligna*

Source: Photographs by courtesy of Donato Boscia, CNR—Institute for Sustainable Plant Protection.

A large host range

The host plant range of *X. fastidiosa* is very large. Based on currently available data, the host range comprises plants in 68 families, 187 genera and more than 300 plant species (Fig. 3).

Figure 3
Number of host plant species of *X. fastidiosa* reported for different botanical families. Families with up to three species reported are grouped



Six of the families are monocotyledons, while 59 are dicotyledons and three are gymnosperms. Despite this reported wide host range, it is important to highlight that not all of these plants express symptoms and are susceptible to disease. For some species certain varieties have been reported showing symptoms whereas others remain generally asymptomatic. In addition, not all host plant species are associated with each *X. fastidiosa* subspecies. There are some indications of host specificity; however its mechanism is not yet fully understood.

A large number of vectors

X. fastidiosa is exclusively transmitted by xylem sap-feeding insects of the order Hemiptera, sub-order Auchenorrhyncha (Redak et al., 2004), which are able with their sucking mouthparts to reach the xylem of their host plants. These insects are generally not direct pests unless they are present at very high population levels. Within the Cicadomorpha the three superfamilies, Cercopoidea, Cicadoidea and Membracoidea, include xylem fluid-feeding groups but, whereas all Cercopoidea (known as spittlebugs or froghoppers) and Cicadoidea (cicadas) are regarded as xylem fluid feeders, the superfamily Membracoidea includes a single xylem fluid-feeding subfamily, the Cicadellinae (known as sharpshooters).

Only these three groups of 'specialists' in xylem fluid feeding have been shown to be vectors of *X. fastidiosa*. Spittlebugs, cicadas and sharpshooters are heterometabolous insects that develop through egg, five nymphal stages and adult winged stage. Nymphs of cicadas and of spittlebugs of the family Cercopidae are subterranean root feeders, whereas nymphs of spittlebugs of the family Aphrophoridae and of sharpshooters develop on the parts of host plants above the ground. All adults feed and live on the aerial parts of host plants (Ossiannilsson, 1981; Tremblay, 1995; Redak et al., 2004).

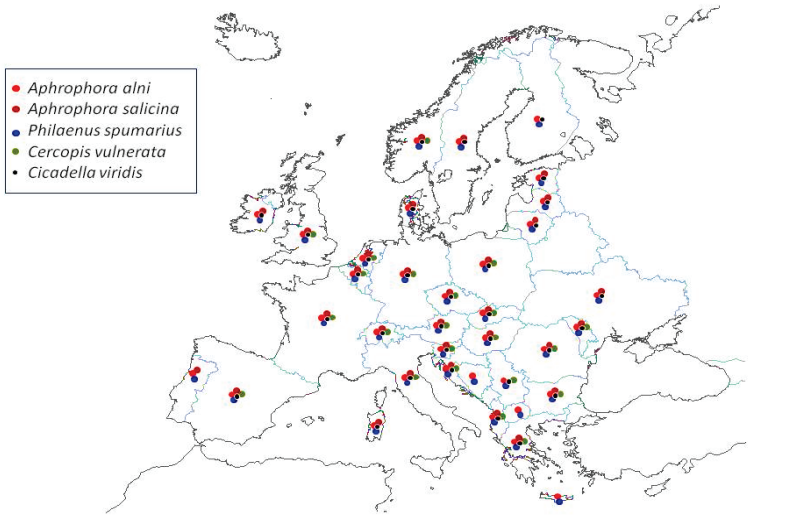
With the exception of *Philaenus spumarius* (Aphrophoridae), an Old World species introduced in North America and identified as a vector of *X. fastidiosa* in California (Purcell, 1980) and in Apulia (Saponari et al., 2014), all the American vector species are absent from Europe according to the Fauna Europaea database (de Jong, 2013). Sharpshooters (Cicadellidae, subfamily Cicadellinae) are by far the most important vectors of *X. fastidiosa* in the Americas (table 1), but only a few species are present in Europe (Wilson et al., 2009). One species, *Cicadella viridis*, is widespread in Europe, but is common only in humid areas

Table 1
Vectors of *X. fastidiosa* in the Americas: main insect groups and most important vector species

Insect group	Most important species	Distribution	Role as vector	Role as vector: criteria
Sharpshooters (Cicadellidae, Cicadellinae): 38 spp.	*Bucephalogonia xanthophis* (Berg)	Neotropical: Argentina, Bolivia, Brazil, Paraguay	High in citrus	Common, abundant on ornamental plants, citrus and nursery stocks
	Dilobopterus costalimai Young	Neotropical: Brazil	High in citrus	Common, abundant on ornamental plants and citrus
	Graphocephala atropunctata (Signoret)	USA and Central America	High in grapevine	Common in diverse ecosystems, on grapevine and ornamental plants
	Homalodisca vitripennis (Germar)	USA (southern states), Mexico (northern part), French Polynesia, Easter Island	High in grapevine	Common and abundant in diverse ecosystems, on grape, ornamentals, citrus and nursery stock
Spittlebugs (Cercopoidea): six species	*Philaenus spumarius* L.	USA Including Hawaii, Mexico, Tahiti	Low	Not associated with disease epidemics
Cicadas (Cicadoidea): two species	*Diceroprocta apache* Davis *Dorisiana viridis* (Olivier)	Mexico, Arizona, Utah, Nevada, California	Doubtful	Missing information on transmission capacity

In contrast, a relatively high number of spittlebug species (Cercopoidea: Aphrophoridae and Cercopidae), which are less important vectors in America, occur in Europe and some, such as *Philaenus spumarius*, are very common, but are generally associated with herbaceous plants. According to Frazier (1944) and Purcell (1989), all the xylem fluid feeders should be considered to be potential vectors. A list of potential vectors of *X. fastidiosa* in Europe, gathering all the sharpshooters and spittlebugs was drawn from the Fauna Europaea database. From this list, the species with the highest potential for *X. fastidiosa* spread were identified, based on three criteria: polyphagy, abundance and frequency in different environments (Table 2, Figure 4).

Figure 4
Reported presence in Europe of the most important potential vector species of *X. fastidiosa*



Source: data from http://www.faunaeur.org; de Jong, 2013

Table 2
Current and potential vector species of *X. fastidiosa* in Europe: main insect groups and most important potential vector species

Insect group	Most common species	Distribution	Potential role as vector	Potential role as vector: criteria
Sharpshooters (Cicadellidae, Cicadellinae): seven species	*Cicadella viridis* (Linnaeus 1758)	All Europe	Moderate to high	Very common, wide host range but hygrophilous
Spittlebugs (Cercopoidea): 34 species	*Aphrophora alni* (Fallen 1805)	All Europe	Moderate to high	Common, wide host range
	Aphrophora salicina (Goeze 1778)	All Europe	Moderate	Common, oligophagous
	Philaenus spumarius (L.)	All Europe	High	Very common and abundant in diverse ecosystems Identified as a vector in Apulia (Saponari et al., 2014)
	Cercopis vulnerata Rossi 1807	Not present in northern Europe	Moderate	Many host plants but mainly associated with herbaceous plants
Cicadas (Cicadoidea): 54 species	*Cicada orni* Linnaeus	Not present in northern Europe	Doubtful	Missing information on transmission capacity
	Cicadatra atra (Olivier)	Balkans, Italy and France	Doubtful	Missing information on transmission capacity
	Lyristes plebejus (Scopoli)	Not present in northern Europe	Doubtful	Missing information on transmission capacity
	Cicadivetta tibialis (Panzer)	Not present in northern Europe	Doubtful	Missing information on transmission capacity
	Tibicina haematodes (Scopoli)	Not present in northern Europe	Doubtful	Missing information on transmission capacity

As stated earlier, cicadas are xylem- fluid feeders and are also expected to be potential vectors, although there are only two reports on their role in *X. fastidiosa* transmission (Paiaõ et al., 2002; Krell et al., 2007). Owing to the large populations of cicadas, particularly in southern EU regions, in addition to the wide host range of plant species utilised by these insects, cicadas could potentially play an important role as vectors of *X. fastidiosa*, however uncertainty is high due to the lack of studies.

Conclusions of the EFSA risk assessment

The EFSA Plant Health Panel has concluded that plants for planting and infectious vectors in plant consignments were the most important pathways for the introduction of *X. fastidiosa* into new areas. The entry of *X. fastidiosa* with plants for planting was rated as very likely mainly because of the very large number of host plant species, the very high trade volumes and the possibility of asymptomatic infection. The likelihood of entry of *X. fastidiosa* with infectious insect vectors in plant consignments was considered as moderately likely.

The assessment identified some uncertainties particularly due to the lack of precise knowledge on distribution, prevalence and symptoms expression of *X. fastidiosa* in the cultivated crops in the countries of origin. Following an entry of X. fastidiosa, the probability of establishment was rated as very likely, based on the very high probability that the pathogen would find a suitable host owing to the very large range of host plants and potential host plants, and to the wide distribution and polyphagy of known and potential vectors. Other elements taken into account were the high probability of finding a climatically suitable environment with few adverse abiotic factors and the lack of effective natural enemies, cropping practices or control measures.

Similarly the probability of spread from established infestations of *X. fastidiosa* was rated as very likely because of the large number of confirmed or potential host plants and the abundance and widespread distribution of known or potential vectors. Spread over short to long distances may occur by human assistance, via trade of infected plants for planting or by passive transport of infectious insects in vehicles. However, infectious vectors may also spread locally by flying or being passively transported longer distances by wind. The uncertainties related to the spread include the contributions of human- and wind mediated spread mechanisms, the lack of data on how far the insect vectors can fly, and on how farming practices could impact potential insect vectors and limit the spread of the disease. The overall potential consequences of *X. fastidiosa* in the European territory were rated as major considering the severe losses on cultivated tree crops, such as on citrus in South America and on grapes in North America.

With regard to risk reduction options, the Panel concluded that, because of the broad host range of the pathogen and its vectors, the key priority should be to prevent introduction. Strategies for preventing the introduction from areas where the pathogen is present and for the containment of outbreaks should focus on the two main pathways of plants for planting and of infectious insects and should be based on an integrated system approach, combining, when applicable, the most effective options (e.g. pest-free areas, surveillance, certification, screen house production, control of vectors and testing for plant propagation material, preparation, treatment and inspection of consignments for the pathway of the infectious vectors).

The Panel recommended the continuation and intensification of research activities on the host range, epidemiology and control of the Apulian outbreak *of X. fastidiosa*. Based on the knowledge acquired by this research, uncertainties could be substantially reduced and a more thorough assessment of the risk and of the mitigation measures could be conducted for the Apulian strain of *X. fastidiosa*.

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Bibliography / More information

- de Jong YSDM, 2013. Fauna Europaea version 2.6. Ed. de Jong YSDM. Web Service. Available online: *http://www.faunaeur.org*
- EFSA (European Food Safety Authority), 2013. Statement of EFSA on host plants, entry and spread pathways and risk reduction options for *Xylella fastidiosa* Wells et al. EFSA Journal 2013;11(11):3468, 50 pp. doi:10.2903/j.efsa.2013.3468. Available online: *www.efsa.europa.eu/efsajournal*
- EFSA PLH Panel (EFSA Panel on Plant Health), 2015. Scientific Opinion on the risks to plant health posed by *Xylella fastidiosa* in the EU territory, with the identification and evaluation of risk reduction options. EFSA Journal 2015;13(1):3989, 262 pp., doi:10.2903/j.efsa.2015.3989. Available online: *www.efsa.europa.eu/efsajournal*
- EFSA (European Food Safety Authority), 2015a. Categorisation of plants for planting, excluding seeds, according to the risk of introduction of Xylella fastidiosa. EFSA Journal 2015;13(3):4061, 31 pp. doi:10.2903/j.efsa.2015.4061. Available online: *www.efsa.europa.eu/efsajournal*
- EFSA (European Food Safety Authority), 2015b. Response to scientific and technical information provided by an NGO on *Xylella fastidiosa*. EFSA Journal 2015;13(4):4082, 13 pp. doi:10.2903/j.efsa.2015.4082. Available online: *www.efsa.europa.eu/efsajournal*
- Frazier NW, 1944. Phylogenetic relationship of the nine known leafhopper vectors of Pierce's disease of grape. Phytopathology, 34, 1000–1001
- Krell RK, Boyd EA, Nay JE, Park YL and Perring TM, 2007. Mechanical and insect transmission of *Xylella fastidiosa* to *Vitis vinifera*. American Journal of Enology and Viticulture, 58, 211–216
- Ossiannilsson F, 1981. The Auchenorrhyncha (Homoptera) of Fennoscandia and Denmark. Part. 2: the families Cicadidae, Cercopidae, Membracidae, and Cicadellidae (excl. Deltocpehalinae). Scandinavian Science Press Ltd, Klampenborg, Denmark, 593 pp.
- Paiaõ FG, Meneguim AM, Casagrande EC and Leite RP, 2002. Envolvimento de cigarras (Homoptera, Cicadidae) na transmissão de *Xylella fastidiosa* em cafeeiro. Fitopatologia Brasileira, 27, 67.
- Purcell AH, 1980. Almond leaf scorch: leafhopper and spittlebug vectors. Journal of Economic Entomology, 73, 6, pp 834–838.
- Purcell AH, 1989. Homopteran transmission of xylem-inhabiting bacteria. In: Advances in disease vector research, Vol. 6. Ed. Harris KF. Springer, New York, USA, 243–266.
- Redak RA, Purcell AH, Lopes JRS, Blua MJ, Mizell III RF and Andersen PC, 2004. The biology of xylem fluid-feeding insect vectors of *Xylella fastidiosa* and their relation to disease epidemiology. Annual Review of Entomology, 49, 243–270.
- Saponari M, Loconsole G, Cornara D, Yokomi RK, Stradis AD, Boscia D, Bosco D, Martelli GP, Krugner RC and Porcelli F, 2014a. Infectivity and transmission of *Xylella fastidiosa* by *Philaenus spumarius* (Hemiptera: Aphrophoridae) in Apulia, Italy. Journal of Economic Entomology, 107, 1316–1319.
- Tremblay E, 1995. Entomologia applicate, Vol 2/1. Liguori Editore, Napoli, Italy, 408 pp.

Solanum Elaeagnifolium: A New Invasive Weed in Lebanon

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Weeds and invasive alien plants are a major threat to natural and agro-ecosystems in Lebanon and the Middle East (ME). Accordingly, early detection, mapping and active management of invasive alien plants such as *S. elaeagnifolium* are extremely important, particularly with the swift increase in global travel and trade, which accelerates weed invasion [2]. *S. elaeagnifolium* is a perennial broadleaved plant in the family *Solanaceae*.

It is one of the most noxious and fastest invasive spreading plants in many crops such as cotton and orchards. Control remains challenging for crop growers and it is included in the lists of plants controlled under noxious weed legislation in Australia, South Africa and approximately 20 states of the USA. In 2006, it was recommended for regulation in the EPPO region as an A2 pest [1]. An outbreak also occurred in Northwestern Iraq and in Jordan leading to farmers' economical suffering [1]. Only recently did the Food and Agriculture Organization sound the alarm on this invasive non-native weed in the ME region.

Mapping of *S. elaeagnifolium* is considered the foundation for the development of a strategic long-term management plan to protect agro-biodiversity and prevent invasion of this non-native invasive alien plant. Surveying its spread in arable and non-arable lands of Lebanon is essential for identifying sources and means of distribution.

An invasive alien plants map is also beneficial in assessing the economic and environmental impacts of invasive alien plants and for their strategic management and monitoring. No similar studies on this subject have previously been conducted in Lebanon. Therefore, the objective of this work was to find out the status of *S. elaeagnifolium* in Lebanon and establish its first baseline data at the national level.

Materials and Methods

Ninety-five villages distributed between two governorates, namely; the Beqaa and the North of Lebanon governorates were surveyed all the way to the Lebanese Frontier (Figure 1). A global positioning system (GPS) Garmin© 2006 was adopted to take precise waypoint, elevation, navigation and distance. In addition, a vehicle device was extensively used to facilitate the quest of the two Weed and Environmental Scientist's Researchers from the American University of Beirut institution team in going off-road for visual observation purposes in arable and non-arable lands (Box 1).

The team consisted of a weed scientist (M. Haidar) from the American University of Beirut and his trained assistant (A. Sabra). Visual aid containing a collected sample of the alien plant, helped in the surveillance process when addressing to the locals including farmers and herders, to ensure the validity of the response and unify the language of the purpose. A digital camera was utilized to record evidence of visited villages.

Fifty-two villages in the Beqaa extended between Ebblias (N33^0 78.021', E35^0.81.618') and Qaa (N34^0 34.874', E36^0 51.509') were surveyed. In comparison, forty-three villages in the North expanded from Batroun (N34^0 27.484', E35^0 65.904') to Machta Hammoud (N34^0 64.637' E36^0 33.181'). Target weed was *S. elaeagnifolium* because it is an epidemic, highly invasive, nonnative weed in our neighboring country Syria [2, 3, 4].

Box 1
Timeline of Operation for *Solanum elaeagnifolium* Surveillance

July 2011	Phase I	-Investigated arable and non-arable, industrial and marginal lands in the West, East, South and North of the Bekaa plain and the Libano-Syrian borders in the North of Lebanon reported a **"Solanum Free Zone"** -*Abutilon theophrasti* field at Hawsh Snayed in the Mi-Bekaa (**First Indication**)
December 2012	Phase II	*S.elaeagnifolium* **First Appearance and Intrusion** in the North Beqaa plain (The percentage of coverage is between 1-5%, the frequency is 2 to 4 diameter in meter and the growth status is seedlings)
June 2013	Phase III	Investigated arable and non-arable, industrial and marginal, inland and coastal lands in the West, East, South and North of the South and the West-Bekaa plain of Lebanon showed **No Sign** for the existence of *S.elaeagnifolium*

Results and Discussion

Post the Syrian conflict, the investigated arable and non-arable, industrial, marginal lands revealed the presence of *S. elaeagnifolium* only in two villages in the North Beqaa governorate (Box 1). In comparison, *S. elaeagnifolium* was not found in any of the ecosystems in the North governorate. This finding was confirmed by farmers, nursery owners, and from the survey of several farms with a yearly crop rotation of barley, legumes and watermelon, or eggplants. These farms are situated between the Lebanese and Syrian borders in the Qaa village of the North-Beqaa governorate. This finding was also confirmed by several Lebanese shepherds, living in Baalbeck and Hermel villages'. Both villages are located in the North East-Beqaa governorate, who regularly takes their herds to the Syrian border to graze. This was also ascertained by few Syrian workers near the Syrian border at the North East-Beqaa plain. This collected data proved necessary when an outbreak of *S. elaeagnifolium* had previously occurred across the Lebanese border in neighboring Syria [2, 3].

It is also mystifying that the neighboring Syrian country is infested with *S. elaeagnifolium* while the North Lebanese frontier (North of Lebanon governorate) is free from this weed. Some farmers cited that *S. elaeagnifolium* appeared after the import of contaminated orchards (Large olives, stone fruit and apple) and vegetable seedlings from Syria two years ago. Accordingly, a needed preventive action-oriented plan should be adopted to keep Lebanese villages bordering the Syrian line intact from any future invasions.

Conclusion and Alien Plant Action Recommendation Plan

This is the first report of the introduction of *S. elaeagnifolium* in Lebanon and the establishment of a baseline data on non-native invasive alien plant of Lebanon. Our observations revealed that the propagation of *S. elaeagnifolium* began with the import of the contaminated orchard seedlings (soil). Thus, regular field surveying and mapping to include other governorates are necessary to track weeds movement in Lebanon. Field-validated research is needed to generate new technologies for combating the infestation of present and future invasive alien plants.

There is a concern that the presence of *S. elaeagnifolium* in the North and Midth of the Bekaa expands due to farmer's lack of awareness, especially with the presence of a "Syrian refugee mess", to reach the temporarily "Solanum Free Zones". Furthermore, the probability of penetration through the International Blue Borderline via the Occupied Palestinian Territories is foreseeable.

This concern is amplified when noticing throughout the field surveys that the population was confounding Solanum with other similar weeds and mostly being inquisitorial about it. Therefore, there should be an urge in initiating the following plan against *S. elaeagnifolium* invasion especially when knowing that it will be a major epidemic pest threatening cash crops at the time of its germination and flowering. The beauty of Solanum flower can lead locals to increase its growth for ornamental purposes. The two scientists urge officials in Lebanon to consider *S. elaeagnifolium* as a quarantine pest. Different control techniques and methods are needed to prevent *S. elaeagnifolium* from entering Lebanon and spreading (Box 2).

Box 2
Control Techniques used at National and Farmer Levels

A- National Level

- Enhance public awareness on *S. elaeagnifolium* risks as it can be carried by herders at the border as a contaminant on footwear through the media (Press Conferences, TV Talk shows, Posters, Flyers, Newspaper, Magazines, Radio and the Internet)
- Establish a seed law by the Ministry of Agriculture
- Create Quarantines at the border allowing only the entrance of clean containers and packaging material into Lebanon
- Cleaning and disinfection of imported machinery and vehicles from countries where the pest occurs
- Sanitization of fields through usage of clean certified seed, clean equipment and tarping grain loads techniques

B- Farmer Level

- Educate farmers through lectures, trainings and workshops via establishing Farmer Field Schools (FFS) in main agriculture areas (Bekaa, North and South)
- Ensure the continuity of the project via training of trainers (ToT)
- Enforce Sterilization
- Integration of weed management system (IWM)

Bibliography / More information

- [1] European and Mediterranean Plant Protection Organization (EPPO), 2007. *Solanum elaeagnifolium*. Data sheets on quarantine pests. Bulletin OEPP/EPPO Bulletin 37, 236–245
- [2] Food and Agriculture Organization (FAO), Iraq and Syria under attack from devastating alien weed Silverleaf nightshade. FAO Media Center 2011.
- [3] European and Mediterranean Plant Protection Organization (EPPO), Solanum elaeagnifolium. Data sheets on quarantine pests, Bulletin 37 (2007) 236–245.
- [4] M. Mekki, Biology, distribution and impacts of silverleaf nightshade (Solanum elaeagnifolium Cav). Bulletin OEPP/EPPO (2007) 114-118.

Figure 1
The surveyed Beq'aa and North governorates

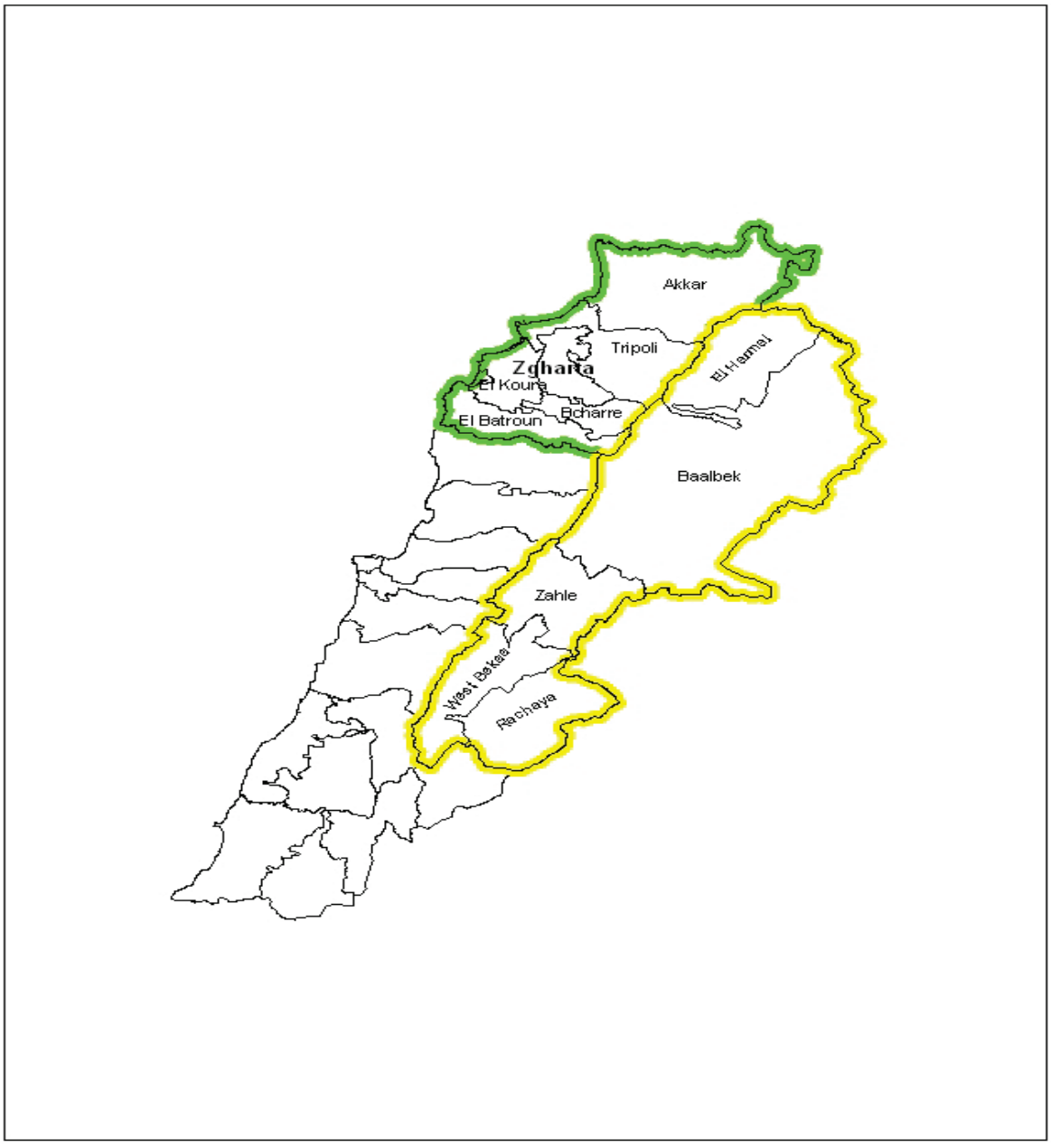
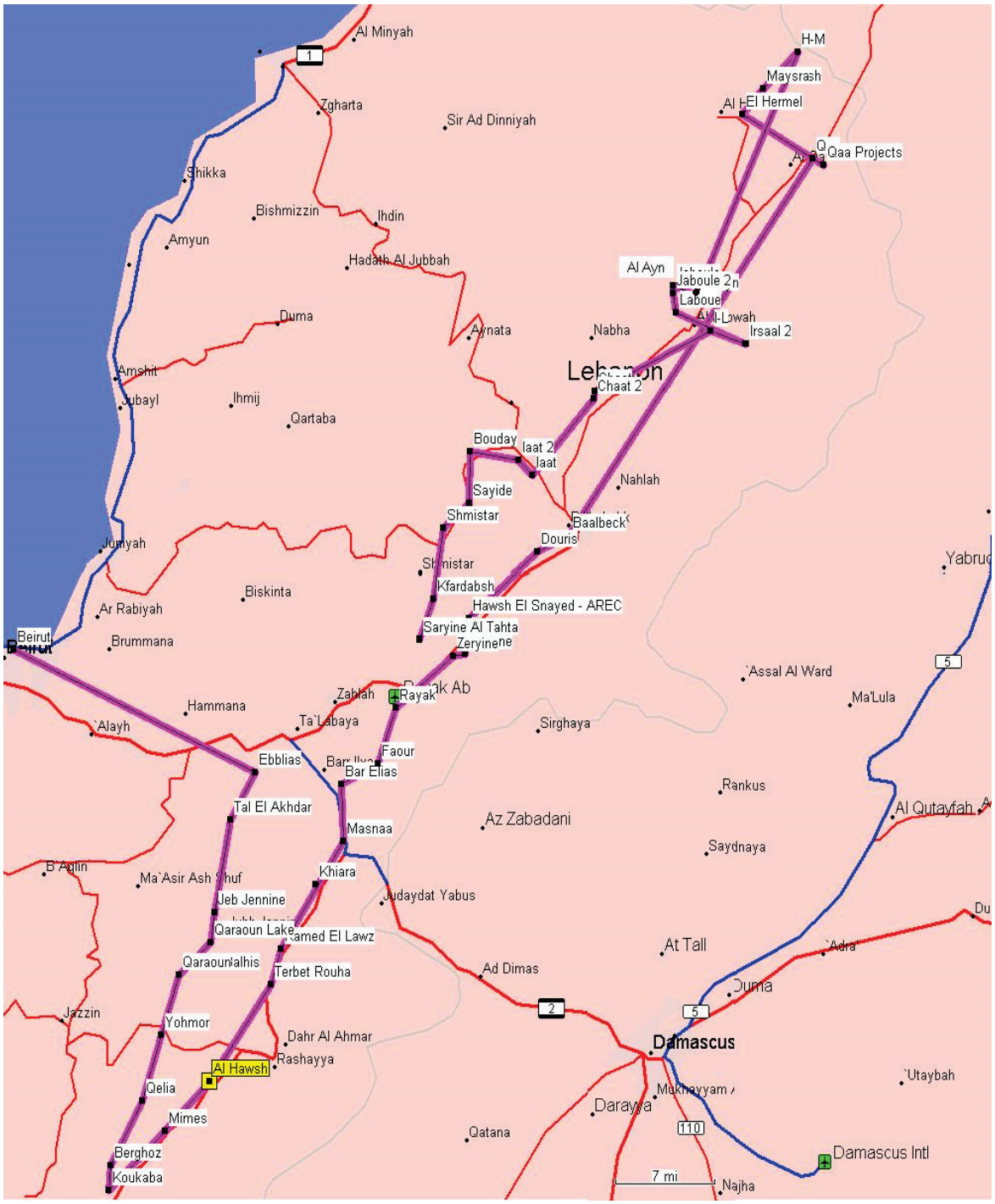


Figure 2
Explored villages in the Beqaa governorate of Lebanon



Alien challenges in Greece: an overview of the terrestrial species

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Although the phenomenon of biological invasions has been noted for some time (Elton 1958), it is only during the last two decades that the biological consequences of exotic invasions have been researched extensively. Invasive species can threaten biological diversity in various ways, from reducing genetic variation and eroding gene pools, through the extinction of endemic species, and by altering habitat and ecosystem functioning. Biological invasions also cause economic impacts that can be valued as financial costs, based on expert extrapolations of high-profile alien pests. A conservative estimate of the annual damage caused in the European Union (EU) by alien species is € 12 billion.

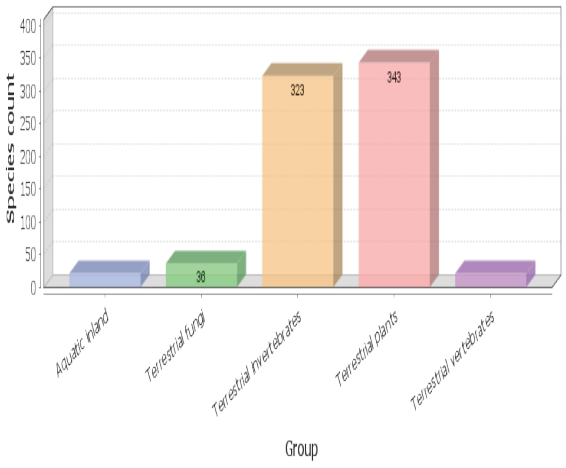
The Convention on Biological Diversity (CBD) calls for the "compilation and dissemination of information on alien species that threaten ecosystems, habitats, or species, to be used in the context of any prevention, introduction and mitigation activities" (CBD 2000). The objective set by Aichi Biodiversity Target 9 is that "by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment". This objective is reflected in Target 5 of the EU Biodiversity Strategy (EU 2011).

To effectively support policies and scientific research on biological invasions in Europe, and to efficiently use the already accumulated knowledge, there is a need for standardization, harmonization and integration. To achieve this goal, the European Commission's Joint Research Centre (JRC) launched the European Alien Species Information Network (EASIN) in 2012 (http://easin.jrc.ec.europa.eu). This network aims at facilitating the exploration of existing alien species information from distributed sources through a network of interoperable web services, and to assist the implementation of European policies on biological invasions (Katsanevakis et al. 2015).

The DAISIE Project

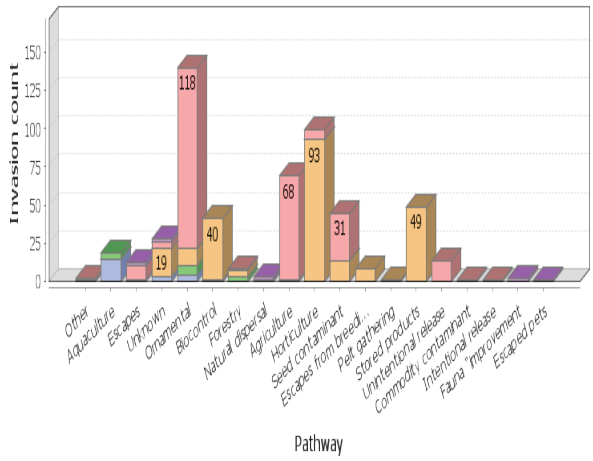
The first pan-European assessment of the impacts of alien species (plants, vertebrates, and invertebrates) in terrestrial, freshwater, and marine environments on ecosystem services was made possible through comprehensive data produced by the DAISIE project (www.europe-aliens.org).This assessment stated that there are 1094 species with documented ecological impacts and 1347 with economic impacts (Vilà et al. 2009). The two taxonomic groups with the most species causing impacts are terrestrial invertebrates and terrestrial plants. The North Sea is the maritime region that suffers the most impacts. Across taxa and regions, ecological and economic impacts are highly correlated. Terrestrial invertebrates create greater economic impacts than ecological impacts, while the reverse is true for terrestrial plants. Alien species from all taxonomic groups affect "supporting", "provisioning", "regulating", and "cultural" services and interfere with human well-being. Terrestrial vertebrates are responsible for the greatest range of impacts, and these are widely distributed across Europe.

Figure 1
Data on alien species counts



Source: DAISIE web site for Greece (www.europe-aliens.org)

Figure 2
Data on alien species pathways of introduction



Source: DAISIE web site (www.europe-aliens.org)

The same database provides also fact sheets on the most invasive species organized by habitat, e.g. terrestrial plants, terrestrial invertebrates, terrestrial vertebrates, terrestrial fungi, aquatic marine and aquatic inland. In these fact sheets information on taxonomy, synonyms, ecology and habitat of the species in reference can be found.

Alien species occurring in Greece are not few and have occupied the scientific interest for many years. The most advanced work has been performed on the marine taxa and has been undertaken by the Hellenic Center of Marine Research. Quite a substantial deal of publications has come out of this work, the most recent of which have been published by Pancucci-Papadopoulou et al. 2005a; Pancucci- Papadopoulou et al. 2005b; Zenetos et al. 2007; 2009a; 2011).Compilation of information on freshwater species has been carried out by Zenetos et al. (2009b), and amended by Koutsikos et al. (2012).

The situation in Greece

The first comprehensive checklist of terrestrial alien plant species in Greece was produced upon completion of the DAISIE project in 2008 and was published in Arianoutsou et al. 2010a.In this paper the state-of-the-art assessment of the alien flora of Greece and its traits is presented. The checklist consists of a total of 343 alien taxa, including 49 archaeophytes. The taxonomy, life traits and habitat of the 294 neophytes are analyzed vs. their naturalization status. Poaceae, Asteraceae, Amaranthaceae, Solanaceae, Fabaceae, and Polygonaceae are the plant families richest in alien taxa. The majority of them are of American origin, followed by those of Asiatic and Mediterranean origin. The neophytes are predominantly herbs, most of them annuals. Although data available are not sufficient, there is strong evidence that most neophytes (75%) are introduced intentionally for agricultural or ornamental purposes. On the other hand, contamination of crop seed propagules has apparently been a main pathway of accidental introduction.

Artificial habitats, especially cultivations and road networks, host the highest numbers of neophytes. Plant habitats of urban and inhabited rural areas such as walls, pavements, construction sites and abandoned constructions are also often colonized by neophytes. The natural habitats that host the highest numbers of neophytes are the coastal zones and inland surface waters. Artificial habitats host the highest numbers of naturalized taxa, as well. However, the naturalized neophytes occur more frequently in natural habitats than casuals, especially in coastal and water related ones.

The total number of the alien plant taxa reported for Greece (343) is relatively low compared to those of other Mediterranean and Southern European countries, namely Italy, Spain and Portugal (1023, 933, 547, respectively – for detailed citations see in Arianoutsou et al. 2010b). The smaller number and density of alien plant species observed in Greece may be related to the fact that it has lower levels of industrialization and of transportation network development, a higher proportion of scarcely if at all populated or cultivated mountainous areas, and a highly dissected physiography with many high and often inaccessible mountain ranges spreading across the mainland.

Out of the 122 naturalized neophytes, 50 are identified as exhibiting invasive behaviour. *Ailanthus altissima*, *Amaranthus albus*, *Chenopodium ambrosioides, Datura stramonium*, *Eleusine indica*, *Erigeron bonariensis*, *Nicotiana glauca*, *Opuntia ficus-barbarica*, *Oxalis pes-caprae*, *Paspalum distichum, Solanum elaeagnifolium, Symphyotrichum squamatum* and *Xanthium spinosum* are typical cases of plants characterized as invasive, having established in a variety of habitats.

*Opuntia ficus-barbarica (*Figure 3*)* and *Ailanthus altissima* invade abandoned rangelands, very often excluding the native herbs and shrubs that would have otherwise been the pioneer plants in this old field succession.

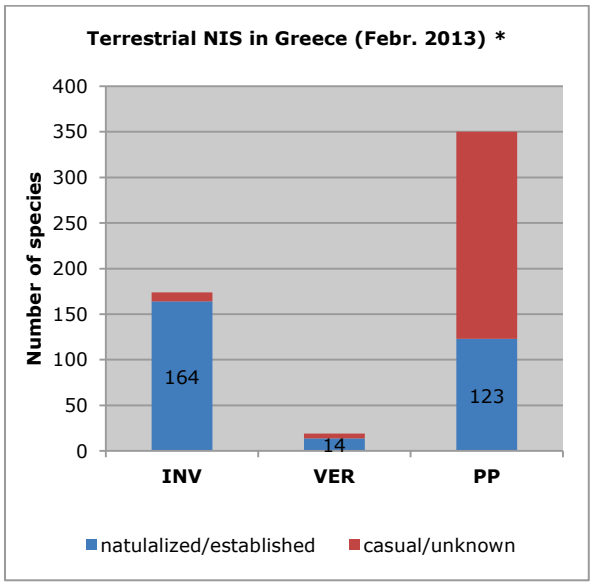
Figure 3
***Opuntia ficus – barbarica* invasion in abandoned rangeland of Central Greece**

Photo: M. Arianoutsou

Extended areas in Central and South Greece, many of the islands of the Aegean, previously used as grazing lands, and now abandoned are heavily contaminated by the prickly pear (*Opuntia ficus-barbarica*), which has no natural predator to control its population spread. However, and despite these problematic landmarks of the Greek landscapes, most aliens are found in artificial habitats, leaving the natural ones relatively intact. The renowned *Oxalis pes-caprae* is becoming increasingly common at urban and suburban ruderal sites, olive groves and shrub and forest edges where it forms dense mats preventing the growth of other species, especially during the important for the Mediterranean habitats autumn to early spring growth period. However, it rarely penetrates natural habitats and is actually restricted to disturbed sites, such as the remnant forest stands on islands or near towns and the reed beds at wetlands with degraded hydromorphology. Nevertheless, *Oxalis pes-caprae* constitutes a serious threat for species of transitional zones and for those species (including orchids and rare bulbs) that use to find a refuge in traditional olive groves.

Regarding the other terrestrial taxa DAISIE database provides a number of 164 naturalized invertebrates and 14 vertebrates (see Figure 4).

Figure 4
Number of alien taxa occurring in terrestrial habitats in Greece



NIS = Non-Indigenous Species, INV = invertebrate species, VER = vertebrates, PP = Primary Producers = Plants

** Data on invertebrates and vertebrates were obtained from the DAISIE database; data on plants derive from Arianoutsou et al. 2010) and the updated 'Alien' database on terrestrial plants held at School of Biology, University of Athens (2014).*

A list of the worst invasive alien species (WIAS) threatening biodiversity in Europe across environments and taxonomic groups has been compiled by the SEBI 2010 expert group. Eighteen (18) of the 100 (WIAS) species threatening biodiversity in Europe (according to the DAISIE database http://www.europe-aliens.org) had been established in the terrestrial environment of Greece (6 plants, 7 invertebrates, 5 vertebrates).

Conclusion

Systematic monitoring of alien species continuation is of high importance. Priority should be given to the prevention of the establishment of aliens, through an improvement of the existing international legal framework, better coordination of international cooperation and the immediate elaboration of a targeted national strategy, which will improve the control of pathways of introduction and will establish an effective early warning system.

Bibliography / More information

- Arianoutsou M, Bazos I, Delipetrou P,Kokkoris Y (2010a) The alien flora of Greece: taxonomy, life traits and habitat preferences. *Biological Invasions* 12:3525–3549.
- Arianoutsou M, Delipetrou P, Celesti-Grapow L, Basnou C, Bazos I, Kokkoris Y, Vilà M (2010b) Comparing naturalized alien plants and recipient habitats across an east-west gradient in the Mediterranean Basin. *Journal of Biogeography* 37:1811–1823.
- Elton CS (1958) The ecology of invasions by animals and plants. Methuen, London
- Katsanevakis S, et al. 2015. European Alien Species Information Network (EASIN): supporting Europeanpolicies and scientific research. *Management of Biological Invasions 6,* in press
- Koutsikos N, Zogaris S, Vardakas L, Tachos V, Kalogianni E, Šanda R, Chatzinikolaou Y, Giakoumi S, Economidis PS, Economou AN (2012) Recent contributions to the distribution of the freshwater ichthyofauna in Greece. *Mediterranean Marine Science* 13(2):268-277.
- Pancucci-Papadopoulou MA, Kevrekidis K, Corsini-Foka M, Simboura N (2005a) Changes in species: invasion of exotic species. p. 336-342. In: *State of the Hellenic Marine Environment,*edited by E. Papathanassiou and A. Zenetos, Athens, HCMR Publications.
- Pancucci-Papadopoulou MA, Zenetos A, Corsini-Foka M, PolitouCh (2005b) Update of marine alien species in Hellenic waters. *Mediterranean Marine Science*6 (2):147-158.
- Vilà M, Basnou C, Pyšek P, Josefsson M, Genovesi P, Gollasch S, Nentwig W, Olenin S, Roques A, Roy D, Hulme PE, DAISIE partners (2009) How well do we understand the impacts of alien species on ecosystem services? A pan- European cross-taxa assessment. Front Ecol Environ 8:135–144. doi:10.1890/080083
- Zenetos A, Pancucci-Papadopoulou MA, Zogaris S, Papastergiadou E, Vardakas L, Aligizaki K, Economou AN (2009a) Aquatic alien species in Greece: tracking sources, patterns and effects on the ecosystem. *Journal of Biological Research-Thessaloniki* 12:135-172.
- Zenetos A, Katsanevakis S, Poursanidis D, Crocetta F, Damalas D, Apostolopoulos G, Gravili C, Vardala-Theodorou E, Malaquias M (2011) Additions and amendments to the marine alien biota of Greek waters (2010 update). *Mediterranean Marine Science*12 (1):95-120.
- Zenetos A., Arianoutsou, M., Baritaki Ch. (2013) Overview of Non Indigenous Species (NIS) in Greece. ESENIAS Country review of IAS, GR.

Interview

Les espèces invasives en Egypte et le futur Canal de Suez 2

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Pourriez-vous donner un aperçu général sur le projet du Canal de Suez 2 et sa contribution au processus de développement en Egypte ?

Il s'agit d'un grand projet de développement égyptien qui a été inauguré le 5 août 2014 et dont la réalisation devrait être achevée en août 2015. Il vise la valorisation de la région du Canal de Suez (Suez, Port- Saïd et Ismailiya) en tant que centre logistique et industriel international intégré au plan économique et urbanistique et équilibré au plan écologique. Le projet a été conçu pour faire de la région du Canal un pôle attractif en ce qui concerne le transport, la logistique, l'énergie, le tourisme, les télécommunications, les technologies de l'information, l'agriculture et l'immobilier. Il vise également le développement de l'actuel Canal de Suez via son extension sur un parcours de 72 km permettant ainsi aux navires et aux tankers d'emprunter le Canal simultanément dans les deux sens, ce qui permet de résoudre les problèmes actuels que pose la navigation dans le Canal. C'est le cas, par exemple, de l'immobilisation des convois en provenance de la partie nord du Canal pendant plus de 11 heures au niveau de la région des Lacs Amers. Bref, le projet vise de manière générale à diminuer le temps de passage à travers le Canal, ce qui contribue à augmenter les ressources financières que l'Egypte en tire.

Un projet d'élevage aquacole est également inscrit dans ce cadre par le biais de 23 bassins de sédimentation installés à l'est du Canal sur une longueur de 120 km et dont la largeur varie entre 3 et 5 km, allant du sud de la région de la Tafriâ jusqu'au Golfe de Suez. Ce projet vise à offrir des produits de haute qualité répondant aux impératifs de la sécurité alimentaire et à développer les ressources halieutiques.

Il est également question d'installer, toujours dans ce projet intégré, une centrale électrique dont la capacité est évaluée à 2500 mégawatts à l'aide de l'énergie solaire et de bonifier 400 000 feddans (*ndlr : 1 feddan équivaut à 0,42 hectares*) au nord du Sinaï par l'intermédiaire du canal de la Paix.

Quant à la contribution du projet au processus de développement, elle pourra être résumée par les points suivants :

- Offrir le plus grand nombre d'opportunités aux jeunes en matière d'emploi.
- Créer de nouvelles zones urbaines.
- Augmenter le PIB égyptien via de nouvelles rentrées en devises.
- Permettre le taux de navigation le plus élevé à l'intérieur du Canal dans les deux sens en augmentant de 50% la voie navigable.
- Réduire le temps de passage de 18 à 11 heures pour les convois venant du nord du Canal.
- Réduire pour les navires le temps d'attente qui se situe actuellement entre 8 et 11heures à 3heures au pire des cas, ce qui permettrait aux armateurs de diminuer le coût du trajet maritime et améliorer le taux de valorisation du Canal de Suez.
- Contribuer au renforcement de l'utilisation du Canal en tant que voie maritime principale et internationale, ce qui lui permettrait d'accéder à un meilleur positionnement.
- Renforcer les capacités de navigation dans le Canal pour répondre à l'avenir aux besoins croissants du trafic commercial international et faire transiter ainsi par le Canal jusqu'à 97 navires à l'horizon 2023 au lieu de 49 en 2014.
- Franchir un pas important pour faire avancer le processus de développement autour de la région de Suez et redynamiser l'économie nationale égyptienne afin de faire de l'Egypte un pôle commercial et logistique de renommée internationale.
- Permettre à 45 navires de transiter dans les deux sens sans interruption avec, à terme, la possibilité pour des cargos dont la calaison atteint 66 pieds d'emprunter toutes les voies du Canal.
- Augmenter le rendement du canal jusqu'à 259% à l'horizon 2023 (13 226 milliards de dollars moyennant 5,3 milliards de dollars actuellement), ce qui se répercutera directement et de manière positive sur le PIB égyptien en devises.

Quels sont les principales espèces de poissons étrangères qui se sont introduites en Méditerranée et dont l'exploitation présente des avantages ?

Parmi ces espèces, je citerai le poisson-lézard, le sigan marbré, le poisson-lapin, les crabes pélagiques, certaines espèces de crevette, le poisson baptisé « Nemiptecus japonicus » le rouget rayé et le barracuda.

Quelles sont les espèces invasives qui se sont déplacées au cours des dernières décennies de l'océan Indien vers la Méditerranée et qui présenteraient de nos jours un danger pour la biodiversité maritime et pour l'équilibre écologique dans la région méditerranéenne ?

Toute intervention humaine impacte l'environnement alentours. Le Canal de Suez n'est, à mon avis, à ce titre ni la première intervention humaine, ni la dernière dans les affaires de la nature. Je pense au contraire que les usines gigantesques dans les grands pays industriels ainsi que les centrales nucléaires, l'industrie des armes, les déchets radioactifs, les eaux de ballast et l'introduction de nouvelles espèces de poissons dans les eaux maritimes dans le cadre de l'aquaculture présentent de réels dangers plus nocifs pour la biodiversité et pour l'écologie maritime que ne le sont les espèces invasives.

Je pense que les conséquences négatives de ces espèces pourront être transformées en éléments positifs si nous savons orienter à bon escient leur exploitation vers telle direction ou telle autre pour en tirer profit. Je rappelle à cet égard, à titre d'exemple, que le poisson-lézard fait partie des espèces les plus présentes dans les prises en Turquie. Je rappelle également, dans le même contexte, que le sigan marbré s'est répandu récemment dans plusieurs pays de la région et dont l'exploitation revêt bel et bien un intérêt économique certain. En outre, il est possible de se lancer dans des activités agro-alimentaires pour nettoyer le poisson-lapin, le commercialiser dans des boites de conserve et, donc de tirer profit de sa chaire délicieuse sans pour autant compromettre la santé des citoyens à cause du venin que ce poisson contient. Je tiens aussi à dire ici que certaines espèces de crevette et de crabes pélagiques présentent elles aussi des avantages économiques très importants compte tenu de leur prix élevé sur les marchés locaux et internationaux.

Comment les centres et les instituts égyptiens de recherche et notamment l'Institut national d'Océanographie et des Pêches contribuent-ils à la lutte contre les effets négatifs du poisson-lapin sur la pêche artisanale en Méditerranée ?

Le poisson-lapin fait partie des poissons dont la chaire est parmi les plus délicieuses, une fois bien nettoyé selon les bonnes règles, ce qui lui permet d'être bien écoulé sur les marchés et de permettre aux consommateurs d'avoir une attitude saine à son égard. Il arrive toutefois que ce poisson soit mal nettoyé et qu'il soit par conséquent la source de légères intoxications.

Aussi importe-t-il de se lancer dans la construction d'usines dédiées à cette espèce de poisson, à l'instar de ce qui se fait au Japon pour éviter qu'elle ne soit directement écoulée sur les marchés. Il est donc utile de bien nettoyer ce poisson et conserver sa chaire par des spécialistes de l'agro-alimentaire. C'est justement ainsi qu'il pourrait être une source de nourriture en Méditerranée. Notons d'ailleurs que des expériences ont été menées pour fabriquer des antidotes à partir des venins que contient le poisson-lapin. Des travaux scientifiques et des projets de recherche à cet effet ont corroboré ce constat.

Comment, à votre avis, sensibiliser les pêcheurs et les consommateurs aux dangers du poisson-lapin sur la santé humaine en Méditerranée et qui devrait s'en charger ?

Bien que la plupart des pêcheurs sache comment se comporter convenablement avec le poisson-lapin, certains parmi les plus jeunes d'entre eux ou ceux qui sont débutants ne connaissent strictement rien aux parties dangereuses de ce poisson. Il faudrait par conséquent faire bénéficier les pêcheurs de programmes de sensibilisation et d'information à travers les médias et des canaux appropriés, outre les séminaires et les ateliers qui s'adressent aux pêcheurs dans le langage qui est le leur. Il importe de noter également que les centres de recherche, les centres d'information appartenant à l'Etat, l'Union des Pêcheurs ainsi que les associations et l'Autorité publique ayant en charge le développement des ressources halieutiques ont un rôle capital à jouer en matière de sensibilisation et de vulgarisation.

Quels sont les centres, les instituts et les autres institutions de recherche en Egypte et ailleurs avec lesquels votre institut coopère au sujet des espèces invasives ?

L'Institut National d'Océanographie et des Pêches (INOP) est la plus ancienne institution égyptienne chargée des sciences de la Mer au Moyen-Orient. Il a été créé en effet en 1924 à Alexandrie. Il coopère avec toutes les institutions étatiques qui s'occupent des ressources halieutiques en Egypte et ailleurs.

En Egypte, notre institut collabore entre autres avec l'Autorité publique chargée du développement des ressources halieutiques, les universités, l'Académie arabe des Transports et des Technologies, le Centre national des Recherches, Le Centre de Toxines et de Vaccins, le Ministère de l'Environnement et l'Autorité du Canal de Suez. Quant à notre collaboration avec l'extérieur, elle se fait avec plusieurs instituts et centres de recherche dans certains pays méditerranéens. Notre institut est d'ailleurs totalement disposé à entreprendre d'autres collaborations sur cette thématique à l'échelle régionale ou internationale. *

** Interview conduite en mai 2015 par Hassane TLILI, journaliste spécialiste des questions agricoles et environnementales.*

Les espèces non indigènes invasives et leurs impacts sur l'environnement et les activités économiques en mer Méditerranée

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La pêche artisanale méditerranéenne est aujourd'hui en crise. Elle se trouve confrontée à des concurrences d'usage, à une réduction des stocks de la plupart des espèces benthiques, à la détérioration des écosystèmes côtiers sous l'effet de la pression anthropique. Les modifications apportées par les changements globaux (augmentation de la température moyenne de l'eau, acidification, surélévation du niveau moyen de la mer, impacts des espèces invasives) sont autant de menaces qui pèsent sur la durabilité d'une activité de pêche artisanale souvent peu capitalistique. Les changements globaux aujourd'hui en œuvre en Méditerranée, vont avoir un impact important sur les pêches côtières. De manière paradoxale, certains de ces changements (prolifération d'espèces invasives) peuvent être mis à profit par l'activité halieutique pour développer des activités nouvelles et doivent être appréhendées comme les voies possibles d'un nouvel essor des pêches côtières.

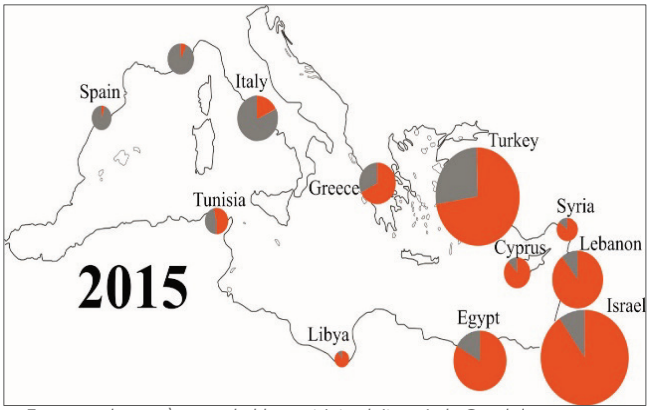
Face aux changements globaux, des scénarios pertinents d'adaptation des pratiques halieutiques doivent être imaginés en Méditerranée. Dans les orientations prochaines des politiques environnementales, les capacités d'anticipation seront déterminantes pour atténuer les effets négatifs de ces changements, voire en tirer profit. L'analyse des interactions historiques hommes-environnement, celle de l'adaptation des communautés littorales à des oscillations naturelles de la ressource, ou à des bouleversements sociopolitiques passés, peuvent contribuer à la mise en place d'un nouveau modèle de gouvernance. L'examen des capacités de résilience des hommes et du milieu est essentiel.

Les menaces sur les ressources vivantes marines se sont amplifiées au cours des dernières décennies et ont conduit à la régression des productions halieutiques. Le développement de l'aquaculture a constitué jusqu'à récemment, la principale alternative pour remédier à cette situation, en garantissant aux populations, surtout riveraines, les apports nécessaires en protéines d'origine marine. Toutefois, le réchauffement global n'a épargné aucune activité liée à l'Homme et présente des impacts désastreux sur les secteurs économiques clés notamment la pêche, l'aquaculture et le tourisme. Les changements globaux ont ainsi amené la plupart des pays méditerranéens à élaborer leurs Stratégies Nationales d'Adaptation, intégrées aux programmes régionaux méditerranéens.

L'une des conséquences majeures du réchauffement global est l'érosion de la biodiversité par l'introduction de plus en plus soutenue d'espèces invasives. Leurs éradications ne semblent pas envisageables, en raison du coût très élevé que représenterait la mise en œuvre de telles politiques, mais aussi de l'impact désastreux qu'auraient ces dernières sur l'environnement marin. Face à un développement très rapide des transports maritimes intercontinentaux, et suite à l'élaboration tardive d'une règlementation efficace de contrôle de ces vecteurs de la contamination que sont les eaux de ballasts, la lutte contre les espèces exotiques semble sans issue. Certaines d'entre elles, observées depuis de longues années sur les côtes de la rive sud de la Méditerranée, sont d'ores et déjà mentionnées en plusieurs points de la rive nord. Sans renoncer aux politiques indispensables de prévention, les sociétés méditerranéennes doivent dès aujourd'hui envisager la valorisation de ces espèces allochtones dont le flux lessepsien va certainement s'accentuer suite à l'élargissement en cours du canal de Suez.

L'invasion biologique en Méditerranée est relativement bien documentée depuis plus d'un siècle, et environ 1000 espèces exotiques ont été inventoriées dont la moitié des taxons sont considérés invasifs (Zenetos et al. 2010, Katsanevalis et al. 2014) (Figure 1).

Figure 1
Pourcentage d'Espèces Non Indigènes (NIS) observées dans quelques pays méditerranéens



En rouge, les espèces probablement introduites via le Canal de Suez.

Source Galil et al, 2015.

Ces derniers peuvent présenter une réelle menace non seulement pour les espèces natives (compétition puis éradication) mais aussi pour la santé humaine et l'économie (pêche, aquaculture, tourisme..). Certaines espèces exotiques présentent des risques très sérieux pour l'Homme (fortement toxiques voire mortelles) comme les poissons *Lagocephalus sceleratus* et *Plotosus lineatus* et la méduse *Rhopilema nomadica.* Paradoxalement, les données relatives à ces espèces exotiques au sud de la Méditerranée sont rares en raison de l'absence d'expertises locales et de l'insuffisance de prospections. Les espèces invasives ne constituent pas une priorité dans les programmes de recherches des pays de la rive sud de la Méditerranée. De même, les études sur les impacts écologiques et socio-économiques de ces espèces envahissantes sont à la fois très rares et récentes (Streftaris et Zenetos 2006 ; Ojaveer et al. 2015).

La Tunisie, de par sa position stratégique en Méditerranée, charnière entre les 2 bassins levantin et occidental, se trouve fortement concernée par le phénomène de bioinvasion. A cet effet, elle devrait recevoir une attention particulière de la part de la communauté scientifique internationale et des décideurs politiques. Sa biogéographie particulière est placée sous l'influence mixte de la Méditerranée occidentale et centrale; divisée par le canal Siculo-Tunisien qui représentait une barrière naturelle à certaines incursions d'espèces invasives. Cet emplacement privilégié de la Tunisie permettra d'expliquer la propagation des espèces exotiques en Méditerranée, de prédire les incursions futures et surtout de minimiser les impacts des espèces les plus envahissantes. Selon une mise à jour récente, 139 espèces faunistiques exotiques sont observées dans les eaux marines tunisiennes (Ben Souissi et al. *sous presse*) essentiellement d'origine indopacifique. Un intérêt particulier devrait être accordé aux milieux portuaires, aux lagunes et aux aires marines protégées considérés comme des zones de refuge, de "transit" et d'acclimatation pour les espèces exotiques. Le canal de Suez et les lagunes sont reconnus comme étant des "hot spot" importants de l'invasion de la Méditerranée. En Tunisie, 16% de la faune exotique a été observée pour la première fois dans les lagunes.

En Tunisie le flux d'espèces exotiques connait une expansion sans précédent depuis les 2 dernières décennies et les impacts sur les écosystèmes, les espèces natives et les activités économiques se font de plus en plus sentir, en particulier pour les taxons d'intérêt halieutique comme les Mollusques, les Crustacés Décapodes et les Poissons. La bioinvasion n'est pas perçue comme une fatalité et des mesures d'adaptation sont déjà mises en place. A titre d'exemple, *Pinctada radiata* (Figure 2), l'une des premières espèces non indigènes mentionnées dans les eaux tunisiennes depuis 1895, connaît une large expansion biogéographique en Tunisie.

Figure 2
***Pinctada radiata* récoltée dans le golfe de Gabès**

Cette huître perlière, très abondante dans le golfe de Gabès peut être considérée comme l'une des pires espèces envahissantes. En effet, elle constitue l'espèce clé du biofouling des filets des cages flottantes de la pisciculture off-shore. Elle colmate les mailles des filets des cages et réduit considérablement les échanges d'eau et le niveau d'oxygène. Cette huître constitue aussi l'une des principales épibiontes massivement fixés sur les rhizomes de *Posidonia oceanica* (espèce emblématique de Méditerranée et largement menacée) et les structures immergées y compris tous les récifs artificiels installés dans le golfe de Gabès. La quantité de coquilles vides et des spécimens vivants rejetés par la mer sur l'île de Djerba est énorme à tel point qu'elle constitue des monticules nommés par les insulaires «cimetière d'huîtres». Pour minimiser les effets de cette l'huître sur l'écosystème golfe de Gabès, un projet d'utilisation de la nacre de *Pinctada radiata* comme matériau biomédical en chirurgie orthopédique a été mis en place dès 2005.

Un autre exemple d'impact sur les écosystèmes et les activités économiques est celui du crabe invasif *Libinia dubia* (Figure 3). Il a été observé depuis les années 90 en Tunisie, non loin d'un terminal pétrolier, ce qui laisse supposer une voie d'introduction via les eaux de ballasts. Ce crabe est resté depuis son occurrence cantonné au seul golfe de Gabès, mais en revanche, il a proliféré de manière spectaculaire. Actuellement, il est qualifié de véritable peste par les pêcheurs traditionnels de la région.

Figure 3
Filet de pêche côtière colmaté par *Libinia dubia*

Ce Décapode colmate leurs filets, dégrade la qualité des prises et réduit drastiquement les captures (-30%). Dans ce contexte une enquête est en cours, auprès de la population cible pour estimer les pertes subies par les pêcheurs; une étude éco-biologique est également engagée pour connaitre les préférences de cette espèce indésirable (régime alimentaire, distribution spatiale, fécondité et phylogénie). Les données préliminaires mettent en exergue le côté prédateur et vorace de cette espèce la rendant fortement compétitive avec la faune locale. Ce crabe a été récemment annexé à la liste noire des espèces invasives les plus nocives établie par l'Union Internationale pour la Conservation de la Nature (UICN) actualisée en 2015. Une caractérisation biochimique est en cours dans le but de valoriser ce crabe à des fins alimentaires ou le cas échéant, à des fins industrielles par la recherche et l'extraction de produits et molécules actives telles que la chitine et le chitosane.

Conclusions

Pour mieux appréhender ces espèces invasives, une base de données complète et régulièrement actualisée s'impose à l'échelle de toute la Méditerranée. Celle-ci doit regrouper d'une part, des données historiques (développement de nouvelles populations, impact ressenti par les pêcheurs sur les ressources autochtones, …) et d'autre part, des données biologiques sur les traits de vie et la diversité génétique des populations ciblées. Ceci permettra d'identifier et de confirmer les voies de transfert révélées par l'analyse historique et d'évaluer les capacités de dispersion de ces espèces. L'analyse de la structuration géographique de la diversité génétique d'espèces allochtones renseigne sur la portée des flux et les mécanismes qui les favorisent. Ainsi, l'approche phylogéographique permettra de comprendre le fonctionnement des phénomènes d'invasion de la Méditerranée sur la base des observations historiques. La caractérisation des processus passés conduira à l'élaboration de prévisions sur le devenir des stocks exploités par les pêcheries artisanales et non encore impactés par les espèces invasives.

Cette nouvelle approche participera à l'élaboration de scénarios pertinents d'adaptation des techniques d'exploitation des ressources halieutiques permettant d'anticiper les impacts des espèces invasives et d'adapter les techniques de valorisation aux nouvelles contraintes associées aux modifications faunistiques. Pour la préservation des espèces natives et des habitats de la Méditerranée, considérée comme un "hot spot" de biodiversité et d'endémisme, il y a lieu de focaliser les efforts surtout dans la rive sud de la Méditerranée. Il faudrait également combler le manque de connaissances dans la Méditerranée Centrale surtout dans la grande Syrte qui constitue un véritable "melting pot". Ces investigations seront de nature à cerner le comportement des espèces invasives en dehors de leur milieu d'origine afin d'atténuer leurs impacts sur le milieu récepteur futur (Méditerranée occidentale et rive Nord). La création d'un observatoire constitué de chercheurs multidisciplinaires des deux rives de la Méditerranée pour l'étude et le suivi de la bio-invasion s'impose. Un système de réseautage et d'alerte précoce doit être nécessairement mis en place pour se préparer (science citoyenne et sensibilisation) aux processus de tropicalisation et de méridionalisation de la rive nord et du bassin occidental de la Méditerranée. De cette manière, il deviendra possible d'atténuer les effets négatifs des espèces invasives sur les écosystèmes récepteurs en cernant leur comportement en dehors de leur biotope natif.

Bibliography / More information

- Galil, B., Boero, F., Fraschetti, S., Piraino, S., Campbell, M., Hewitt, C., Carlton, J., Cook, E., Jelmert, A., Macpherson, E., Marchini, A., Occhipinti-Ambrogi, A., Mckenzie, C., Minchin, D., Ojaveer, H., Olenin, S., Ruiz, G., 2015. The enlargement of the Suez Canal and introdution of Non-Indigenous Species to the Mediterranean Sea. Letter to the editors. *Association for the Sciences of Limnology and Oceanography* (ASLO): 2-4.

- Katsanevakis, S., Wallentinus I., Zenetos A., Leppäkoski E.i, Çinar, M.E., Oztürk B., Grabowski M., Golani D., Cardoso A.C. 2014. Impacts of invasive alien marine species on ecosystem services and biodiversity: a pan-European review. *Aquatic Invasions,* 9, 4: 391–423.

- Ojaveer, H., Galil, B S., Campbell, M. L., Carlton, J. T., Canning- Clode, J., Cook, E J., Davidson, A D., Hewitt, C L., Jelmert, A., Marchini, A., McKenzie, C H., Minchin, D., Occhipinti-Ambrogi, A., Olenin,S., Ruiz, G., 2015. Classification of Non-Indigenous Species Based on Their Impacts: Considerations for Application in Marine Management. PLOS Biology |DOI:10.1371/journal.pbio.1002130,1-13.

- Streftaris, N., Zenetos, A., 2006. Alien marine species in the Mediterranean - the 100 'worst invasives' and their impact. *Mediterranean Marine Science*, 7 (1), 87-118.

- Zenetos, A., Gofas, S., Verlaque, M., Çinar, M. E., Garcia Raso, J. E., Bianchi, C. N., Morri, E., Azzurro, E ., Bilecenoglu, M., Froglia, C., Siokou, I., Violanti, D., Seriso, A., San Martin, G., Giangrande, A., Katagan, T., Ballesteros, E., Ramos-Espla, A., Mastrototaro, F., Ocana, O., Zingone, A., Gambi, M.C., Streftaris, N., 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science*, 11(2), 381-493.

Current Status and Future Prospects of Invasive Plants in Turkey

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Introduction

The introduction and invasion of alien species in new habitats and regions have gained enormous pace over the past century. The Invasive Alien Species (IAS) plants in particular, are posing considerable threats to ecosystem, biodiversity, human health and economies etc. at global level. Spread and establishment of Invasive Alien Plants (IAPs) cause heavy economic losses. Total loss of the global economy has been estimated to 5% of annual production (Pimentel et al., 2002). The increased economic activities; trade, transport, travel and tourism have resulted in introduction of new species in non-native habitats. The human agency either deliberately or accidentally, is the pivotal source of introduction and spread of non-native species in the new ranges in general. Some of the IAPs in different countries were introduced by humans to get different benefits (bio-control agents, food and feed, or other such purposes) or for ornamental purposes without knowing their long term impacts in the introduced ranges. Williamson and Brown (1986) suggested ten's rule which states that 10% of the introduced species become established and only 10% of the established species become invasive. However, recent studies revealed that the rate of introduced species becoming invasive is exceeding 50% which shows that invasion process has gained enormous pace.

The introduced plants in new ranges cause disastrous results. IAPs have negative impacts on each and every aspect of habitats and have strong potential to replace native species. They also pose significant concerns to the conservation of endangered plants as they have the potential to replace them from the habitats of high conservation value. IAPs surpass natives by disturbing habitat balance, imbalance plant communities, and are carrier of diseases which might destroy economically important crops and spread to agricultural areas. Aquatic habitats are also severely affected by the invasion of IAPs. Decline in water quality, damage to inland ecosystems, hurdles in irrigation systems, hindrance in navigation system and decline in fish production due to loss of oxygen are some of the damages caused by the aquatic IAPs. Interference in recreational activities and losses to infrastructure are some other negative impacts of aquatic IAPs.

Some allergenic IAPs including *Heracleum mantegazzianum* Sommier & Levier, *Ambrosia artemisiifolia* L. etc. have greatly diverted the attentions of ecologists towards the impacts of introduced species. However, the most significant impacts of IAPs are the drastic changes of ecological balance due to intense competitions for light, nutrients, water, space and other resources with the natives. The replacement of native species by IAPs changes the animal communities associated with them thus disturbs the ecological balance of the invaded habitats.

Climate change, changing land use patterns, continuous disturbance of established habitats and lack of awareness about the negative impacts of IAPs further accelerate the invasion process and create new habitats favorable for invasion (Richardson and Rejmanek, 2011; Lockwood et al., 2013). Phenotypic plasticity, being free from natural enemies, reproductive ability even under extreme climates and excellent acclimatization abilities of IAPs strengthen the invasion under varying climatic regimes and disturbance levels.

Current Status of IAPs in Turkey

Turkey consists of two peninsulas that bridge the Europe and Asia continents. The large peninsula (Anatolia) connected with Asia while, the small one (Thrace) is connected to Europe. The country is bounded by seas on three sides; the Aegean Sea on the west, the Black Sea on the north and the Mediterranean on the south, while the Sea of Marmara is enclosed within the north-west. The country has varying landscapes including arid plains to high mountains (tropical and sub-tropical) with huge latitudinal and climatic variations.

The geological and climatic variations have produced tremendous ecological diversity. On the basis of floral richness; Turkey is one of the richest country in the middle latitudes in terms of plant diversity with a total of 12000 plant species (Arslan et al., 2015), and new species are being added with continuing research. Recent studies (Anonymous, 2015) reported that a new taxon to the flora of the country is added in every 5 and half day. Turkey is among the countries having great number of endemic species (about one third of total species in Turkey are endemic).The country hosts even some exotic crops such as tea, banana, avocado, papaya and kiwi. These facts indicate that the country has suitable habitats for almost all kind of terrestrial and/or aquatic IAPs (trees, shrubs, grasses, herbs or vines etc.).

Talking about the agricultural potential, the country has an important position in both imports and exports of agricultural, livestock and forestry products, especially breeding materials (seed and seedling imports etc.). Thus contaminated agricultural products are important pathways for introduction of IAPs. The classic examples of invasive plants introduced to Turkey through importing seeds are; *Physalis* spp., *Cuscuta campestris* Yuncker, *Echinochloa oryzicola* (Vasinger) Vasinger, *Paspalum* spp, *Eleusine indica* (L.) Gaertn. etc. (Onen, 2015).

Turkey is one of earliest human settlements in the world, located at the intersection of transport and migration routes, and a resting location for animals especially birds on their migration between their summer and winter homes. Due to historic and cultural diversity of country millions of tourists visit the country every year. Tourism and animal migrations are some other pathways of introduction and spread of the IAS in the country. Many different imported plants are also being used for ornamental or recreational purposes at touristic resorts/places, parks and gardens such as *Amorpha fruticosa* L., *Albizia julibrissin* Durazz, *Broussonetia papyrifera* (L.), *Lonicera japonica* Thunb. On the other hand aquatic plants such as *Echornia crassipes* (Mart.) Solms and *Ludwigia peploids* (Kunth) P.H. Raven etc (Onen, 2015) are invasive in aquatic and marine habitats of the country. Small aquatic plants are frequently used in aquariums and are easily available through internet at cheap price. Although, *E. crassipes* is listed on quarantine list of country, it is being sold on internet. The plant is thrown out after short term use and thus expanding its range rapidly.

The ongoing projects of road construction, infra structure development, energy project preferences have given the pace to transportation of goods from and across the borders. Moving vehicles, transportation of soil over long distances and movement of workers provide ideal environments for range expansion of exotic plants. The common ragweed in Turkey is an excellent example of the range expansion of the exotic plants which has expanded its range along the newly constructed Black Sea highways (Onen et al., 2013, 2014). The plant was transported from its initial intrusion point to over long distances.

In the current scenarios of increased awareness about IAPs, awareness on invasive plant's adversities in Turkey is still not adequate. Scientific community has been continuously raising voice on the issue of biological invasions by organizing national and international conferences and workshops. The 2nd International Workshop on Invasive Plants in the Mediterranean Type Regions of the World, International Workshop on IAS in Agricultural and Non-Agricultural Areas in ESENIAS Region, 8th European Conference on Biological Invasions: "Biological Invasion, from understanding to action", and Invasive Plants Workshop "Reality or Lurking Horror" have been conducted in Turkey in 2010, 2013, 2014 and 2015 respectively are some of the voices/efforts to create the awareness. The increasing number of alien species is being recorded and is considered as new additions to the flora of country. However, the non-seriousness about the issue is depicted from the fact that only two species are taken on the quarantine list of Turkey. The species included in quarantine list are (*Arceuthobium* spp. and *E. crassipes*).

An estimation of the flora of Turkey indicates that 1.5% of the species in Turkey are exotics (Arslan et al., 2015). The book entitled "Flora of Turkey" describing Turkish flora doesn't describe the origin of many species thus recognition of total number of alien plants is difficult. Therefore, descriptions of native and alien species based on their origin are urgently needed. Although many scientists are describing the species which are alien to the flora of Turkey, but the comprehensive list of alien plants in Turkey is lacking. The lack of collaboration among different public and private organizations and scientific communities and awareness about IAPs are the main reasons of absence of such kind of information.

The field of Invasion Ecology in Turkey is younger than other parts of the Europe due to which scientific studies and administrative attention to IAPs are limited. For example, some of the European countries have already established monitoring and information systems (MIS) for IAS. The countries have greatly benefited from established MIS for early detection and managing IAPs. Monitoring and information system for IAPs in Turkey have not been established yet. In recent years, some surveys have been conducted to determine the current status of a limited number of species. For example a project funded by Gaziosmanpasa University is aimed at mapping the distribution of *A. artemisiifolia* in Black Sea region. The project is accepted as part of Cost Action "Sustainable Management of *Ambrosia artemisiifolia* in Europe" (SMARTER FA-1203). Most recently a project has been initiated for developing "Monitoring and Information System of Invasive Alien Plants in Turkey" funded form The Scientific and Technological Council of Turkey (TUBITAK). The project is accepted as a part of the COST Actions of European Union (Alien challenge - FA-1209).

The project deals with / aimed at providing information on the current and potential distribution of five troublesome invasive plants in Turkey (*Ambrosia artemisiifolia, Sicyos angulatus, Persicaria perfoliata, Physalis angulata*and *Physalis philadelphica*) along with the characterization of some biological and ecological aspects. Further the most important aim of the project is to develop the early detection and rapid response system of IAS in Turkey through a web based system (www.i-bil.com). The project is continuing and the system is under development.

Although the project is continuing, five plants will not be enough to describe the IAPs of Turkey. Therefore, a strong collaboration is needed among several organizations to map a real picture of IAPs. Furthermore recently,48 scientists working in diverse fields of research have completed the first volume of "Invasive Plants Catalogue of Turkey" which has been published by the Ministry of Agriculture and Livestock. The Catalogue is published in local language (Turkish) indicating a positive sign that awareness of invasive plants has started to increase. The catalogue will also help to improve web based MIS. In addition, a public awareness campaign has also been initiated about the adverse impacts of IAPs by non-governmental organization (NGO) supported by Ministry of Environment and Urbanization. The organization has mapped the distribution of *Sicyos angults* (a troublesome vine in tea plantations) in the Black Sea Region of the country and prepared the leaflets to describe possible management options. Although several works have recently been started, effective combating with IAPs demands a lot more. The mapping and establishment of monitoring and information system will not be enough to win the war. In current scenarios of missing efforts on invasive plants, future invasions are suspected to be stronger and irresistible.

Several scientists working in the field of invasion ecology have pointed out the importance of concerted actions against the spread of other IAS groups and general management options are being practiced (especially crop pests and diseases) in the country. Many invasive plants have been recorded in agricultural (sunflower, cotton, tea plantations, wheat etc.) and non agricultural areas (Onen, 2015) however, no effective management options are being practiced against plants compared to other IAS taxonomic groups. Therefore, serious efforts are needed to accomplish the task related to stop the further invasion and management of IAPs.

Future Prospects

The focus on already established species may give rise to the invasive species of future. While focusing on the established species and trying to understand the invasion process, the newly introduced species are ignored and silently invade their new ranges. The newly recorded alien plants will become invasive in various regions in the future. Although awareness on IAPs is slowly rising in Turkey, the attention on already established species is not enough to tackle the issue of current and future invasions.

The current state of knowledge on IAPs in Turkey suspects a challenging future for the ecologists as the silent invaders in the country will cause considerable losses in multidimensional habitats. The most challenging task in the future is expected in health sector as pollen allergies, dermatitis, phytophotodermatitis and asthma etc. caused by IAPs. Currently, pollen inventory in the country has almost totally been ignored. The awareness is required to warn public adopting safety measures to avoid the negative/allergenic impacts of IAPs. The other important sector that will be affected by invasive plants is the agriculture. Many invasive plants have already been recorded and found to be established in different cropping zones causing considerable yield reductions in sunflower, cotton, corn, soybean, wheat etc. (Onen, 2015). High reproductive potential of these invasive plants coupled with climate change might probably cause significant difficulties in agriculture production in future.

The IAPs observed along the roadsides are expected to expand their ranges inwards as a source of infection thus affecting the arable crops by competition for light, nutrients and space. The costs incurred on mowing along the roadsides, natural and rural areas will be massive. The existence of endemic and endangered plants occurring in natural habitats is likely to be challenged. The future changing climatic scenarios are also important issues likely to yield challenging results in terms of range expansion of IAPs. The warming over Turkey's climatic regions is suspected to be in the range of 2 to5 ºC. These changing climate scenarios will affect the agriculture both by decreasing the yield due to frequent drought episodes, and opening new habitats for already established and new IAPs.

The article is concluded with the remarks that the current works on invasive plants are not sufficient to cope with the pace of biological invasions in Turkey. Rapid and intense invasion of IAPs in different habitats due to the coupled effects of climate change and lack of interest is expected in future resulting in severe ecological and economic losses. Some of the endemic endangered species are also expected to be extinct due to their replacement by exotic plants. Therefore, concerted efforts are needed to create the awareness about IAPs to tackle the issue. However, the increased awareness and research efforts are even not sufficient for the successful management / eradication of these plants. It is recommended that the issue of IAPs must be included in top priority agenda of the country.

Bibliography / More information

- Anonymous 2015. Türkiye'nın floristik (Bitkisel) zenginlik (Floral richness of Turkey). http://biyologlar.com/index.php/kunena/203-Botanik/4057-turkiye-nin-floristik-bitkisel-zenginligi. Date Accessed: 02.06.2015.
- Arslan ZF, Uludag A, Uremis I (2015) Status of invasive alien plants included in EPPO Lists in Turkey. EPP/EPPO Bulletin 45 (1): 66-72.
- Lockwood JL, Hoopes MF, Marchetti MP (2013) Invasion ecology, Malden, MA, USA, WileyPublishing.
- Onen H (2015) Invasive Plants Catalogue of Turkey. Ministery of Food, Agriculture and Livestock T.C. Gıda, Tarım ve Hayvancılık Bakanlığı, TarımsalAraştırmalar ve and General Policy Directorate. , Plant Health Research Department. ISBN: 978-605-9175-05-0, Ankara. (In Turkish).
- Onen H, Gunal H, Ozcan S (2013) Invasion status of Common Ragweed (Ambrosia artemisiifolia L.) in Turkey In: Uludag et al (eds) Proceedings of 4th ESENIAS Workshop: International Workshop on IAS in Agricultural and Non Agricultural Areas in ESENIAS Region. pp 50.
- Onen H, Gunal H, Ozcan S (2014) The Black Sea highway: The Route of Common Ragweed (Ambrosia artemisiifolia L.) Invasion in Turkey In: Uludag et al (eds) Proceedings of 8th International Conference on Biological Invasions from understanding to action. pp 76.
- Pimentel D (2002) Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species., Boca Raton, FL: CRC., 369,
- Richardson DM, Rejmánek M (2011) Trees and shrubs as invasive alien species - a global review. Diversity and Distribution 17: 788-809.
- Williamson M, Brown KC (1986). The analysis and modelling of British invasions. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 314, 505–522.

Participation du CIHEAM

à MEDCOP 21

Le CIHEAM a participé à MEDCOP 21, une rencontre des acteurs de la Méditerranée, qui s'est tenue à Marseille les 4 et 5 juin 2015, en amont de la Conférence des Nations unies sur les changements climatiques (COP21) qui aura lieu à Paris fin 2015.

C'est le directeur adjoint du CIHEAM Montpellier, M. Jean-Paul Pellissier, qui est intervenu pour notre Organisation, lors de l'atelier consacré aux villes et aux territoires durables. Insistant sur l'importance du développement rural pour les stratégies de durabilité en Méditerranée, celui-ci avait pris soin de présenter une communication intitulée « *Villes et territoires de Méditerranée face aux défis de la transition écologique* »

MEDCOP 21 a permis de souligner l'engagement commun dans la lutte contre le changement climatique et a mis en lumière la contribution des collectivités locales, des associations, des entreprises, des réseaux constitués œuvrant en tant que catalyseurs du développement durable.

En se fixant pour objectif de contribuer à la construction d'un véritable Agenda positif Méditerranéen cette manifestation vise aussi et surtout à saisir par-delà les contraintes, les opportunités qu'offre la lutte contre le changement climatique. Elle contribue par des propositions concrètes et partagées à une Méditerranée de projets.

La feuille de route pour la protection du climat est un « Agenda Positif Méditerranéen » qui sera présenté lors de la Conférence des Nations Unies sur le climat, COP 21.

Phytosanitary challenges for the Mediterranean viticultural industry: emerging grapevine viruses

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In a globalized world like the one we are living in, cases of pathogens crossing boundaries and spreading in new environments are more frequent than one can think of. In general, these events do not escape the attention of scientists and, sometimes, also that of the layman, especially when they threaten the very survival of certain agricultural crops. The recent devastating outbreak of a peculiar strain of *Xyella fastidiosa* subsp. *pauca* that ravages the olive trees of southern Apulia (Martelli *et al*., 2015) represents a primary example of such an instance.

In 2013, the European grape industry ranked first in the world, with a crop of 29 million tons Italy, France and Spain being among the top five producers in the world (http://faostat3.fao.org/home/E, 2013). The economical importance of the grape industry exceeds the value of grape and wine productions if the impact is taken into account of the many "wine routes" and related cultural and touristic aspects, which are implemented in a number of countries the world over. In this framework, the relevance of potential threats represented by new viruses and the diseases they are associated with goes beyond the simple detrimental effects on the yield.

In the last years, a group of newly detected viruses, either alien to or already present and emerging in the Mediterranean basin, were brought to the fore due to:

1) increased movement and exchange of infected propagation material;

2) implementation of certification protocols which, by knocking out a number of regulated viruses from sanitized stocks may have favoured the expression of symptoms previously masked by those elicited by the agents of widespread diseases such as leafroll, infectious degeneration and rugose wood;

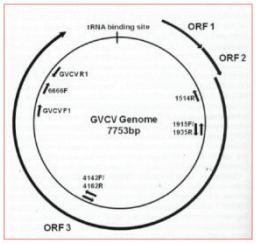
3) The advent of new generation sequencing (NGS), a technique that was instrumental for the discovery of the novel DNA viruses Grapevine red blotch-associated virus (GRBaV). Grapevine vein clearing virus (GVCV). Grapevine Roditis leaf discoloration-associated virus (GRLDaV, and the RNA virus Grapevine Pinot gris virus, (GPGV). Of these pathogens and the diseases they are associated with a brief account is given hereafter.

Grapevine vein clearing

Figure 1

Grapevine vein clearing virus

Zhang *et al.*,2011, *Phytopathology* **101**: 1081-1090



Genus: *Badnavirus*
Nucleic acid: circular double-stranded DNA
Genome size: 7753 nt
Geographical origin: Midwest USA
Ospite: *Vitis vinifera* and French hybrids
Symptoms: Vein clearing, decline
Vector: unknown

Symptoms occur in early spring and consist of narrow stripes of chlorotic tissues along the major and minor veins of fully expanded leaves of young shoots. Chlorotic veins which are characteristically translucent when the symptomatic leaves are held against sunlight. Young shoots have short internodes with zigzag growth. Mature leaves are small-sized, deformed and display various patterns of chlorotic to yellowish tissues and rolled margins. In advanced stages of infection the vines become dwarfed, bear fewer bunches and may show decline (Lunden *et al*., 2009)

Grapevine vein clearing virus (GVCV), a non mechanically transmissible virus with a DNA genome belonging to the genus *Badnavirus*, is associated with the disease (Zhang *et al*., 2011). The completely sequenced genome is a double-stranded circular DNA 7,753 bp in size, predicted to encode three open reading frames (ORFs) on the plus strand: two unknown proteins of 24 kDa (ORF1) and 14 kDa (ORF2), respectively, and a polypeptide 220 kDa in size (ORF3) comprising movement protein, coat protein, reverse transcriptase and RNase H. GCVC is related to *Commelina yellow mottle virus* (ComYMV), a definitive specie of the genus *Badnavirus*, family *Caulimoviridae*, with which it groups in phylogenetic trees (Zhang *et al*., 2011).

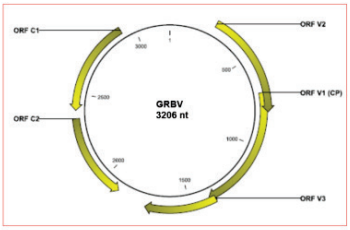
The virus occurs as genetically diverse populations, is transmitted by grafting from grape to grape but the way of natural spreading in the vineyards is unknown (Guo *et al*., 2014). It should be noted that some badnaviruses are transmitted by pseudococcid mealybugs. Should this be the case for GVCV, efficient spreading the the vineyards could be expected. Information on varietal susceptibility are limited to few *V. vinifera* cultivars and French hybrids. A possible resistance was found in the hybrid Chambourcin in which the virus was not detected upon grafting (Guo *et al*., 2014). Until now GVCV has been reported only from the Midwest of the USA. Detection is accomplished by RT-PCR using virus-specific primers.

Grapevine red blotch

Figure 2

Grapevine Red blotch-associated virus

Krenz et al., 2012. Journal of Virology 86



Family: *Geminiviridae*
Genus: unassigned
Nucleic acid: ss DNA
Genome size: 3206 nt
Origine geografica : USA
Ospite: *Vitis vinifera*
Symptoms: red blotches, chlorotic areas
Vettore: Erythroneura zic-zac ?????

Grapevine red blotch disease is considered an emerging threat for the grapevine industry (Sudarshana et al., 2015). In red-berried cultivars symptoms consists of red spots or blotches that appear in late spring/early summer in the basal leaves and coalesce later in the season. By converse, white-berried cultivars display chlorotic areas with irregular margins which may turn necrotic over time. A differential diagnostic trait from leafroll consists on the presence of reddening of the veins on the underside of the leaf blade. It is not known whether there is any effect on fruit yield or plant longevity, however a delay in fruit ripening and a reduced sugar content of the fruit juice has been observed.

A virus with a circular single-stranded DNA genome structurally comparable to that of members of the family *Geminiviridae* has been found in diseased vines, to which the name of Grapevine red blotch-associated virus (GRBaV) has been given. Recent surveys report the occurrence of the virus in the USA (New York, California, Washington) and Canada (British Columbia). In California, GRBaV was detected in 73 accessions at the National Clonal Germplasm Repository (Al Rwahnih *et al*., 2015). The viral genome is 3,206 nt in size and contains six ORFs, three in the viral sense orientation and three in the complementary sense orientation (Krenz *et al*., 2012; Al Rwahnih *et al*., 2013). In phylogenetic trees, constructed with the viral coat protein or polymerase genes, or with the full-length sequence, GRBaV forms a distinct branch, separate from those comprising members of the seven extant genera of the family *Geminiviridae*.

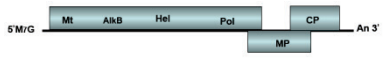
This is the second geminivirus-like virus infecting a woody species, and the first ever found in grapevines. GRBaV is transmitted by grafting and to seedlings of different grape cultivars by *Erythroneura zic-zac* (Viginia creeping leafhopper) (Poojari *et al*., 2013), thus it is liable to spread readily in the vineyards. Detection is by PCR with specifc primers using as template DNA extracted from leaf petioles or bark scrapings from dormant canes. As yet, no effective control measures have been devised. However, disease management based on the production and use of sanitized propagating material would be desirable.

Grapevine leaf mottling and deformation

Figure 3

Grapevine Pinot gris virus

Giampetruzzi *et al.*, 2012, *Virus Research* **163**; 262-268



Genus: *Trichovirus*
Nucleic acid: single-stranded (+)RNA
Genome size: 7258 nt
Geographical origin: Italy
Host: *Vitis vinifera* cv. Pinot noir
Symptoms: leaf mottling, stunting
Mechanical transmission: unsuccessful
Serological relationship with GINV: none

This virus is phylogenetically related to the Japanese *Grapevine berry inner necrosis virus* (GBNV) and was recently reported from Korea

When shown, symptoms of this disease resemble those induced by nepoviruses, i.e. chlorotic mottling, puckering and deformation of the leaves, stunting, reduction of the quantity and quality of the yield (Saldarelli *et al*., 2015).

Among susceptible cultivars, Traminer is more strongly affected than Pinot gris, Pinot noir and Glera. Symptomless infections may occur. A virus with filamentous particles denoted Grapevine Pinot gris virus (GPGV) is consistently associated with diseased and symptomless vines, but the viral strains found in these latter vines differ molecularly from those found in the symptomatic ones (Glasa *et al*., 2014; Saldarelli *et al*., 2015). The viral genome is a single-stranded positive-sense RNA which has been assembled from libraries of the siRNAs population extracted from vines and deep sequenced (Giampetruzzi *et al.,* 2012). The complete sequence of the genomic RNA encompasses 7,259 nucleotides, organized in three open reading frames (ORFs) which in the 5′ → 3′ direction encode: (i) a polypeptide 214 kDa in size comprising the replication-associated proteins (methyltransferse, helicase and RNA-dependent RNA polymerase) (ORF1); (ii) the 46 kDa move- ment protein (ORF2) and (iii) the 22 kDa coat protein. The 5′ and 3′ untranslated regions are 104 and 82 nt long, respectively. The 3′ end is polyadenylated.

The structural organization of the viral genome is identical to that of members of the genus *Trichovirus* with which GPGV is phylogenetically related. In phylotrees the virus groups in the same clade with *Grapevine berry inner necrosis virus* (GINV) with which it shows an identity at the amino acid level of 66% (ORF1), 65% (ORF2) and 71% (ORF3). The two viruses, however, are serologically unrelated and retained as different species.
The virus is graft-transmissible and seems to be spreading naturally, as shown by an increase from 15 to 34% of infected cv. Pinot noir vines in the vineyards of Trentino and Friuli Venezia Giulia (north-eastern Italy) in a 3-year period (2010-2012). However, the way of spreading has not yet been ascertained. Although the virus was found by RT-PCR in pools of individuals of the grape erineum mite *Colomerus vitis* collected from diseased vines, the results of transmission trials to grapevine seedlings have not yielded conclusive results (Beber *et al.,* 2013) It should be noted that *C. vitis* is the alleged vector of the related GINV.

Currently, GPGV has been reported from northern Italian regions (Emilia-Romagna, Veneto, Trentino, Friuli-Venezia Giulia) and Apulia (southern Italy) as well as from Slovakia, Slovenia, Czeck Republic, Greece and Korea. Detection is by RT-PCR with virus specifc primers. Inclusion of GPGV among the viruses regulated in the Italian certification scheme would be desirable, which will encompass disease management based on the production and use of sanitized propagating material.

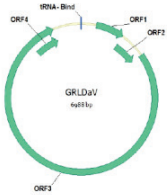
Roditis leaf discoloration

Figure 4

Grapevine Roditis leaf discoloration associated virus

Maliogka *et al.*, 2015, *Virus Research* **203**; 47-55

Genus: *Badnavirus*
Nucleic acid: circular double-stranded DNA
Genome size: 6988 bp
Geographical origin: Greece
Host: *Vitis vinifera* cv. Roditis
Symptoms: leaf discoloration and deformation
Mechanical transmission: successful



This disease, described in Greece by Rumbos and Avgelis (1989) is characterized by symptoms that are prominent in late summer and consist of yellow and/or reddish discolorations of the tissues along the veins, the interveinal areas, or variously extended sectors of the leaf blade. Leaves are deformed in correspondence of the discolored sectors. Bunches are reduced in number and size, and have low sugar content.

The aetiology of this disease has remained undetermined for a long time, for different viruses were serologically identified in infected vines but no evidence of a cause-effect relationship could be established (Maliogka *et al*., 2015).

Recently, a novel mechanically transmissible DNA virus belonging to the genus *Badnavirus*, was recovered from symptomatic vines (Maliogka *et al.,* 2015) to which the name of Grapevine roditis leaf discoloration-associated virus (GRLDaV) has been assigned. The completely sequenced viral genome is a circular double-stranded DNA 6988 bp in size, encoding four open reading frames (ORFs), three of which (ORF1, ORF2 and ORF4) code for proteins of unknown function while ORF3 encodes a polyprotein with motifs related to the replication, encapsidation and movement of the virus. GRLDaV is phylogenetically closest to *Fig badnavirus* (FBV-1).

Virus detection is by real time PCR. The disease has been recorded only from Greece, is graft-transmissible and its putative agent (GRLDaV) can be transferred by manual inoculation to herbaceous hosts. Since natural disease spreading in three vineyards different from the planting site of the original record was observed between 1988 and 1992 (Rumbos and Avgelis, 1993), now that the putative disease agent has been identified as a badnavirus, it is plausible to hypothesize that a vector, possibly a pseudococcid mealybug, be responsible for it.

Bibliography / More information

- Martelli G.P., Boscia D., Porcelli F., Saponari M., 2015. The olive quick decline syndrome in south east-Italy: a threatening phytosanitary emergency. *European Journal of Plant Pathology* (submitted).
- Guo Q., Honesty S., Xu M.L., Zhang Y., Schoelz J., Qiu W.P., 2014. Genetic diversity and tissue and host specificity of *Grapevine vein clearing virus*. *Phytopathology* 104:539-547.
- Lunden S., Meng B., Avery J.D., Qiu W.P., 2009. Characterization of grapevine vein clearing complex on Chardonnay. *European Journal of Plant Pathology* 126: 135-144.
- Zhang Y., Singh K., Kaur R., Qiu W., 2011. Association of a novel DNA virus with the grapevine vein-clearing and vine decline syndrome. *Phytopathology* 101:1081-1090.
- Al Rawhanih M., Dave A., Anderson M., Rowhani A., Uyemoto J.K., Sudarshana M.R., 2013. Association of a DNA virus with grapevines affected by Red blotch disease in California. *Phytopathology* 103: 1069-1076.
- Al Rwahnih M., Rowhani A., Golino D., Islas C., Preece J., Sudarshana M. 2015. Detection and genetic diversity of Grapevine red blotch-associated virus isolates in table grape accessions in the National Clonal Germplasm Repository in California. *Canadian Journal of Plant Pathology,* 37: 130-135.
- Krenz B., Thompson J.R., Fuchs M., Perry K.L. 2012. Complete genome sequence of a new circular DNA virus from grapevine. *Journal of Virology* 86: 7715.
- Poojari S., Alabi O.J., Fofanov Y., Naidu R.A. 2013. A leafhopper-transmissible DNA virus with novel evolutionary lineage in the family *Geminiviridae* implicated in grapevine readleaf disease by next generation sequencing. *PLOS ONE* 8: e64194.
- Sudarshana M., Perry K., Fuchs M. 2015. Grapevine red blotch-associated virus, an emerging threat to the grapevine industry. *Phytopathology*, doi: *http://dx.doi.org/10.1094/PHYTO-12-14-0369-FI*
- Beber R., de Lillo E., Malagnini V., Gualandri V., Poggi Pollini C., Ratti C., Saldarelli P., Valenzano D., Vernile P., Terlizzi F., 2013. Transmission trials of Grapevine Pinot gris virus by the eriophyoid mite *Colomerus vitis*. *Journal of Plant Pathology* 95: S4.36.
- Giampetruzzi A., Roumi V., Roberto R., Malossini U., Yoshika- wa N., La Notte P., Terlizzi F., Credi R., Saldarelli P., 2012. A new grapevine virus discovered by deep sequencing of virus- and viroid-derived small RNAs in cv Pinot gris. *Virus Research* 163: 262-268.
- Glasa M., Predajna L., Kominek P., Nagyova A., Candresse T., Olmos A., 2014. Molecular characterization of divergent Pinot gris virus isolates and their detection in Slovak and Czech grapevines. *Archives of Virology* 159: DOI 10.1007/ s00705-014-2031-5.
- Saldarelli P., Giampetruzzi A., Morelli M., Malossini U., Pirolo C., Bianchedi P., Gualandri V. 2015. Genetic Variability of Grapevine Pinot gris virus and Its Association with Grapevine Leaf Mottling and Deformation. *Phytopathology* 105: 555-563.
- Maliogka V., Olmos A., Pappi P.G., Lotos L., Efthimiou K., Grammatikaki G., Candresse T., Katis N.I., Avgelis A.D., 2015. A novel grapevine badnavirus is associated with Roditis leaf discoloration disease. *Virus Research* 203: 47-55.
- Rumbos I.C., Avgelis A.D., 1989. Roditis leaf discoloration - a new virus disease of grapevine: symptomatology and transmission to indicator plants. *Journal of Phytopathology* 125: 274-278.
- Rumbos I.C., Avgelis A.D., 1993. Further investigations on 'Roditis leaf discoloration disease'. *Extended Abstracts 11th Meeting of ICVG, Montreux, Switzerland*: 76.

Control of tomato leafminer as a new invasive species: costs and lessons

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Introduction

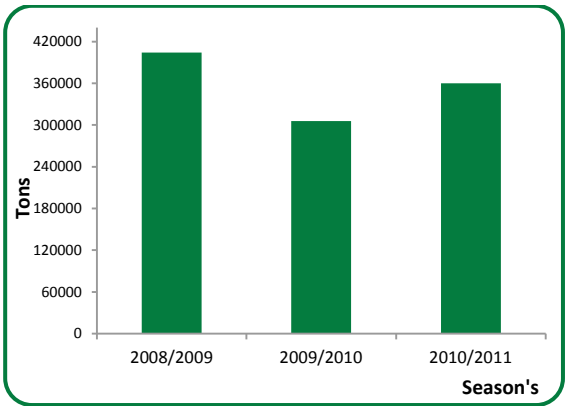
Invasive species or invasive alien species are non native organisms or exotic species that cause or have a potential to cause damages to the environment, human health and consequently to the economy. Biodiversity experts define invasive species as any exotic species that threatens the stability and balance of an ecosystem. The introduction can be accidental or intentional, like food and fruits through ports and airports, but the qualifier of ''invasive'' implies that this introduced species was well established, reproduced, spread and eventually replacing the native(s) specie(s).

Each species (animals, plants and microorganisms) has their natural or native area that can range from a few hectares to a whole continent. They have to face many local environmental factors (physical and biological).

The Souss valley (Southwest of Morocco) has experienced 2 introductions of invasive species during the last 20 years. The first one was TYLCV in 1998 and *T. absoluta* in 2008. After the introduction of the tomato leafminer, *T. absoluta*, it became the number one pest on the protected tomato crops in the Souss valley. The study was initiated to estimate the impact of this new invasive pest on the management (IPM and conventional) of tomato crops. The most important way to highlight this impact was to evaluate the plant protection products sprayed to control *T. absoluta.*

Moroccan tomato exports have been growing from 237,000 to 421,000 tons respectively, between 2004 and 2009. However, there is a decline in production for export (313,769 t in 2009/2010 compared to 421,145 t in 2008/2009, Figure 1).

Figure 1
Tomato exports from the Souss Valley of Morocco before and after the invasion of *T. absoluta*



Biology of *T. absoluta*

The tomato leafminer, *T. absoluta* (Lepidoptera: Gelechiidae), is a microlepidopterous (Figure 2) and multivoltine species that feeds on leaves, fruits, stems, buds and flowers (Figure 3 and 4). The larvae cause damage by feeding on the leaves' mesophyll causing the photosynthetic capability to be affected. Moreover, injury to fruits causes important losses (Figure 5). The tomato is the host plant of choice, but *T. absoluta* can infest other cultivated solanaceae (eggplant, potato, tobacco) or wild species *(Solanum nigrum, Datura stramonium).*

Figure 2
***T. absoluta* adult**

Figure 3
Larva of *T. absoluta* feeding on tomato leaves (left) and fruit (right)

Figure 4
Larva of *T. absoluta* feeding on a tomato stem

Figure 5
Total damage caused by *T. absoluta* in tomato greenhouse (Souss Valley of Morocco)

The life cycle depends on the temperature and can take from 76 days at 14 °–C to 24 days at 27 °C and the number of generations ranges from 10 to 12. The threshold temperature is 7 °C. The average number of eggs laid is 200 on the lower side of leaves and on the sepals of immature fruits. *T. absoluta* have 4 larval instars.

Impact of invasive pest *T. absoluta* in Morocco

In order to evaluate the impact of the invasion of tomato leafminer (*T. absoluta*) in Morocco, we should first select the best way or criterion to achieve the following:

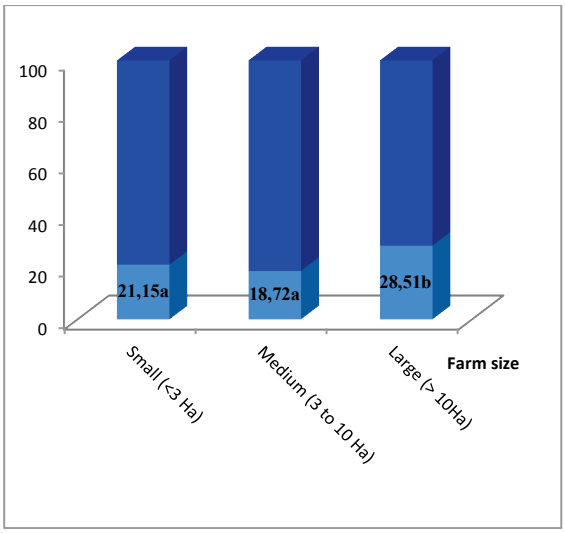
- Estimation of damage at farm level (small scale).
- Estimation of losses at export level (national or regional exports).
- Statistics of plant protection products imported and authorized to prevent *T. absoluta* (national level).
- Estimate the costs of plant protection products (PPP's) really used to control *T. absoluta*.

The last criterion seems to best illustrate the effects and gives the real impact of this new invasion because of its direct link to end users of PPP's.

During the first season after the *T. absoluta* invasion (2009-2010), 13% (78 farms, Table 1) of the total tomato crops in the Souss valley were surveyed. The farm sizes, cultivars, greenhouse structures, insect proof (passive aeration), plantation dates, density of plantation, distance from the Atlantic Ocean, total and export yields, number of sprays and PPP's sprayed (chemical and biological) were parameters considered to achieve this study.

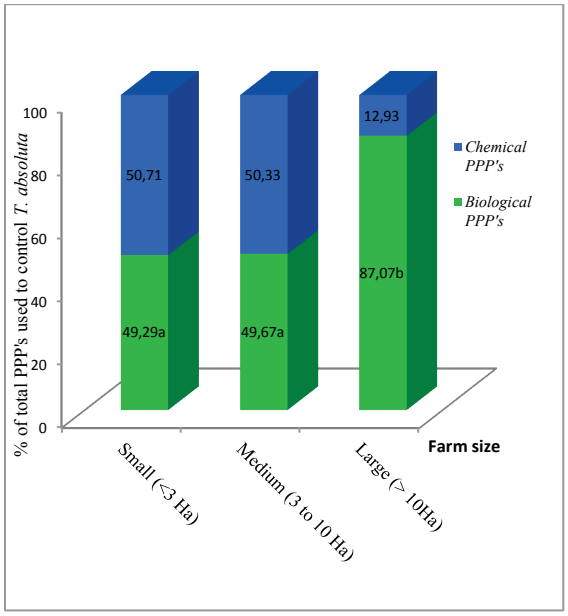
Depending on farm size, the largest farms (>10 Ha) spent approximately one third (29%), of total PPPs used, to control *T. absoluta*. Regarding the smallest and medium farms, this rate ranged from 21 to 19%, respectively. However, the total mean of rates for all farms surveyed was 22,5 % (Figure 6).

Figure 6
Rate of plant protection products used to control *T. absoluta* *



**The rates followed by the same letter are not statistically different at P<5% according to the Student Newman-Keuls test.*

Figure 7
Rates of biological and chemical plant protection products used to control *T. absoluta* *



**The rates followed by the same letter are not statistically different at P<5% according to the Student Newman-Keuls test.*

Figure 7 shows the strength of IPM programs implemented after the invasion of *T. absoluta.* The largest farms invested more than two other classes of farms in biological PPP's to control this new invasive pest, and 87% of the total budget dedicated to purchase PPP's to control *T. absoluta* was biological (mainly *B. thuringiensis* and *N. tenuis*). In fact, the mean of total rates of biological and chemical PPP's was 70% and 30%, respectively.

What we should learn from invasive pests?

At the level of the farmer/technician, the experience of implementing the basic IPM system is acquired and good field experience is gained in biocontrol. This was the main benefit of the introduction of TYLCV infested *Bemisia tabaci*, followed by the new invasive pest (*T. absoluta*) had no great impact in the Souss valley of Morocco.

At the level of institutions and decision-makers, regulation was further strengthened and alert and monitoring systems were improved.

To deal with further invasion like *Drosophila suzukii*, greening disease, *Xylella fastidiosa*, *Rhynchophorus ferrugineus* and *Bactrocera invadens* a strategic approach should be established (Figure 8).

Figure 8
Strategic scheme to deal with new invasive pests

STRATEGIC APPROACH		
Quarantine pest and disease alerts	Prevention system	Early detection
Surveillance and Monitoring	Rapid response	Control and Eradication

Quarantine pest and disease alerts

Alert systems should be established internationally and especially among close neighbors. The alert will save precious time before and after the invasion of new invasive species. This time can be used for the recognition of biology of this new pest and measures for eradication if necessary. The risk assessment process can be very useful to categorize the importance of future candidates as new invasive pests. The ISPM (International Standards for Phytosanitary Measures) N°1 produced by the International Plant Protection Convention describes the general and specific principles of plant quarantine as related to international trade.

Prevention system

Prevention measures should be emphasized on the basis that prevention is better than intervention once the pest has spread. From an ecological view, prevention is the most appropriate and least damaging for the environment (fauna and flora). Prevention can be effective when efforts focus on vigilance tools to minimize the risk of new invasions of pests and diseases and/or vectors in borders. However, lack of technical and human resources makes exhaustive checks at customs very difficult or impossible. As an example, France has banned importation of any plant material assumed as a host of *Xylella fastidiosa* from Italy and despite this measure, the disease was detected in Rungis Market (France) last month (April 2015). The same decision was made by Morocco but *X. fastidiosa* was not detected.

We must not forget that the inspection of plant export material should be done at the national territory before loading, by the national plant protection organization in order to avoid the spread of quarantine pests and diseases to the destination country (ex: *Ceratitis capitata* to Russia and USA).

Early detection

The early detection is strongly tightened with surveillance and monitoring measures. The '' Guidelines for surveillance" (ISPM N°6) is very helpful when used for surveillance to detect early any new invasive pest.

Surveillance and Monitoring

Surveillance is defined as an official process which collects and records data on pest occurrence or absence, by survey, monitoring or other procedures (ISPM N°5). There are 2 types of surveillance: General surveillance and specific survey. The Guidelines for surveillance (ISPM N°6) and Guidelines for pest risk analysis (ISPM N°2) provide details on general surveillance and specific survey requirements. The monitoring concerns basically specific surveys. It should be noted that other specific guidelines can be used for monitoring and surveillance (ex: trapping) of some quarantine pests like fruit flies (Anonymous, 2003). Also a review published in EPPO bulletin in 2012 by Augustin et al., gives an overview of techniques to be followed for surveillance of quarantine pests.

Rapid Response

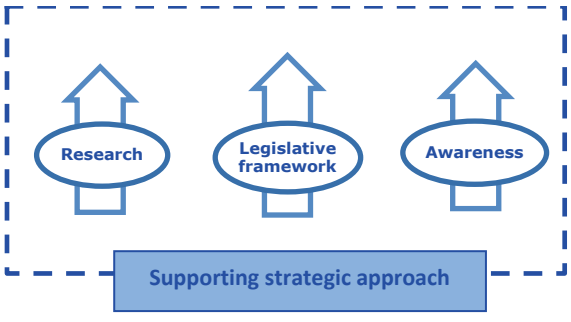
Keeping in mind that 24h is sufficient for incubation of bacteria and fungi, and 24h is more than enough for a pest for mating and laying a minimum of eggs. So, even if the new invasive species was intercepted and good surveillance is done, the response should be rapid in order to restore balance as an environmental view and to limit the spread and heavy damage as an agronomic and economic view.

Control and eradication

Eradication is defined in the glossary of phytosanitary terms (ISPM N°5) as any application of phytosanitary measures to eliminate a pest from an area. The ISPM N° 9 titled Guidelines for Pest Eradication Programs details the steps and measures to be taken in case of pest eradication. The full process (including contingency plan) of control and eradication is implemented and supervised by National Plant Protection Organization (Office National de la Sécurité Sanitaire des produits Alimentaires, ONSSA in Morocco) and when an eradication process is achieved the verification of the absence of invasive species should be completed.

It is clear that operation of control and eradication of new invasive species, once widely established, is extremely difficult and very costly. That's why prevention, early detection and rapid response have to be successful and making eradication cost-effective.

Figure 9
Supporting strategic approach by scientific research, legislation and awareness



Research

A scientific research finding is helpful in detection (first reports), to review pest risk analysis (ex: change in pest virulence, climate change), surveillance and control. Thus, the prioritization of national research plans needs to be subject to continuous updating. Regarding a special case of risk analysis of GMOs, species that can be considered as exotic species, the data is lacking or the scientific community has not ruled on the issue of GMOs. This example is the most illustrating case that only scientific research can provide answers. The scientific research gives strong evidence to convince policy makers, in aspects regarding invasive species, on budgeting, legislation, prioritization, etc. Applied research can offer concrete solutions (technological or biological) to control a new invasive species that has hitherto seemed intractable.

During the steps of identification, recognition and preparation for the control eradication process, the research institutions and scientific journals were the first source of information. The appendix 2 of ISPM N° 18 describes an example (irradiation treatment) of the research protocol to undertake trials (preliminary, large scale).

Legislative framework

According to a definition of ISPM N°5, legislation is any act, law, regulation, guideline or other administrative order promulgated by a government. The phytosanitary legislation is the basic laws granting legal authority to a national plant protection organization from which phytosanitary regulations may be drafted.

The legislation is the guardrail guiding key personnel through the process of prevention, detection, surveillance and eradication of invasive species. It also prevents any deviations from the right process. However, a successful legislative framework needs to be coherent, comprehensive, easy to apply and fit with the purpose of invasive species' issues. Continuous revision and updating established by legislation is necessary to go with scientific finding.

Awareness

Raising the awareness level among key personnel is usually done. However, awareness is very limited among the general public. The successful strategy of awareness needs to be based first in raising understanding of the general public related to invasive species and the actions to be taken in prevention, detection and eradication. In fact, the national plant protection organizations establish their own outreach programs to achieve this goal.

Conclusion

Reasonable management of a new species' invasion, during the entire process including measures before introduction, is vital to preserve the environment and to prevent economic losses. However, it should be noted that invasion is not successful in all cases. In the north of Morocco, the red palm weevil *Rhynchophorus ferrugineus* was detected in 2008 on canary palm (*Phoenix canariensis*) and the early detection and rapid response by ONSSA was successful. Currently, the red palm weevil is eradicated from Morocco despite the fact that the threat is still present. Some other examples of invasion were destined to failure. A native entomopathogenic fungus of USA, *Zoophthora phytonomi*, has adapted to the invasive alfalfa weevil *Hypera postica* and provides good suppression. The African citrus psyllid *Trioza erytreae* (Figure 10) is located in Madeira and Canary Islands but the disease was not detected until now.

Figure 10
African citrus psyllid direct damage on upper side (left) and larva on lower side of citrus leaves

Bibliography / More information

- Augustin S., N. Boonham, W. J. De Kogel, P. Donner, M. Faccoli, D. C. Lees, L. Marini5, N. Mori, E. P. Toffolo, S. Quilici, A. Roques, A. Yart and A. Battisti (2012) A review of pest surveillance techniques for detecting quarantine pests in Europe, EPPO Bulletin, 42 (3), 515–551.
- Topics in applied ecology (Management of invasive species): Relavant ecological concepts, ideas, and topics (Population dynamics, predator–prey relationships, competition, disease–host interactions, natural selection.)
- Anonymous (2003) Trapping Guidelines for area-wide fruit fly programmes, IAEA/FAO-TG/FFP, 2003. IAEA, Vienna.
- Anonymous 2013 International standards for phytosanitary measures. Secretariat of the International Plant Protection Convention, FAO

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Citrus HLB is an emerging disease transmitted by psyllid vectors. Can it be prevented? If not, can it be managed?

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HLB (Huanglongbing) disease of citrus endangers the very existence of citrus worldwide. Prior to 2003, the disease was widely distributed throughout Asia, Eastern Africa and the Arabian Peninsula (Bové, 2013). Two major Gram-negative bacteria, *Candidatus* Liberibacter africanus (Laf) and *Candidatus* Liberibacter asiaticus (Las) are the causal agents of the disease, respectively in Africa and Asia (Bové, 2006). Today *Candidatus* Liberibacter asiaticus has invaded South, North and Central America. Brazil experienced HLB first in 2004, Florida in 2005, Cuba in 2006, Belize and Mexico in 2009/2010, California, Texas, Guadalupe and Argentina in 2012. In Brazil two liberibacters cause the disease: Las and a third citrus liberibacter species, *Candidatus* Liberibacter americanus (Lam). Two insect vectors are responsible for the fast spread of the disease: the African citrus psyllid, *Trioza erytreae,* essentially in Africa, and the Asian citrus psyllid, *Diaphorina citri*, in Asia and America (Fig. 1 and 2).

Figure 1
The two citrus psyllids, vectors of HLB

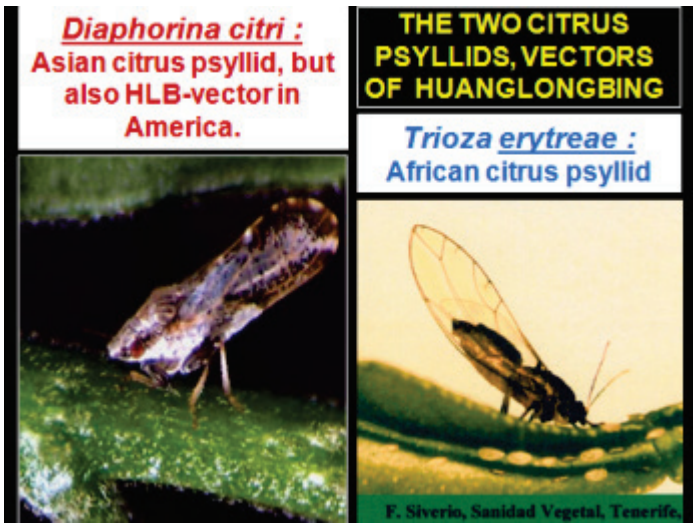
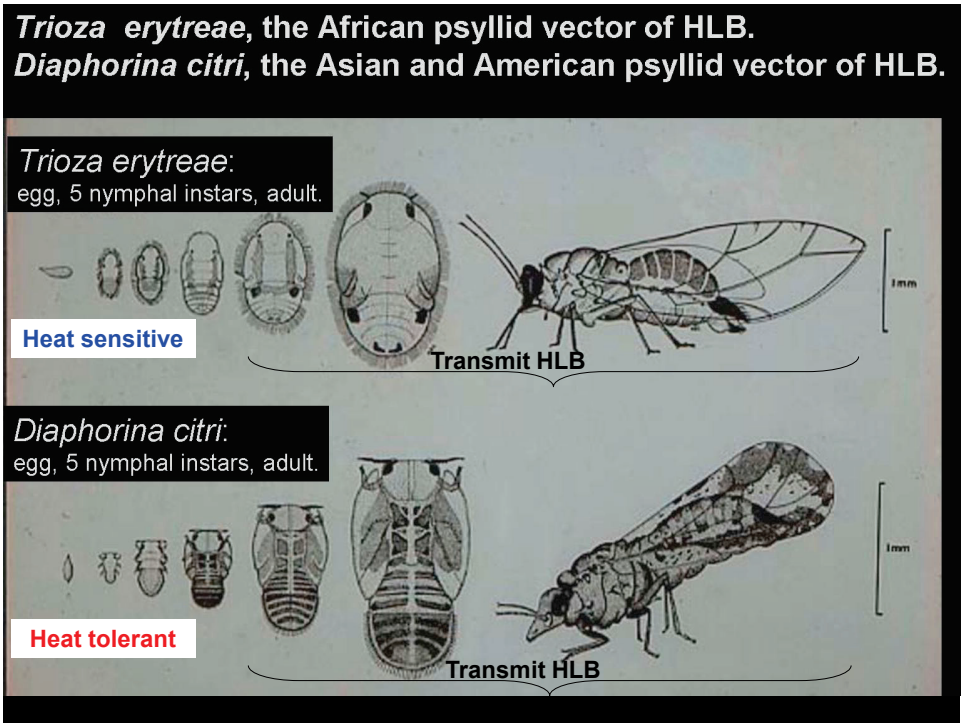


Figure 2
The two HLB psyllid vectors and their nymphal instars



Two citrus growing regions are still free of the disease: (i) Australia, known for its excellent plant quarantine, but with HLB present in nearby Timor and New Guinea islands, and (ii) the Mediterranean region, but with the African citrus psyllid vector largely present in the Atlantic islands of Madeira (Portugal) and Canarias (Spain). Unfortunately, this HLB vector has been reported in November 2014, in the province of Pontevedra, Galicia, Spain, as well as in Portugal, South of Galicia. This is the first time that an HLB vector has been reported from continental Europe. No other countries in the Mediterranean Basin have announced the presence of HLB vectors. The occurrence of *T. erytreae* in two Mediterranean citrus growing countries has to be taken seriously into consideration, since it has been observed that HLB shows up sooner or later once a vector has become present (Table 1). It seems as if the period between presence of the vector and report of the disease has become shorter in recent years.

Table 1
Year of first report of hlb vector (*D. citri* or *T. erytreae*) and year of first report of HLB disease for various countries (Bové, 2013)

Country	*D. citri*	HLB	Country	*T.erytreae*	HLB
Brasil	1942	2004	South Africa	1897	1928
Argentina	1984	2012	Kenya	1918	1981
Florida	1998	2005	Ethiopia	1918	1976 ?
Cuba	1998	2006	Swaziland	1958	1965
Guadalupe	1998	2012	Rwanda/Burundi	1958	1988
Texas	2001	2012	Madagascar	1961	1968
			Zimbabue	1962	1981
			Tanzania	1967	1984
			Malawi	1967	1988
			Camerun	1967	1988

Can HLB be prevented in such countries as Spain and Portugal where an HLB vector has just been reported? If not, can HLB be controlled? These questions were already addressed by a discussion group held during the CIHEAM course in Zaragoza from March 31 to April 5, 2015 on "Emerging and Quarantine Diseases of Mediterranean Fruit and Vegetable Crops" (Duran-Vila *et al.*, 2014). Also, an extensive workshop on HLB control was held in Valencia, Spain, in the frame of the XII International Citrus Congress, November 18th to 23rd, 2012 (Bové & Rogers, 2015).

The situation in the affected Portugal/Spain area

It should be pointed out first that the presence of *T. erytreae* in Spain and Portugal does not represent a double insect-vector focus but a single one, overlapping the northern border between the two countries (M. Cambra & M.M. López, personal communication). The psyllid vector was essentially diagnosed by the conspicuous and specific bumps on the upper side of the leaves resulting from the development of *T. erytreae* nymphs on the lower side of the leaves (Fig. 3, 4 and 5).

Figure 3
***Trioza erytreae* nymphs develop in concave nests on the lower leaf side**

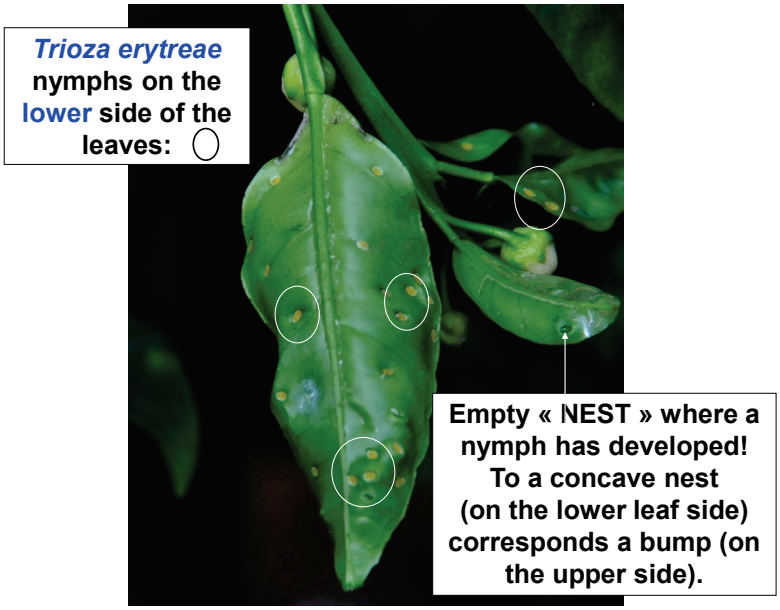


Figure 4
Nymphal nests on the lower leaf side, and corresponding bumps on the upper leaf side

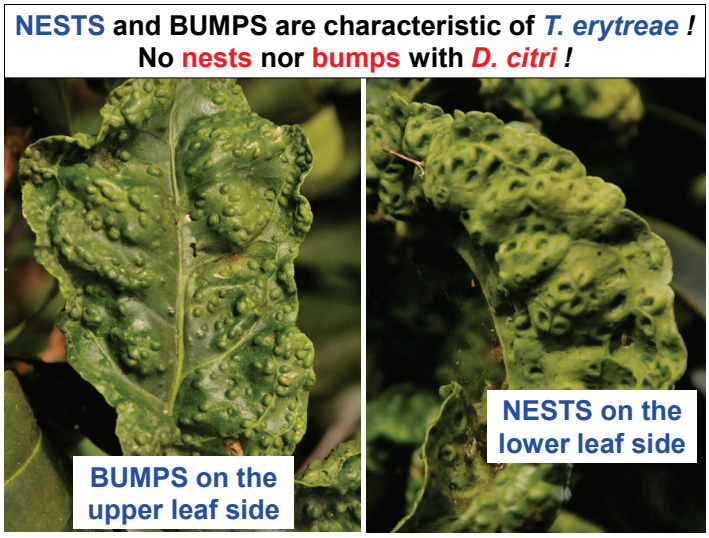


Figure 5
Citrus leaves severely distorted by nymphal bumps and some normal leaves

Such bumps are characteristic of *T. erytreae* and they are never observed in the case of the Asian psyllid vector, *D. citri.* As shown by figures 4 and 5, the bumps can be so numerous and distort the leaves so much that *T. erytreae* is not only a vector but also a pest. The "bump" symptoms were observed on the many lemon trees, commonly grown as backyard trees, knowing that there are no commercial citrus orchards in the area. Several factors explain the occurrence and the abundant development of *T. erytreae* in the area: (i) the African psyllid is known to be heat sensitive and requires, for development, relatively cool environments such as those of the contaminated area where summers are not too hot and winters not too cold; (ii) lemon is a preferred citrus species for the psyllid development; (iii) in the backyards, the lemon trees are rarely if ever, treated with insecticides.

HLB prevention?

First, progression of the psyllid further South, towards the citrus growing areas of Spain and Portugal must be prevented. Second, in the affected area, *i.e.* where *T. erytreae* is present, the entrance of HLB has to be prevented. As these preventions involve both Spain and Portugal, there must, by all means, be coordination between the two countries.
Lowering the psyllid population in the affected area would limit both the southward movement of the insect as well as the spread of HLB in the affected area in case the disease has already been or will be imported. Cutting down all the lemon trees indispensible for psyllid multiplication or giving them insecticide treatments would undoubtedly lower the insect population but these solutions will probably never be accepted and carried out. Biological control with psyllid ectoparasites such as *Tamarixia dryi* against *T. erytreae* will lower the insect-vector population but not sufficiently to prevent the spread of HLB. In Reunion island, *T. dryi* was able to parasitize not only *T. erytreae* but an additional psyllid, *Trioza eastopi*, breeding on a non-citrus weed, *Litsea chinensis*, common in the Reunion citrus orchards. Thus, the population of *T. dryi* strongly increased, resulting in the disappearance of *T. erytreae,* which however alone, without *T. eastopi*, would not have been eliminated. In South Africa, *T. dryi* occurs naturally but it does not prevent the spread of HLB by *T. erytreae.* Therefore, if biological control is used, it will do no harm, but it will not be of great help. In any case, regular surveys for the putative presence of *T. erytreae* must be conducted South of the affected area. In both the affected area and the area South of it, regular inspections for putative HLB symptoms have to be carried out: blotchy mottle leaf symptoms (Fig. 6 and 7) as well as HLB colour inversion fruit symptoms (Fig. 8). HLB symptoms must be confirmed by PCR detection of citrus liberibacters. The possible infection of *T. erytreae* with liberibacters should also be regularly examined by PCR.

Figure 6
Leaf symptoms of South-African HLB-blotchy mottle on sweet orange

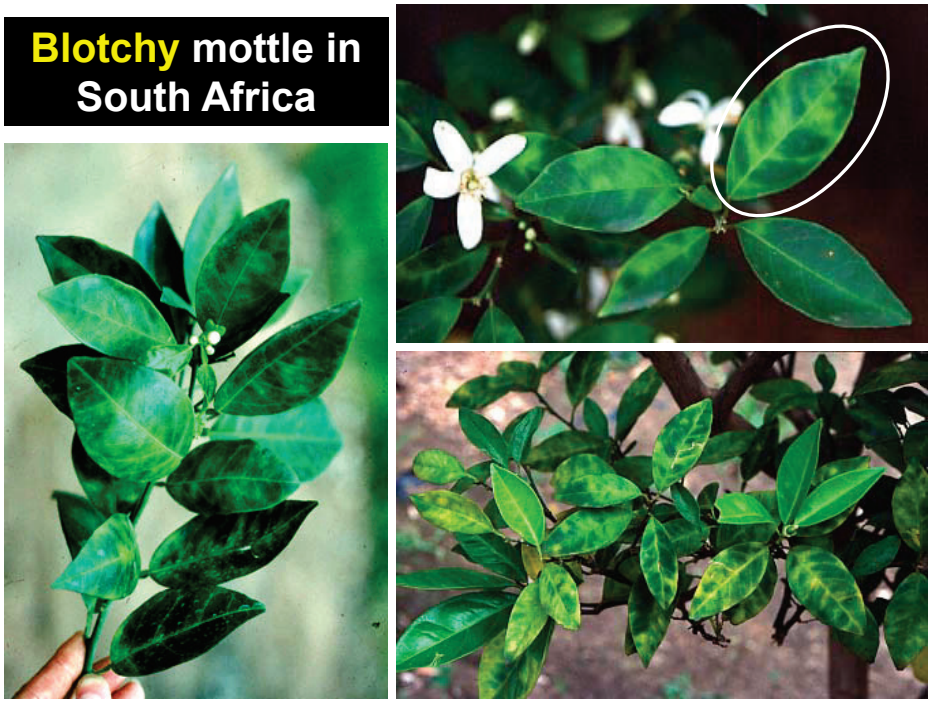
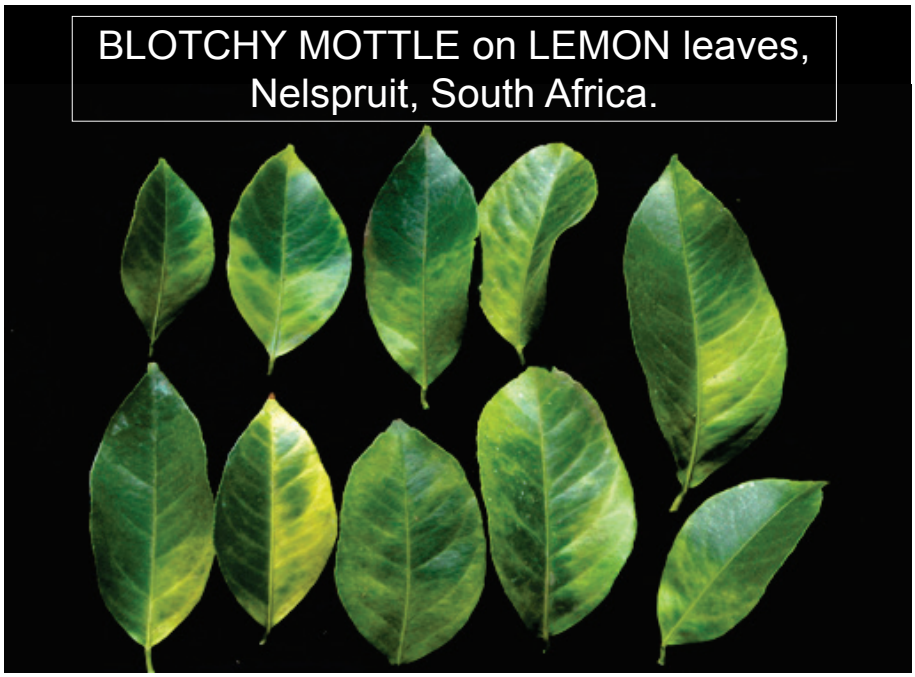


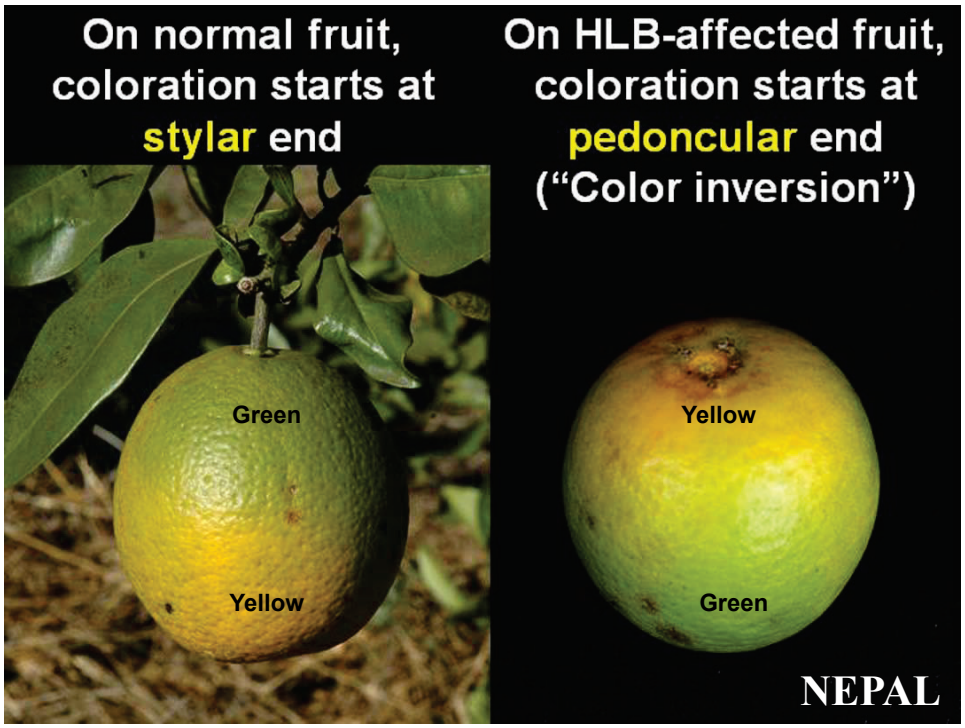
Figure 7
Leaf symptoms of South-African HLB-blotchy mottle on lemon



HLB eradication?

In case HLB prevention fails and evidence for presence of the disease is obtained by symptom observation and PCR detection of liberibacters, HLB eradication must be immediately started. The earlier HLB is detected after it enters the affected area and the earlier HLB eradication is started, less difficult the eradication will be. In the *T. erytreae*-affected area of Spain/Portugal, the trees endangered to become affected by HLB are backyard trees and such trees when showing HLB-symptoms should be immediately cut down and removed. In addition, symptomless trees in the vicinity of symptomatic trees must be tested by sensitive techniques such as real time PCR (rt-PCR), for detection of liberibacters and removed if testing positive. Psyllid samples, in and around the symptomatic trees and the liberibacter-positive trees, should be tested for liberibacters by rt-PCR. In this way, the extend of the liberibacter-infected focus can be determined. Also, it is possible that symptomless trees in the infected focus are already infected, but do not show symptoms as yet, since there is a latency period between the time the tree is infected by the psyllids and the time the tree shows symptoms. The latency period is variable. Some trees have a short latency period (~ 6 months), other trees have a long latency period (~ 18 months). Probably several infected foci will be found. Within the area comprising the various foci, all citrus trees should receive drastic insecticide treatments to decrease the psyllid population. The insecticide can be applied by spraying on the canopy or, better for ecological reasons, by trunk applications (Fig. 8).

Figure 8
Fruit symptoms of HLB: colour inversion on sweet orange



In case eradication of the above foci does not succeed, HLB will probably spread and reach commercial citrus areas. HLB management can now be attempted.

HLB Management?

In São Paulo State, where HLB management has been successful, HLB symptoms were (observed in March 2004 in commercial orchards, PCR evidence for Liberibacters became available in May 2004 and HLB eradication started in July 2004. The management system applied comprises three essential measures (three-pronged system, TPS): (i) insecticide treatments of all trees in the farm several times per year to drastically decrease the population of psyllid vectors; (ii) inspections of all trees in the farm several times per year to identify symptomatic trees and their removal within a week; (iii) replacement of removed trees by healthy trees grown in covered, insect-free nurseries. Over the years, experience in HLB management was gained and factors were identified which made management easier and successful or more difficult (Belasque et al., 2010). These factors are summarized in Table 2.

Table 2
Factors which made it easier or more difficult to achieve HLB control in São Paulo State

FACTORS	EASIER	MORE DIFFICULT
Size of farm	Large: ≥ 400 ha	Small: ≤ 400 ha
Shape of farm	Square	Elongated rectangle
Age of trees	Mature trees	Young trees
Farm in region of low or high HLB-incidence	Low: ≤ 2%	High: ≥ 15%
Presence of farms with no HLB management *	Far away	Close-by
% of HLB-trees in the farms at 1st inspection	Low: ≤ 1%	High: ≥ 10%
Time of 1st inspection after farm was infected	Soon after infection	Long after infection
Number of HLB-inspections with platforms	12 per year	4 per year
Number of insecticide treatments	24 per year	6 per year
Higher tree density at farm-borders	Yes	No
Extra insecticide treatments at farm-borders	Yes	No
QUALITY OF CONTROL	**EXCELLENT**	**POOR**

* See Figure 9

Figure 9
Border effect (rectangle): Psyllids tend to accumulate on the borders of groves. More trees become infected and more HLB trees are removed on the borders. Hence: Psyllid treatments should be more frequent on the borders than inside the grove. The less borders, the better. São Paulo State, Brazil

Several of the factors that make HLB-management by the TPS successful in Brazil, are not met by most of the citrus farms in the Mediterranean area, including those of Spain and Portugal. In particular, in the Iberian Peninsula, by comparison with Brazil, farms are very small and show all types of shapes. Therefore, it is to be feared that HLB management by the TPS system will not be successful, unless citrus health management areas (CHMAs) are formed. In a CHMA, several adjacent citrus farms totalling about 500 ha are handled as individual blocks of a large farm and managed concomitantly. In a given region, as many CHMAs as possible should be organized. No CHMAs should contain abandoned farms or farms without HLB management. In Florida, CHMAs have carried out insecticide control of psyllids, but without removal of symptomatic trees. Such CHMAs have been unsuccessful in HLB control because both psyllid control by insecticides and symptomatic tree removal are indispensible to achieve HLB control.

Figure 10
Sprayer for trunk application of insecticides

In Florida also, foliar sprays and insecticide treatments for psyllid control have been used to "live" with HLB. The foliar sprays contain micronutrients as well as potassium nitrate, phosphite and/or salicylic acid. The percentage of HLB-infected trees in orchards receiving these sprays is very high if not 100%. In Brazil, none of these nutrient-sprays (8 different treatments) has had beneficial effects on the yields of normal trees or HLB-affected trees; for all treatments, after one, two or three years of treatment, the yield of HLB-affected trees was reduced, respectively by 15, 43 and 62% in comparison with the yield of healthy trees, and the HLB severity of the affected trees increased from 15% to more than 50% during the three years. In the three plots with heavy insecticide control of the psyllids, the percentage of HLB affected trees increased from 2% to 10% and in the plot without psyllid control, from 2% to 23%.

If, in the Iberian Peninsula, HLB management fails; the survival of the citrus industry will entirely rely on the development of cultivars (i) resistant to the HLB liberibacters, (ii) repelling the psyllids, or (iii) lethal to the psyllids. These cultivars have to be obtained by genetic modification because so far no useful, natural resistance has been found within the *Rutaceae*. As of 2015, no such cultivars are available for commercial use.

Conclusion

In conclusion, at this moment the African citrus psyllid, *Trioza erytreae*, present in the Iberian Peninsula (Spain and Portugal), as a single focus, has not yet invaded the citrus growing regions. Also, HLB itself is not yet present. As seen above, HLB management is not easy and the structure of the Mediterranean citrus industry is not favorable to an easy management. Therefore all efforts should be made to keep the disease out and, if it gets in, to have it eradicated. Nevertheless, the possibility of its entering the citrus growing regions must be envisaged. Without further waiting, the feasibility of CHMAs has to be evaluated and the Iberian citrus regions should be subdivided into a number of putative CHMAs, so as to be ready in case of HLB. Also, it is essential, eventually by law, that all citrus nurseries become covered and insect-free so as to be protected against insect vectors and capable of producing healthy plants. Finally, solutions based on genetically modified cultivars must become the subject of research and development in the frame of a coordinated action involving all citrus growing countries of the Mediterranean basin.

Bibliography / More information

- Belasque, J.; Jr., Bassanezi, R. B.; Yamamoto, P. T.; Ayres, A. J.; Tachibana, A.; Violante, A. R.; et al. (2010). *Lessons from huanglongbing management in São Paulo State, Brazil.* Journal of Plant Pathology 92, 285–302.

- Bové, J. M. (2006). *Huanglongbing: a destructive, newly emerging, century-old disease of citrus.* Journal of Plant Pathology 88, 7–37.

- Bové, J. M. (2013). *Heat-tolerant Asian HLB meets heat-sensitive African HLB on the Arabian Peninsula. Why?* 3rd International Research Conference on HLB (Orlando, FL, USA).

- Bové, J. M.; Rogers, M.E. (Co-Conveners) (2015). *Huanglongbing Control Workshop: Summary.* Proceedings of the XII International Citrus Congress, Valencia, Spain, November 18th -23rd, 2012. (B. Sabater-Muñoz, P. Moreno, L. Peña, L. Navarro Editors). Acta Horticulturae 1065 (2), 869–889.

- Duran-Vila, N. ; Janse, J.D. ; Foissac, X. ; Melgarejo, P. ; Bové. J.M. (2014). *Addressing the threat of huanglongbing in the mediterranean region: a challenge to save the citrus industry.* Journal of Plant Pathology 95 (4, Supplement), S4.3-S4.8.

Drosophila suzukii in Tuscany (Italy), from cherry crops to vineyards and beyond

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Drosophila suzukii Matsumura, the Spotted Wing Drosophila (SWD), is a small fly native to South- East Asia, belonging to the Drosophilidae family. The female, provided with a strong and sclerotized ovipositor, is able to lay eggs under the skin of unwounded ripening fruits. The larva, feeding on the fresh mesocarp, causes a depressed and soft area in it, and leads the fruit to rapid decomposition. Among the numerous hosts of economic importance, the most common fruits affected by SWD are: blueberry, raspberry, blackberry, strawberry, cherry, apricot, plum, fig, and grapevine.

In the fall of 2008, *D. suzukii* has been reported simultaneously in Spain and Tuscany (Central Italy), then, a year later in Northern Italy and other countries as France and Russia (Cini *et al*., 2012). In the following years, the species has been reported in many European and Italian regions causing a lot of serious damages on various fruit crops. In fact its high biotic potential, as well as the wide range of hosts, makes this fly a very dangerous pest (Cini *et al*., 2012). To better monitor the spreading of SWD in Europe, to study the incidence of its natural enemies, and to develop IPM strategies, in 2012-2014 the Euphresco project "DROSKII" was performed. This project involved five European countries (Italy, Austria, Switzerland, Germany and United Kingdom) and was coordinated by CRA-ABP (Simoni *et al*., 2014). Thereafter, since July 2014 another project Euphresco, "IPMDROS", having Spain as coordinator, and Belgium, Austria, Italy (CRA ABP) and Turkey as partner countries, has been started.

This contribution reports briefly the activities carried out in Tuscany, in 2013-2014 years, to verify the spread and incidence of SWD on different crops of various areas of the region.

Materials and methods

In the years 2013 and 2014, a survey on *D. suzukii* population was carried out in Tuscany mainly in sweet cherry orchards in Lari district (Pisa province), in a biological blueberry crop, apricot orchard and vineyard in Castiglione della Pescaia area (Grosseto province), and in two vineyards, a botanical garden and a small wood in Montalcino area (Siena province). Other samplings were performed in Casentino (Arezzo province), Vada (Leghorn province), Florence and Siena provinces.

Monitoring of *D. suzukii* adults was made by using a device consisting of a red plastic jar (300 ml volume) with a removable lid. Six holes (4 mm diameter) were present on the top edge of the jar to allow flies to enter. The traps were filled with a mix of apple vinegar, red wine and sugar; by using a coated wire, they were hanged to the plant canopies within the shaded side and at the fruit level.

The traps were usually checked and refilled every 7-14 days. All the captured insects, after filtering the content of the trap, were dumped into a glass jar with 70% alcohol. At the facilities of the CRA-ABP (Florence), the flies were then examined under a stereomicroscope to count and identify males and females of *D. suzukii* and other Diptera. As regard *D. suzukii* preimaginal population, samples of fruits were regularly collected from each orchard and transferred to the laboratory: here a part of the sample was examined by stereomicroscope to assess the infestation level, the other part was stored into boxes and maintained at 25°C and 60-70% R.H. to check any emergence of Diptera adults. All Drosophilidae specimens were individually examined to identify males and females of SWD.

In 2013, the monitoring of *D. suzukii* adult population was performed in Lari area by 22 traps on sweet cherry, from the beginning of the ripening period to the end of harvest, in Castiglione della Pescaia area by 25 traps on blueberry, from late May to the end of summer, and by 16 traps on vineyards, from the middle of August to the end of harvest. In 2014, the SWD survey continued in Castiglione della Pescaia area, in the blueberry crop (seven traps) and in a close apricot orchard (three traps) and a vineyard (three traps). In the same year, *D. suzukii* was monitored also in Montalcino area, using six traps in two vineyards, one trap in a botanical garden and one trap in a small wood. The survey began in January and continued until the end of the year.

Results

From the investigation carried out in 2013, it was ascertained that *D. suzukii* was present with a very abundant population in the sweet cherry growing area in Lari. High numbers of SWD adults were trapped both in biologically and conventionally managed orchards. Laboratory observations on fruit samples showed percentages of infestation ranging from 20 to 50%, confirming the establishment of the species as key pest on sweet cherry crops of this district (Gargani *et al*., 2013).

As regard the blueberry crop in Castiglione della Pescaia, the monitoring of 2013 revealed a limited presence of SWD adults in traps and no infestation on sampled fruits. A similar situation was registered in same year in the vineyards of this area with few catches in the ripening period but no cluster infested. During the sampling period, other Diptera Brachycera Cyclorrhapha Acalyptratae were collected in all the traps; the ratio between SWD and these Diptera varied from 9 to 60% according to period and area of monitoring (Gargani *et al*., 2013).

Some traps used for short periods in other ecosystems allowed to ascertain the presence of *D. suzukii* in small orchards of cherry and khaki and in Natural Reserve of Casentino (Arezzo province) and in some urban gardens in the province of Leghorn and Florence. In 2014 SWD catches of SWD were continuously registered throughout the year. In Castiglione della Pescaia, on blueberry, apricot and wine grape, catches had the trend shown in the Figures 1, 2 and 3.

Figure 1
Castiglione della Pescaia (Grosseto), 2014, blueberry crop. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

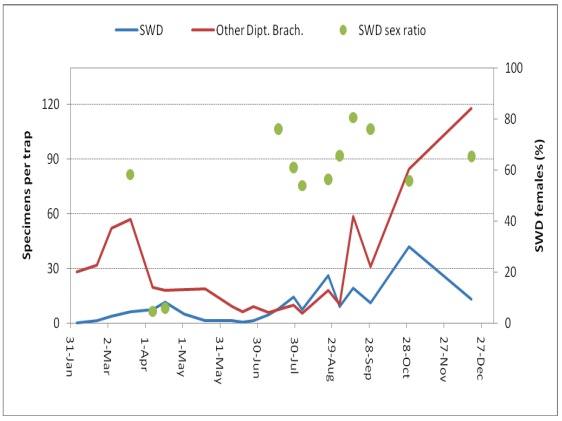


Figure 2
Castiglione della Pescaia (Grosseto), 2014, apricot crop. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

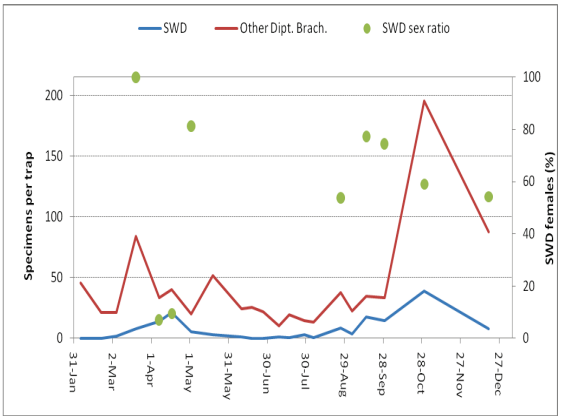
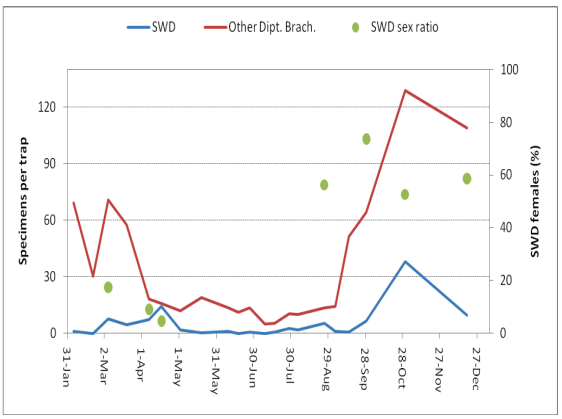


Figure 3
Castiglione della Pescaia (Grosseto), 2014, vineyard Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD

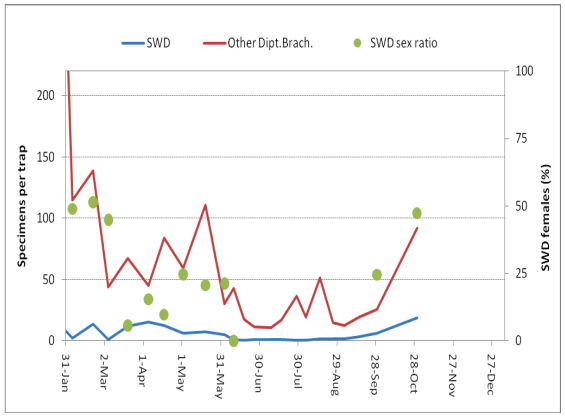


SWD captures showed a similar trend in 2014 in the three agro-ecosystems of Castiglione della Pescaia. After a light presence in the winter months, on the whole, there was an increase in captures in the spring. During the fruit ripening and the harvest periods (late May - first week of August for blueberry, late May - mid-August for apricot, mid-September for grapes) it has been observed a reduction of the captures. A sensible increase in captures was registered at the end of the harvest, with higher effectiveness of traps probably due to non-competition of fruits. The sex ratio of SWD, assessed only when the captures of the insect averaged more than 7 specimens per trap, varied considerably during the sampling period without a clear reason (Figg. 1, 2 and 3).

As regard catches of other Diptera Brachycera Cyclorrhapha Acalyptratae, although higher than those of SWD, the trends were quite similar, with the exception of those registered in vineyard, where from late August the number of catches increased clearly by creating alert among farmers, worried about a dangerous SWD infestation on grapevine. Actually, as showed in Figure 3, most of the adults captured were other Diptera, in particular other Drosophilidae. The presence of preimaginal *D. suzukii* population on grape was also evaluated by sampling and laboratory analysis of clusters by excluding high SWD infestation. On the other sampled fruits collected from ripening period until the end of harvest, only on blueberry were found fruits attacked by *D. suzukii*, at maximum of 6% in the middle of July.

As regard the Montalcino area, the trend of catches registered in the two vineyards monitored are showed in the Figure 4.

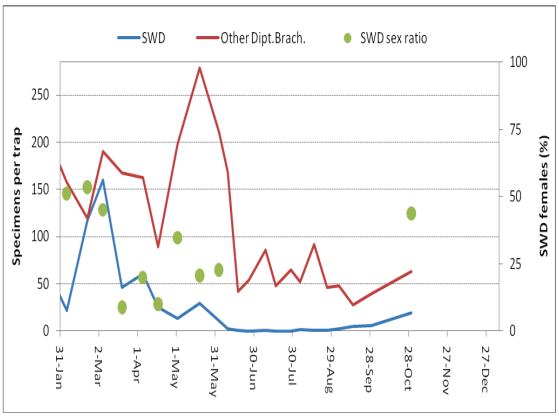
Figure 4
Montalcino (Siena), 2014, vineyard. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD



Populations of SWD in the vineyards remained always limited during all the year, while the other Diptera showed a quite variable trend during the season. In particular, analogously to the vineyards in Castiglione della Pescaia, there is an increasing population registered in summer. Even if in these vineyards there was a massive presence of Drosophilidae adults flying around clusters, from the lab observations conducted on samples, only in one cluster, a male of *D. suzukii* was found, while a great number of other Drosophilidae was recorded.

In the botanical garden and into the wood in Montalcino area, catches indicated a very different trend compared with that in vineyard (Fig. 5). During the winter there have been numerous catches of *D. suzukii* as well as of other Diptera. From spring onwards SWD populations have been declining, while the other Diptera showed a peak of catches in the spring and, then, a decline in summer.

Figure 5
Montalcino (Siena), 2014, botanical garden and small wood. Captures of SWD and other Diptera Brachycera adults and sex ratio of SWD



Conclusions

SWD has showed a rapid spreading throughout Tuscany as well as in many other Italian and European regions (Vitagliano *et al.*, 2013). In the district of sweet cherry production in Lari, *D. suzukii* has assumed the characteristics of key pest already in 2013 when our surveys allowed to detect a percentage of fruit infestation between 20 to over 50% with 0.2-0.9 larvae per drupe on average (Gargani *et al.*, 2013).

In the investigated area of Castiglione della Pescaia, in 2013 and 2014, on blueberry, known as particularly susceptible crop (Grassi and Pallaoro, 2012), on apricot and grapevine, the number of adult captures was not particularly high and damage on the fruits were limited. This is probably ascribable to the typical microclimate of the coastal region, where low humidity and frequent ventilation create unsuitable conditions for SWD population.

As reported by other Authors (Grassi and Pallaoro, 2014; Briem *et al*., 2014), in 2014, SWD adults were captured throughout the year, including the winter period, characterized by particularly mild temperatures. Furthermore, the highest catches were observed in the periods following the completion of harvest, leading to assume a greater competitiveness of mature fruits compared to the food traps.

A special comment deserves the situation on vineyard. In the last three years, the presence and the potential harmfulness of *D. suzukii* on wine grape has been studied by many Authors. Faced with specific situations, where on some grape varieties significant attacks by SWD have been reported, in general, the researches confirm that wine grape is a minor host for SWD (Ioriatti *et al*., 2015).

Our results are in agreement with these studies: in 2014, the climatic conditions in large parts of Tuscany were characterized by mild temperatures and abundant rainfalls and, during the ripening of grape, high populations of Drosophilidae were noted around the bunches. The catches, however, showed that the number SWD was lower than other drosofiliids; furthermore, rare specimens of *D. suzukii* were detected on the clusters examined in laboratory. During cool and wet harvest periods, high numbers of SWD adults can be observed on damaged berries (Ioriatti *et al*., 2015).

So, by close perspective, it is important to consider that, due to the high reproductive potential of SWD, if the environmental/climatic conditions will be conducive to the development of very abundant populations, the actual and potential damage of this species should be taken in high account. In fact the ongoing climatic change could lead to more frequently cool and rainy summers, like the one occurred in 2014 in many Italian regions, and consequently make the relationship between SWD and vine sour rot more complex and harder to control.

Bibliography / More information

- Briem M., Breuer K., Köppler H., Vogt F., 2015 - Phenology and occurrence of Spotted Wing Drosophila in Germany and case studies for its control in berry crops. IOBC Bull. Working Group "Integrated Protection of Fruit Crops, Subgroup Soft Fruits", Vol. 109: 233-237.
- Cini A., Ioriatti C., Anfora G., 2012 – A review of invasion of *Drosophila suzukii* in Europe and a draft research agenda for integrated pest management. Bull. Insectol., 65: 149-160.
- Gargani E., Tarchi F., Frosinini R., Mazza G., Simoni S., 2013 – Notes on *Drosophila suzukii* Matsumura (Diptera Drosophilidae): field survey in Tuscany and laboratory evaluation of organic products. Redia, XCVI: 85-90.
- Grassi A., Pallaoro M., 2012 – *Drosophila suzukii* (Matsumura), a revolution for soft fruits in Trentino. Ecofruit. 15th International Conference on Organic Fruit-Growing. Proceedings for the conference, Hohenheim, Germany, 20-22 February 2012, pp. 179-186.
- Ioriatti C., Walton V., Dalton D., Anfora G., Grassi A., Maistri S., Mazzoni V., 2015 - *Drosophila suzukii* (Diptera: Drosophilidae) and its potential impact to wine grapes during harvest in two cool climate wine grape production regions. J. Econ. Entomol.: 1-8.
- Simoni S., Baufeld P., Northing P., Bell H., Gargani E., *et al*., 2014 - Overview on DROSKII project: evaluation on two year experience on insight on the damage potential of *Drosophila suzukii* and control measures. IOBC Working Group Integrated fruit production, Subgroup soft fruit, VIII Workshop on Integrated fruit production, Vigalzano di Pergine di Valsugana, 26-28 May 2014: 118.
- Vitagliano S., Grassi A., Anfora G., Angeli S., 2013 – L'insetto esotico *Drosophila suzukii*: ecologia e linee di difesa. Italus Hortus 20(3): 3-17.

Interview

Changement climatique et espèces invasives en Afrique de l'Ouest

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Pourriez-vous présenter brièvement l'ISRA ?

Créé en 1974, l'ISRA (Institut Sénégalais de Recherches Agricoles) est un établissement public à caractère scientifique et technologique (EPST), ce qui lui a permis d'avoir plus d'autonomie et de pouvoir communiquer sur les résultats de ses recherches. L'ISRA mène des travaux de recherches autour de cinq axes :

- Les productions végétales
- Les productions et la santé animales
- Les productions forestières
- Les productions halieutiques
- Les questions socio-économiques liées aux activités agricoles et au développement rural durable

Parmi les dimensions prioritaires prises de plus en plus en compte dans le travail effectué par l'ISRA il y a celles relatives à la valorisation de la recherche, à la formation, à la vulgarisation et à la sécurité alimentaire et nutritionnelle qui revêtent une importance particulière.

Pourquoi les chercheurs de l'ISRA sont-ils plus attentifs, depuis quelques années, aux conséquences des facteurs environnementaux sur le processus de production agricole ?

Nous sommes conscients que toute recherche devrait être socialement acceptable par les populations et rentable au plan économique, d'où notre souci permanent de garder des relations de proximité avec toutes les parties ayant un rôle capital dans la production agricole et notamment celles qui font vivre l'agriculture familiale qui a pu jusqu'ici participer activement à la sécurité alimentaire. D'ailleurs, depuis la nuit des temps, les espèces dites rustiques ont été au cœur de l'activité agricole dans les pays de l'Ouest africain, tout particulièrement des populations locales.

Or, de nos jours, on s'aperçoit que des espèces non-indigènes (exotiques) peuvent allègrement entrer en compétition avec les espèces locales et qu'elles peuvent constituer un danger pour la biodiversité ainsi que pour la sécurité alimentaire. Du coup, nous nous trouvons face à au moins trois défis cruciaux :

- Mieux connaître les effets possibles et réels des facteurs environnementaux extrêmes sur les ressources végétales, animales, forestières et halieutiques ;

- Mieux identifier les mécanismes à travers lesquels les espèces invasives se propagent et se maintiennent dans les écosystèmes des pays de l'Afrique de l'Ouest ;

- Mieux travailler sur une approche d'adaptation à ces espèces sans oublier deux impératifs: i) maintenir la biodiversité ; ii) participer activement à la sécurité alimentaire et nutritionnelle des populations locales.

Pour ce faire, nous devons développer fortement nos connaissances et avoir un champ d'intervention concerté pour essayer de relever ces défis dans un cadre bien défini par l'ensemble des opérateurs selon les règles d'éthique et de déontologie

Pourriez-vous donner quelques exemples de plantes invasives qui posent problème aujourd'hui en Afrique de l'Ouest ?

Le « tipha australis » est un bon exemple d'espèces invasives devenues un vrai danger pour certains pays. Sa présence au Sénégal remonte à plusieurs décennies. Quant à son impact environnemental, il s'est accentué avec la mise en eau du barrage anti-sel de Diama sur le fleuve Sénégal. Nous avons trouvé un moyen très utile pour ralentir la propagation du typha en l'utilisant comme combustible. C'est un excellent remède pour éviter le déboisement et une bonne réponse dans le cadre de processus d'adaptation à de telles espèces.

Depuis 2013, des gazières à tipha sont fabriquées et commercialisées à l'échelle locale. Le « striga hermontica » est une autre espèce invasive non moins dangereuse au Sénégal et dans d'autres pays d'Afrique de l'Ouest. Connue par les paysans sénégalais sous le nom de « ndoukhoum », cette plante est un ennemi des cultures vivrières (sorgho, mil, etc…). Elle se nourrit d'eau, de sucres et de nutriments provenant des racines de céréales et empêchent ainsi leur croissance.

Il existe d'autres espèces invasives à propos desquelles il est important de mener des recherches plus détaillées et plus exhaustives. C'est le cas, entre autres, de la mouche blanche, de la cochenille farineuse du manioc, de la fougère d'eau ou encore du mûrier à papier etc.

Que faut-il faire en Afrique de l'Ouest pour organiser une lutte plus efficace contre les espèces invasives ayant surtout un impact négatif sur les écosystèmes fragiles et la sécurité alimentaire ?

Tout institut dédié à la recherche agronomique devrait apporter une contribution efficace à ce que j'appelle « des recherches stratégiques ». A l'ISRA, nous mettons l'accent tout particulièrement sur les moyens susceptibles de mieux nous aider à faire face aux dangers qui menacent ces cultures de base : le riz, l'arachide, le haricot, le mil, le fonio etc, sans occulter les espèces horticoles et l'arboriculture fruitière.

Tous les instituts de recherche de l'ensemble des pays d'Afrique de l'Ouest devraient davantage coopérer et mutualiser les résultats des travaux portant sur ces espèces qui pourraient hypothéquer notre sécurité alimentaire et nos écosystèmes fragiles.

A l'ISRA, nous sommes bien engagés dans cette optique qui consiste à renforcer des partenariats régionaux avec les instituts des pays voisins et avec d'autres pays qui travaillent sur cette question. C'est surtout le cas de la France où nous avons mis en place une coopération fructueuse avec l'INRA (Institut National de la Recherche Agronomique) et le CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement), mais également avec l'IRD (Institut de Recherches pour le Développement) et l'IP (Institut Pasteur).

Plus que jamais, une bonne coopération en Afrique de l'Ouest fondée sur la mutualisation des moyens, des actions, des expériences et des acquis de la recherche est devenue nécessaire. Cette démarche est bonne pour l'intégration de la sous-région et pour son développement humain, social, économique, environnemental et politique.

Alors que les tenants d'une thèse pessimiste pensent que le continent africain n'a pas compris jusqu'ici les enjeux colossaux des espèces invasives, ceux qui sont confiants dans la possibilité de vaincre ces espèces disent que la plupart des cultures vivrières en Afrique viennent d'ailleurs et que les Africains ont su les domestiquer et les mettre au service de la sécurité alimentaire. Comment vous situez-vous par rapport à ces deux thèses ?

Le chercheur est optimiste par nature. Mais encore faudrait-il poser les bonnes questions pour pouvoir bien appréhender le phénomène des espèces invasives tel qu'il se pose aujourd'hui à cause des changements climatiques extrêmes. Je pense personnellement que parmi les questions fondamentales que chaque institution de recherche devrait poser, celles qui suivent sont importantes : quel type de recherche privilégier ? Avec qui les entreprendre et pour quels objectifs ? Et qui sont les destinataires ?

A l'ISRA, nous sommes persuadés, en tout cas, qu'élargir le champ de la recherche participative est incontournable, car le citoyen ordinaire a un rôle très important dans l'élaboration, la mise en œuvre et le suivi de tout projet s'inscrivant dans la logique du développement local durable. S'attaquer au problème des espèces invasives et à tout autre problème lié au développement sans une participation active de la population locale et de ses connaissances et ou savoirs, consisterait à emprunter une voie inappropriée.*

** Interview conduite en mars 2015 en marge de l'édition du SIA 2015 de Paris, par Hassane Tlili, journaliste spécialiste des questions agricoles et environnementales.*

Assessment in Syria of apple rootstocks resistance to woolly apple aphid (*Eriosoma lanigerum Hausm*)

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Activity background and context

Apple rootstocks are different in their susceptibility to woolly apple aphid (WAA) *Eriosoma lanigerum* (Homoptera: Aphididae), WAA is an invasive pest that cause severe damage, it can feed on both roots and vegetative parts of apple trees, however root infestation can cause the death of the tree in extreme cases, that the root infestation cannot be chemically controlled (Klimstra and Rock, 1985). Researchers found the efficient solution to this case is through using rootstocks which have the genetic resistance to this pest, that they are usually considered as field immune to the pest and they are used to prevent infestation of the belowground parts (Bus *et al*., 2008). There are three defined apple resources which have the resistance genes to WAA "Northern spy" cultivar is one of these resistant resources, it has the gene *Er1*, it was used in the past as an apple rootstock, then introduced into apple rootstock breeding program as a parent in East Malling institute in cooperating with John Innes institute.

While the rootstock "Robusta 5" which belongs to *M.* x *robusta* species, was identified as a resource of the gene *Er2* (King *et al.,* 1991; Alston *et al.,* 2000). Likewise, the gene *Er3* which also responsible to the resistance to WAA was identified in "Aotea 1" from *M. sieboldii* species (Bus *et al.,* 2008). These available resources are very important in apple breeding program, that it can be used as parents to produce resistance rootstocks. However these three genes are different in their resistant mechanism, which led to the strategy of pyramid the resistant genes to insure better resistant to WAA (Sandanayaka *et al.,* 2003). This can be achieved through the integration between field evaluation for WAA resistant seedlings, and linked resistant genes using molecular markers which is defined as marker assisted selection (MAS), to speed up apple breeding program for WAA resistant genes. However, the locus of *Er1, Er2* and *Er3* were determined on apple genetic map, that the *Er1*and *Er2* are the essential genes used in the selection of apple rootstocks resistant to WAA (Bus *et al.,* 2008).

Our research aimed to evaluate and identify some of apple rootstock genotypes have the genetic resistance to WAA for rootstock breeding program in Syria depending on phenotypic and genetic evaluation.

Methodological approach

The present investigation was carried out at the agricultural scientific research center –GCSAR- in Sweida province, which located at 1525m altitude in the south of Syria.

Plant material

One year old seedlings from a hybridization between the apple rootstock MM106 (semi vigor rootstock, has the resistance gene *Er1* to WAA from its parent "Northern Spy") and the local apple cultivar Sk(Skarji) which has many desirable agronomic traits and tolerant to environment stress. Thus by this hybridization we aimed to get new rootstocks have the desirable traits from the two parents particularly resistance to WAA.

Phenotypic for resistance to WAA

Seedlings were planted in lines, the planting distance was 25 cm between plants and 70 cm between lines, all the agricultural processes (irrigation, fertilization and weeding)were achieved, the infestation was done in late June 2010 by placing shoot pieces with heavily infested WAA colonies in each seedling, the infestation was repeated twice in interval two weeks, the seedlings were not subjected to chemical control all the season.

WAA infestation was assessed 4 months after inoculating at the first season, and at the end of second season using 6- point scales according to (Bus *et al.,* 2008):

- 0: No infestation
- 1: Light infestation consisting of several small, separate colonies
- 2: Medium infestation and galling with some colonies starting to coalesce
- 3: Many colonies coalescing and up to 2 shoots completely infested and galled
- 4: Heavy infestation and galling on 2-5 shoots
- 5: Heavy infestation and galling on more than 5 shoots

The percentage of infested seedlings in each scale within each genotype was calculated. For genetic evaluation seedlings classified as 0 or 1 to be resistant and those scoring 2-5 to be susceptible.

Genetic evaluation

DNA extraction

DNA extraction was achieved using CTAB protocol according to Porebski *et al.,* (1997), by collecting leaves from the resistant plants and some of susceptible ones in addition to the parents.

PCR amplification

PCR amplification was achieved using 8 markers (table 1) linked to the resistant genes for woolly apple aphid (*Er1, Er2* and *Er3*), which developed according to linkage map (Bus *et al*., 2008).

The reaction was performed with volume (10 µl) consisted of: 1 µl 10 X buffer + 1 µl dNTPs + 1 µl forward primer + 1 µl reverse primer + 3 µl DNA + 0.1 µl Taq + 2.9 µl dH_2O. The cycling profile for the markers NZsc_G327, NZsc_O05, NZsc_E01 and NZsc_A01 consisted of an initial denaturation step of 3 min at 94 c, followed by 35 cycles of 30 s at 94C, 30 s at 55 C and 1min at 72C, the amplification process was finished with 5 min at 72C. For the markers NZms_EB145764, NZms_EB106753, NZsn_O05 and NZsc_C20 were used touchdown PCR consisted of an initial denaturation step of 5 min at 94 c, followed by 10 cycles of 30 s at 94C, 30 s at 70 C and 45 s at 72C, the temperature was reduced 1C every cycle, followed by 20 cycles of 30 s at 94C, 30 s at 60 C and 45 s at 72 C, the amplification process was finished with 10 min at 72 C.

Table 1
Shows the markers linked to the resistant genes to woolly apple aphid, the sequence of forward and reverse primers, and the product size (bp)

Marker name	Marker type	Original RAPD/EST	WAA gene	Forward primer	Reverse primer	Product size (bp)
NZsc_C20	SCAR	OPC20	*Er1*	TCTCTAACT CAATAACTC CCAAGAC	ACTTCGCC ACCATTAT CACTCCTG A	2,000
NZsc_GS3 27	SCAR	GS327	*Er1*	GCCAAGCT TCAATGTC GGAGTAGA T	CAAGCTTC CCCTAAGG CTATTGCC A	1,600
NZsc_O05	SCAR	OPO05	*Er1*	CCCAGTCA CTAACATAA TTGGCACA	CCCAGTCA CTGGCAAG AGAAATTA C	1,700
NZsn_O05	SNP	OPO05	*Er1* *Er3*	AACGTCAT GTCAATAT	CCCAGTCA CTGGCAAG AGAAATTA C	880
NZsc_E01	SCAR	OPE01	*Er3*	CCCAAGGT CCGAACAC AAATGAGA G	CCCAAGGT CCAAAACT ATCCCGAA G	1,350
NZSc_A01	SCAR	OPA01	*Er3*	CAGGCCCT TCAGCAAA GAGGTGTC T	CAGGCCCT TCACTACT AATAAGAA C	1,250
NZms_EB1 06753	SSR	EB106753	*Er1* *Er3*	TCTGAGGC TCCCAAGT CC	TAGGAGCA GAAGAGGT GACG	175
NZms_EB1 45764	SSR	EB145764	*Er2*	TTCCAGCG ATCCAAAAC AAT	GCTCAGGA ACACCTCG TTCT	198

Visualization of the PCR products

The PCR products were detected by electrophoresis on 1% agarose gel in 1X TBE buffer, stained with ethidium bromide and visualized by UV light and photographed using gel doc. NZms_EB106753 and NZms_EB145764 markers detected by running PCR products on a 8% polyacrylamide gel in 1X TBE buffer.

Results and discussion

Breeders of apples rootstocks have focused on extending the range of rootstock attributes and the benefits they confer to scions propagated upon them. woolly apple aphid (*Eriosoma lanigerum*) is the considerable pest in all apple rootstock breeding programs to develop apple rootstocks which offer resistance to this pest depending on phenotypic and genetic evaluation.

Phenotypic evaluation

The results of seedlings infestation with WAA showed differences between the two seasons of assessment. At the first season all seedlings were presented in scale 0 and 1 (100% resistant). At the second season the percentage of resistant and susceptible seedlings were changed that the percentage of resistant seedlings became (40.6 %), and the susceptible seedlings grouped in the scale 3. These results were in agreement with Fazio and Beers (2010), that the resistant rootstocks did not change, while the infestation increased within the susceptible ones in the second season. The resistant seedlings due to the main role of the rootstock MM106 as a parent takes its resistance property from Northern spy cultivar which has the resistant gene *Er*1 for WAA (Webster *et al.*, 2000).

Table 2
The percentage of infested seedlings for each scale among studied seedlings during the two seasons

Season of assessment	Percentage of infestation %					
	0	1	2	3	4	5
2010	81.2	18.8	0	0	0	0
2011	28.1	12.5	0	59.4	0	0

Genetic evaluation

At the end of the second season the susceptible seedlings were excluded from the apple rootstock breeding program and the resistant seedlings were genetically evaluated to insure the presence of considered resistant genes for WAA. The results showed that the marker NZsn_O05 linked to *Er*1 and *Er*3 genes was the most efficient marker, it gave allele has the predictable size 880 bp according to Bus *et al*., (2008), in 6 seedlings (4 in the scale 0 and 2 in the scale 1), in addition to the rootstock MM106 (Figure 1) which used as control for the gene *Er*1.However, this marker could not distinguish all the resistance seedlings which lead to advance genetic researches and use new techniques to detect WAA resistant genes, this result was in agreement with Bus *et al.,* (2008),they found that this marker discriminated 70 plants from 77 ones showed the resistance property.

The marker NZSc_E01 linked to the gene *Er*3 gave three polymorphic alleles, one of them was 1350 bp as the same of predictable size by Bus *et al.,* (2008) which was noticeable in the most studied seedlings (resistant and susceptible ones), while the remaining seedlings have two other alleles size 700 bp was existed in 3 resistant seedlings while the 500 bp was found in two seedlings (one resistant and the other susceptible).

The markers NZsc_C20, NZsc_O05 and NZsc_GS327 linked to the resistant gene *Er*1 did not give any PCR products. On the other hand, the markers NZms_EB145764 (linked to the gene *Er*2), NZms_EB106753 (linked to the genes *Er*1 and *Er*3) and NZSc_A01 (linked to the gene *Er*3) gave same alleles in both resistant and susceptible seedlings (monomorphic alleles) so they were not able to distinguish between resistant and susceptible seedlings. Although, these markers gave the same expected size as mentioned by Bus *et al.,* (2008) except NZSc_A01. This is possibly that these markers were may not tightly linked to the resistant genes.

Concluding remarks

The studied markers could not discriminate between all resistant seedlings and susceptible ones except the marker NZsn_O05. Therefore, it is necessary to develop new linked markers to WAA resistant genes depending on studied plant material, through using available techniques such SNPs and SSR. In addition, breeding programs should depend on the strategy of pyramiding the resistant genes to give durable resistance to WAA.

Bibliography / More information

- Alston, F. H., Phillips, K. L. and Evans, K. M. (2000). A *Malus* gene list,Acta Hort., 538(561-570)
- Bus, V.G.M., Chagné,D., Bassett,H.C.M.,Bowatte,D., Calenge,F.F.,Celton,J.M.,Durel,C.C.E.,Malone,M.T.,Patocchi, A.,Ranatunga,A.C.,Rikkerink,E.H.A.,Tustin,D.S.,Zhou,J. and Gardiner,S.E. (2008). Genome mapping of three majorresistance genes to woolly apple aphid (*Eriosomalanigerum*Hausm.), Tree Genetics and Genomes, 4, (223-236)
- Fazio, G. and Beers, B. (2010). Wooly Apple Aphid resistance in advanced rootstock selections, Final project report.
- King, G. J., Alston, F. H., Battle, I., Chevreau, E., Gessler, C., Janse, J., Lindhout, P., Manganaris, A. G., Sansavini, S., Schmidt, H. and Tobutt, K. (1991). The 'European apple genome mapping project'- developing a strategy for mapping genes coding for agronomic characters in tree species, Euphytica, 56,(89-94)
- Klimstra, D. E. and Rock, G. C. (1985). Infestationof rootstocks by woolly apple aphid on weak or deadapple trees in North Carolina orchards,JournalofAgricultural Entomology, 2, (309-312)
- Porebski, S., Bailey, G. L. and Baum, B. R. (1997). Modification of a CTAB DNA extraction protocol for plants containing high polysaccharide and polyphenol components, Plant Molecular Biology Reporter, 15(1),(8-15)
- Sandanayaka, W., Bus, V., Connolly, P. and Newcomb, R. (2003). Characterization associated with woolly apple aphid *Eriosomalanigerum,* resistance of three apple rootstocks, EntomologiaExperimentalis et Applicata, 109,(63- 72)
- Webster, T., Tobutt,K. and Evans, K. (2000).Breeding and evaluation of new rootstocks for apple,pear and sweet cherry, 43rd Conference, Napier, New Zealand. Pages (100-104)
- Webster, A.D. and Wertheim,S.J. (2003). Apple rootstocks, In: Botany, Production and Uses D.C. Ferree and I.J. Warrington (eds.),CAB International,(91-124)

EFSA's environmental risk assessment of the apple snail for the EU: a novel approach

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Introduction

In the context of a pest risk assessment, the potential consequences caused by a harmful organism needs to be estimated including the environmental consequences, besides the evaluation of other risk components. This publication describes a novel approach that was developed by the Panel on Plant Health (Panel) of the European Food Safety Authority (EFSA) and used to perform the environmental risk assessment for the apple snails for the EU.

Apple snails are considered to be serious rice pests and can cause devastating effects on the flora and fauna of natural wetlands. In 2010 the Island apple snail, Pomacea maculata, started its invasion in the rice fields in the Ebro Delta in Spain where it is currently still spreading. Today, the snail is not only present in rice paddies but also in some nearby wetlands, and it has been found moving upwards along the Ebro riverbeds.

In 2012, on the request of the European Commission, the EFSA Panel on Plant Health (Panel) evaluated a Spanish pest risk analysis on the apple snail (Spanish Ministry of Environment and Rural and Marine Affairs, 2011) and concluded that the risk posed by the apple snail to the natural environment was not sufficiently addressed and recommended that further study should be performed. Consequently the Panel was requested by EFSA to perform an environmental risk assessment on the apple snail for the EU.

The snail population density was identified as the driver of the ecosystem change, and therefore the factor playing the major role in determining the impact of the snail on the environment. The Panel developed a population dynamics model to estimate the potential population densities of snail eggs, juveniles and adults, and to identify the potential snail hot spots in Europe. As a result maps were generated to represent the potential snail density distribution in the EU territory (EFSA PLH Panel, 2013).

The environmental risk assessment procedure developed by the Panel and presented in its guidance document (EFSA Panel on Plant Health, 2011) was used to assess the negative impact of the snail invasion on the shallow freshwater areas containing macrophytes such as wetlands, shallow lakes, river deltas and the littoral zone of deeper lakes and rivers in Europe (EFSA PLH Panel, 2014).

This work has been published in two scientific opinions[1] by the EFSA Panel on Plant Health and the key aspects from these scientific opinions are presented in this paper.

Potential establishment of the apple snail in the EU

A brief summary of the key biological features of the apple snail that were considered in the population dynamics model used to assess the potential establishment of the apple snail in the EU is presented.

Brief summary of the biology of the apple snail

Apple snails are tropical and sub-tropical freshwater snails from the family Ampullariidae (Mollusca: Gasteropoda). Within the genus Pomacea, the difficulty to differentiate the species P. canaliculata and P. maculata on the basis of their morphological characteristics is recognised by many authors (Cowie and Hayes, 2005; Cowie et al., 2006). Hayes et al. (2012) provides a clarification on the taxonomy, describing their morphological and genetically based diagnostics, and re-evaluating their biogeographic ranges showing that the two species differ mostly genetically. Figure 1 shows a picture of an adult golden apple snail.

Figure 7
Adult golden apple snail – *Pomacea canaliculata*

Source: by courtesy of Nils Carlsson

Both snail species are highly invasive outside their native area of distribution in South America (Cowie, 2002). The invasiveness of these snails can be explained by their main biological characteristics.

The apple snails are polyphagous, they have a very broad diet which consists mainly of aquatic plants, including a wide range of plant species both cultivated and wild species, but also periphyton (algae, small crustaceans and other sessile organisms that are attached to rocks, submerged wood and the sediment), detritus and fish and snail eggs. Their broad diet allow the snails to remain at high densities even when aquatic plants resources are depleted (Carlsson et al., 2004).

[1] EFSA PLH Panel (EFSA Panel on Plant Health), 2013. Scientific opinion on the assessment of the potential establishment of the apple snail in the EU. EFSA Journal 2013;11(12):3487, 49 pp. doi:10.2903/j.efsa.2013.3487. Available online: www.efsa.europa.eu/efsajournal
EFSA PLH Panel (EFSA Plant Health Panel), 2014. Scientific Opinion on the environmental risk assessment of the apple snail for the EU. EFSA Journal 2014;12(4):3641, 97 pp. doi:10.2903/j.efsa.2014.3641. Available online: www.efsa.europa.eu/efsajournal

They have a high reproductive rate, apple snails have separate sexes (Halwart, 1994), and the female in favourable conditions is able to lay a number of egg batches, each of several hundred eggs, every week, for a long reproductive period. The females are able to store sperms after copulation for 140 days (in P. canaliculata) which can be used to fertilise series of egg batches in the absence of a male (Estebenet and Cazzaniga, 1992; Estebenet and Pizani, 1999). The total fecundity can be very high as illustrated by several authors: Estebenet and Martín (2002) estimated more than four thousand eggs laid per female and per year distributed in 8-57 egg masses; Liu et al. (2012) recorded egg masses containing 42 to around 880 eggs, with the females laying 1-15 egg masses after one copulation.

They can survive extreme conditions, being amphibious, using both gills and lungs, and can survive in poorly oxygenated waters. When threatened by predators, the snails can hide in their shell closing the operculum as an efficient protection mechanisms. The snails also use this physical protection to hibernate buried in the mud within the moisture enclosed in their shells for periods of several months when their habitat dries out (Oya et al., 1987).

In the tropical climates the average lifespan is approximately 1 year. Whereas, in subtropical and temperate climates, the snail's feeding and reproduction is reported as seasonal with a lifespan up to 3–4 years (Estebenet and Martín, 2002; Seuffert et al., 2010).

Population dynamics model of Pomacea canaliculata

A population dynamics model was developed by the Panel in a first step to represent the potential distribution of the apple snail in Europe and to derive the spatio-temporal distribution of the potential snail density to support the environmental risk assessment.

Considering the similarities between the two species P. canaliculata and *P. maculata* and considering that in the literature very few studies were performed on P. maculata, the population dynamics model was developed using mainly data and measurements from experiments performed on *P. canaliculata*.

In order to determine the spatial and temporal pattern of the environmental impact of the invasive species, its population density and its spatial and temporal variation has to be estimated. The Panel used the snail density to describe and predict the effect of the trophic interaction between the snail and the host plant community. This effect is to be considered to understand the ecosystem disturbance produced by the invasive species.

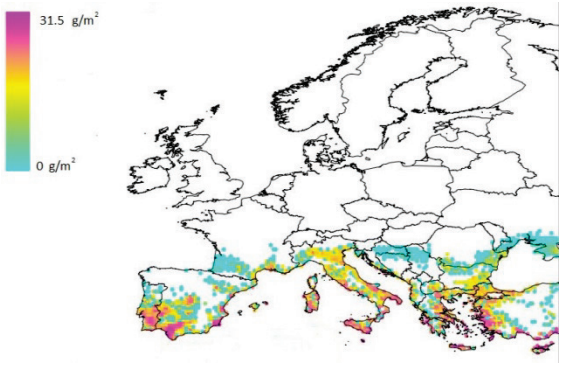
The density of the apple snail in terms of snail biomass was identified as the driver of the ecosystem change and was used to assess the effect of the snail on the environment. As for other poikilotherm organisms, the temperature is the main driver of the snails physiology. To assess the invasive snail's potential establishment in terms of potential density distribution in Europe, the Panel developed a temperature-dependent physiologically-based demographic model (PBDM).

Considering that the juvenile and adult stages preferably live in the water, a specific model was used to estimate the water temperatures starting from data on air temperature. The model is presented in EFSA PLH Panel (2013).

The population dynamics model takes into account the complexity of the life-cycle. Three developmental stages were used: eggs; juvenile and reproductive adults (male and females). Following a thorough review of the literature the Panel estimated the stage-specific parameters to define the three biodemographic functions for P. canaliculata (i.e., survival, development and fecundity rate functions) (EFSA PLH Panel, 2013). Population dynamics were described by a Kolmogorov equation (Di Cola et al., 1999) discretised with a time step of one hour for each point of the spatial grid covering the whole Europe. The dimension of the cell in this grid is 25 × 25 kilometres for Europe. The simulated snail density in each node was obtained using the specific climatic condition of the node. The potential distribution of P. canaliculata in Europe was obtained by calculating the average snail density per year for each node of the grid covering Europe. (For further details on the model and data, see EFSA PLH Panel (2013)). Owing to their trophic activity, only juvenile and adult stages are represented in figure 2.

The Panel defined the potential snail biomass as the biomass in a given point of the simulation grid where a suitable habitat is present at a time t. The potential snail biomass expressed in g/m2 depends only on climatic factors.

Figure 2
Distribution of total potential biomass (g/m²) of Pomacea canaliculata (juveniles + adults) across Europe



The colour code in the legend corresponds to biomass values, and the minimum value is above 0 (EFSA PLH Panel, 2014)

The area of potential establishment in Europe of Pomacea, comprises wetlands of southern Europe (i.e. Spain, southern France, most of Italy and Greece) and the Balkans up to the latitude of the Danube river. (EFSA PLH Panel, 2013).

Environmental risk assessment of the apple snail in the EU

The PLH Panel's environmental risk assessment of the apple snail for the EU (EFSA PLH Panel, 2014) was performed following the guiding principles presented in the Panel's ERA framework (EFSA PLH Panel, 2011). The procedure is based on scenario analysis and was performed in 4 steps: (i) in order to assess the impact of the snail on the ecosystem services, the unit of assessment, here defined as Service Providing Unit (SPU), a functional unit whose components (individuals, species or communities) are characterised by functional traits defining their ecological role (Vanderwalle et al., 2008); (ii) definition of the scales for the assessment (temporal horizon, spatial scale and biomass scale); (iii) assessment of the limiting factors (considering the impact of the potential biomass of the resistance and resilience of the receiving environment and management options), and; (iv) identification of the ecosystem traits-services and traits-biodiversity relationships potentially affected by the activity of the snail.

Three different assessments were performed by the Panel: (i) the effect of the snail biomass on ecosystem traits; (ii) the impact of the snail invasion on the ecosystem services, and; (iii) the impact of the snail invasion on components of the biodiversity. The different assessments were performed based on expert judgements that were collected by the Panel through an expert elicitation process that is presented in details in EFSA PLH Panel (2014).

The scenario analysis

A single SPU was defined i.e. shallow fresh water areas containing macrophytes such as wetlands, shallow lakes, river deltas and the littoral zone of deeper lakes and rivers. The interaction between the SPU and cultivated areas (rice fields) is taken into account.

The assessment was performed for two time horizons: (i) 5 years after establishment when the snail population density has reached its potential maximum level, and population dynamics is mainly influenced by the resistance of the receiving environment; and (ii) 30 years after establishment when the resilience of the environment plays a major role.

The area of potential establishment was predicted by the population dynamics model and expressed in terms of distribution of potential snail biomass (Figure 2).

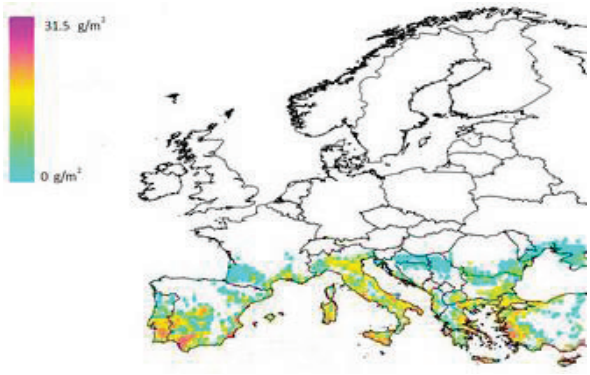
The Panel considered three mechanisms limiting the potential biomass of the pest, the resistance and resilience of the receiving environment and management options for controlling the apple snail. As presented in EFSA PLH Panel (2014) the resistance is related to the 'force' the ecosystem opposes to the establishment process resulting from arrival or spread (e.g., quality and availability of host plants limiting the possibility to build up a local population).

The resilience is defined as the capacity of the ecosystem to control the driving force and restore conditions similar to the ones existing before the perturbation (e.g., the action of the community of natural enemies regulating the pest population abundance). The management consists of options to reduce and manage apple snail populations. Several were presented in the Spanish pest risk analysis (Spanish Ministry of Environment and Rural and Marine Affairs, 2011), and were discussed in EFSA PLH Panel (2012). Only some of these options are expected to have serious negative environmental effects on the wetlands. In particular this is the case of (1) keeping rice paddies dry for long periods, (2) burning vegetation and river bank conditioning and (3) treating rice paddies and/or irrigation canals with (a) lime, (b) saline water, (c) snail attractants containing methaldehyde or (d) saponins.

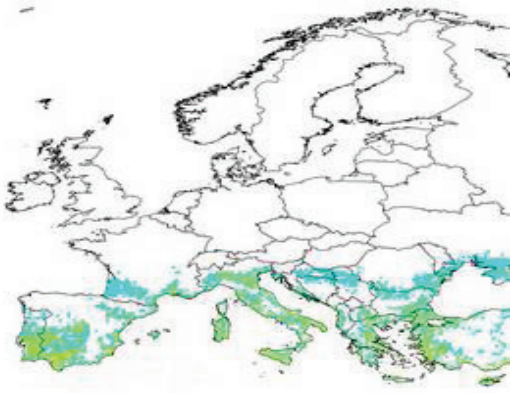
Expert judgement was used to provide estimates of the scaling factors representing the effects of resistance, resilience and management on the potential snail biomass. They are coefficients ranging from 1 (no effect) to 0 (max effects) multiplying the potential snail biomass to obtain the realized biomass. Further details on the method used to collect the expert judgments and the values of the scaling factors are presented in EFSA PLH Panel (2014). The realized snail biomass is the expected snail biomass in a given point of the simulation grid where a suitable habitat is present at time t considering the effects of limiting factors. To estimate the realized snail biomass, the Panel used the estimate of the potential snail biomass applying the limiting factors in the two time horizons (5 years and 30 years after establishment). Consequently two maps were generated (Figure 3a and 3b) to represent the realized biomass in Europe.

Figure 3
Distribution of average realized biomass (g/m²) of *Pomacea canaliculata* juveniles + adults over Europe

Estimations obtained by multiplying the potential biomass by the values of the scaling factors (resistance, resilience, management) estimated for two time horizons: (a) average realized biomass after 5 years; (b) average realized biomass after 30 years. (Extracted from EFSA PLH Panel (2014)).



a. 5 years



b. 30 years

The average realized snail biomass after 30 years is lower than after 5 years, because it is expected that (i) macrophytes non-palatable for Pomacea will replace the largely disappeared palatable macrophytes, and (ii) natural enemies may reduce Pomacea numbers more efficiently at the longer time horizon. (EFSA PLH Panel, 2014).

Effect of snail biomass on ecosystem traits

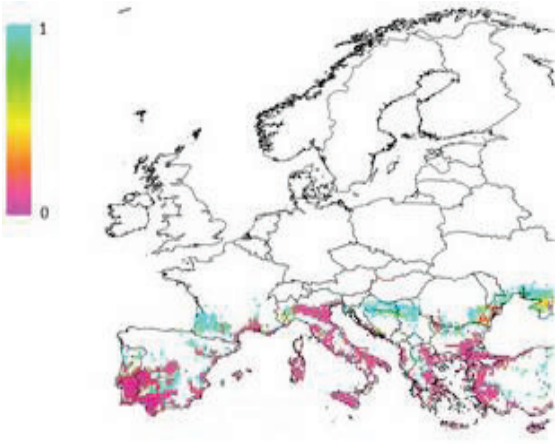
In the scientific opinion EFSA PLH Panel (2014) the Panel assessed the effect of the realized snail biomass on a set of the ecosystem traits (the complete list is presented in table 2). In a first step the relationships between snail biomass and ecosystem traits in the service providing unit were identified. Then the impact was evaluated in terms of change of the level of the ecosystem trait due to the increase of snail biomass by means of a procedure based on the collection of expert judgement. The uncertainty associated with each trait–biomass relationship was not assessed. Finally the Panel mapped the expected impact in Europe of the invasive snail on some ecosystem traits. An example is presented in figure 4.

Table 2
List of the ecosystem traits assessed by the Panel in EFSA PLH Panel (2014)

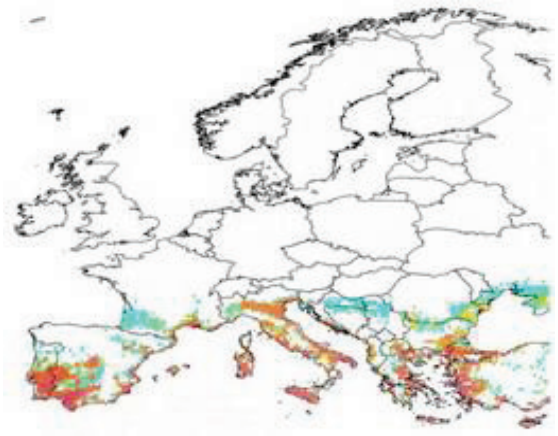
Traits assessed for impact relationship with snail biomass		
Traits related to the macrophytes	**Traits related to water quality**	**Traits related to biodiversity**
Edible macrophyte biomass	Oxygen concentration	Aquatic invertebrates biodiversity
Biomass of non-edible macrophytes	Phosphorous concentration	Amphibian biodiversity
Dominance (macrophytes/phytoplankton	Sedimentation rate	Fish biodiversity
Macrophyte species diversity	pH (percentage of variation)	Bird biodiversity
Structural complexity of the habitat	Denitrification	Zooplankton biodiversity
		Zooplankton biomass
		Periphyton biomass

Figure 4
Example of a representation of the spatial distribution in Europe of the effect of the snail invasion on the edible plant biomass extracted from EFSA PLH Panel (2014)

Distribution of the index I_ET representing the change in the edible plant biomass due to the effects of the realized snail biomass at the two time horizons. Values of the index close to zero correspond to high impact on the ecosystem trait, while values of the index close to 1 denote a low impact: (a) 5 years, short term; (b) 30 years, long term.



a. 5 years



b. 30 years

Impact of the snail invasion on the ecosystem services and biodiversity components

The impacts and associated uncertainties were estimated by the Panel through expert elicitation for each ecosystem service and biodiversity component. Each expert provided an estimate of the probability distribution of the percentage of reduction in ecosystem service provision and in biodiversity for the defined service providing unit. Five categories of reduction were considered for both the ecosystem services and the biodiversity components (see Table 3).

The assessment was performed for the maximum realized biomass (the worst case scenario) in the short and long term This methodology is presented in details in EFSA PLH Panel (2014) and the rating system used is similar to the one described in the PLH Panel guidance document on the environmental risk assessment of plant pest (EFSA PLH Panel, 2011). The rating system developed by the Panel in EFSA PLH Panel (2011) and adjusted in EFSA PLH Panel (2014) is based on a probabilistic approach ensuring consistency and transparency of the assessment. In addition a method was developed for the quantification of uncertainties that are categorised as low, medium or high.

Table 3
Rating system used in EFSA PLH Panel, 2014 for assessing the impact of an apple snail invasion on ecosystem services and biodiversity components

Magnitude class	***% reduction***
1. Minimal	Zero or negligible loss
2. Minor	0<M=5%
3. Moderate	5<M=20%
4. Major	20<M=50%
5. Massive	M>50%

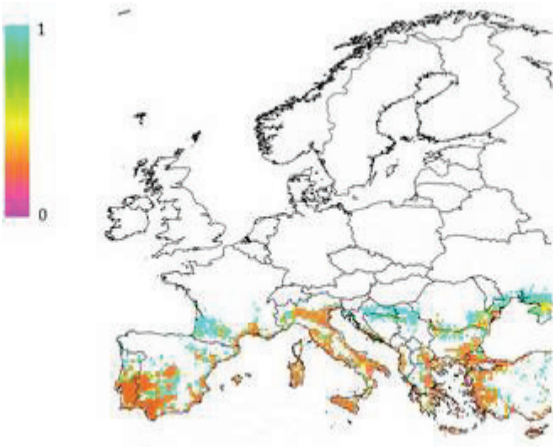
This methodology was applied by the Panel to assess the ecosystem services and biodiversity components listed in Table 4. Finally the Panel mapped the impact in Europe of the invasive snail on some biodiversity components. An example is presented in figure 5.

Table 4
List of ecosystem services and biodiversity components assessed in EFSA PLH Panel (2014)

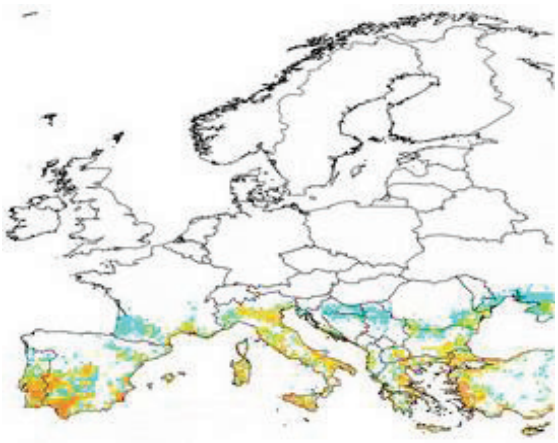
Ecosystem services assessed for impact of snail invasion		**Biodiversity components assessed for impact of snail invasion**
Provisioning services	**Regulating and supporting services**	
Food	Climate regulation	Genetic diversity
Genetic resources	Water regulation/cycling /purification	Native species diversity
Fresh water	Erosion regulation	Native habitats, communities and/or ecosystems diversity
	Nutrient cycling	Threatened species
	Photosynthesis and primary production	Habitats or other ecological entities of high conservation value
	Pest and disease regulation	
	Pollination	

Figure 5
Example of a representation of the spatial distribution in Europe of the effect of the snail invasion in Europe on the threatened species extracted from EFSA PLH Panel (2014)

Distribution of the index I_ET representing the change in threatened species due to the effects of the realized snail biomass in the two time horizons. Values of the index close to zero correspond to high impact on the ecosystem trait, values of the index close to 1 denote a low impact: (a) 5 years, short term; (b) 30 years, long term.



a. 5 years



b. 30 years

Conclusions

Following the development of the apple snail population dynamics model and the environmental risk assessment for the apple snail in the EU the EFSA PLH Panel concluded that:

- The area of potential establishment in Europe of Pomacea, comprises wetlands of southern Europe (i.e. Spain, southern France, most of Italy and

- Greece) and the Balkans up to the latitude of the Danube river. (EFSA PLH Panel, 2013).

- The average realized snail biomass after 30 years is lower than after 5 years, because it is expected that (i) macrophytes non-palatable for Pomacea will replace the largely disappeared palatable macrophytes, and (ii) natural enemies may reduce Pomacea numbers more efficiently at the longer time horizon. (EFSA PLH Panel, 2014).

- Regarding the potential impact of the apple snail on the ecosystem services, the Panel concluded that the apple snail invasion represents a moderate risk for genetic resources, climate regulation, pest and disease regulation and pollination in both the short and the long term. The Panel estimated the risk for food as moderate in the short term and major in the long term, while the risk for water regulation and erosion regulation is major in both the short and the long term. The risk for fresh water is assessed as massive in both the short and the long term and the risk for nutrient cycling and photosynthesis and primary production of macrophytes was assessed as massive in the short term and major in the long term. The uncertainty is medium for all the ecosystem services in the short term, except for erosion regulation, for which uncertainty is high in the short term. Water regulation, erosion regulation and pest and disease regulation have high uncertainty in the long term, while all the other ecosystem services have medium uncertainty in the long term. In the worst case scenario (maximum realized snail biomass), the overall effect of the snail invasion on the shallow freshwater wetlands of southern Europe is major on the ecosystem services both in the short and in the long term.

- Regarding the potential impact of the apple snail on the biodiversity components, the Panel concluded that the apple snail invasion represents a major risk for genetic diversity and native species diversity in both the short and the long term. For native habitat, the short term risk was estimated as massive and the long term risk as major. For threatened species and habitat of high conservation value, in both the short and the long term the risk was assessed as massive. The uncertainty is low for habitat of high conservation values in the long term and medium in the short term. For all the others biodiversity components the uncertainty is medium for both the short and the long term. In the worst case scenario, the overall effect of the snail invasion on the shallow freshwater wetlands of southern Europe is massive on the biodiversity in the short term and major in the long term.

- The overall risk estimated for biodiversity is higher than the one for ecosystem services, both in the short and in the long term. This could be explained by the fact that in natural environments the biodiversity components are more sensitive to perturbations and that the ecosystem services are based on functional components and are able to reduce the impact.

Bibliography / More information

- Carlsson NOL, Brönmark C and Hansson LA, 2004. Invading herbivory: the golden apple snail alters ecosystem functioning in Asian wetlands. Ecology, 85, 1575–1580.

- Cowie RH and Hayes KA, 2005. Invasive ampullariid snails: taxonomic confusion and some preliminary resolution based on DNA sequences. In Proceedings – APEC symposium on the management of the golden apple snail, September 6–11, 2004 Edited by: Lai P-Y, Chang YF, Cowie RH. Taipei: National Pingtung University of Science and Technology, 7–16.

- Cowie RH, 2002. Apple snails (Ampullariidae) as agricultural pests: their biology, impacts and management. In: Molluscs as crop pests. Ed. Barker GM. CABI Publishing, Wallingford, UK, 145–192.

- Cowie RH, Hayes KA, Thiengo SC, 2006. What are apple snails? Confused taxonomy and some preliminary resolution. In Global Advances in the Ecology and Management of Golden Apple Snails Edited by: Joshi RC, Sebastian LS. Muñoz, Nueva Ecija: Philippine Rice Research Institute, 3–23.

- Di Cola G, Gilioli G and Baumgartner, 1999. Mathematical models for age structured population dynamics. In: Ecological entomology. Eds Huffaker CB and Gutierrez AP. John Wiley & Sons, New York, USA, 503–534.

- EFSA PLH Panel (EFSA Panel on Plant Health), 2011. Guidance on the environmental risk assessment of plant pests. EFSA Journal 2011;9(12):2460, 121 pp. doi:10.2903/j.efsa.2011.2460. Available online: www.efsa.europa.eu/efsajournal

- EFSA PLH Panel (EFSA Panel on Plant Health), 2012. Scientific Opinion on the evaluation of the pest risk analysis on Pomacea insularum, the island apple snail, prepared by the Spanish Ministry of Environment and Rural and Marine Affairs. EFSA Journal 2012;10(1):2552, 57 pp. doi:10.2903/j.efsa.2012.2552. Available online: www.efsa.europa.eu/efsajournal

- EFSA PLH Panel (EFSA Panel on Plant Health), 2013. Scientific opinion on the assessment of the potential establishment of the apple snail in the EU. EFSA Journal 2013;11(12):3487, 49 pp. doi:10.2903/j.efsa.2013.3487. Available online: www.efsa.europa.eu/efsajournal

- EFSA PLH Panel (EFSA Panel on Plant Health), 2014. Scientific Opinion on the environmental risk assessment of the apple snail for the EU. EFSA Journal 2014;12(4):3641, 97 pp. doi:10.2903/j.efsa.2014.3641. Available online: www.efsa.europa.eu/efsajournal

- Estebenet AL and Cazzaniga NJ, 1992. Growth and demography of Pomacea canaliculata (Gastropoda: Ampullariidae) under laboratory conditions. Malacological Review, 25, 1–12.

- Estebenet AL and Martín PR, 2002. Workshop: "Biology of Ampullariidae"—Minireview—Pomacea canaliculata (Gastropoda: Ampullariidae): life-history traits and their plasticity. Biocell, 26, 83–89.

- Estebenet AL and Pizani NV, 1999. Elección de pareja, cópula y desove en Pomacea canaliculata (Gastropoda: Ampullariidae). IV Congr Latinoamer Malacol (Resúmenes), Coquimbo, Chile, p. 91.

-

- Halwart M, 1994. The golden apple snail Pomacea canaliculata in Asian rice-farming systems: present impact and future threat. International Journal of Pest Management 40, 199–206.

- Hayes KA, Cowie RH, Thiengo SC and Strong EE, 2012. Comparing apples with apples: clarifying the identities of two highly invasive neotropical Ampullariidae (Caenogastropoda). Zoological Journal of the Linnean Society, 166, 723–753.

- Liu J, He Y, Tan J, Xu C, Zhong L, Wang Z and Liao Q, 2012. Characteristics of Pomacea canaliculata reproduction under natural conditions. Chinese Journal of Applied Ecology, 23, 559–565.

- Oya S, Hirai Y and Miyahara Y, 1987. Overwintering of the apple snail, Pomacea canaliculata Lamarck, in north Kyushu, Japan. Japanese Journal of Applied Entomology and Zoology, 31, 206–212.

- Seuffert ME, Burela S and Martín PR, 2010. Influence of water temperature on the activity of the freshwater snail Pomacea canaliculata (Caenogastropoda: Ampullariidae) at its southernmost limit (Southern Pampasa, Argentina). Journal of Thermal Biology, 35, 77–84.

- Spanish Ministry of Environment and Rural and Marine Affairs, 2011. Pest risk analysis on the introduction of Pomacea insularum (d'Orbigny, 1835) into the EU. April 2011. Unpublished report, Spanish Ministry of Environment and Rural and Marine Affairs , Spain, 45 pp.

- Vanderwalle M, Sykes MT, Harrison PA, Luck GW, Berry P, Bugter R, Dawson TP, Feld CK, Harrington R, Haslet JR, Hering D, Jones KB, Jongman R, Savorel L, Martins de Silva P, Moora M, Paterson J, Rounsevell MDA, Sandin L, Settele J, Sousa JP and Zobel M, 2008. Review paper on concepts of dynamic ecosystems and their services. Rationalising Biodiversity Conservation in Dynamic Ecosystems (RUBICODE) project, 94 pp. Available online: http://www.rubicode.net/rubicode/outputs.html

MoU between CIHEAM and the Center for Mediterranean Integration (CMI)

On June 17, 2015, in Paris, the Secretary General of CIHEAM, Mr. Cosimo Lacirignola, and the Manager of the Center for Mediterranean Integration (CMI), Mr. Mourad Ezzine, signed a Memorandum of Understanding (MoU) in order to undertake joint activities to contribute towards Development, Inclusive Growth and Youth Empowerment in the Mediterranean.

CIHEAM and the CMI encounter each other in Mediterranean research and cooperation, public policy and multilateral fora discussions, publications and activities able to increase debate in the Mediterranean countries and providing regional public goods.

CIHEAM and the CMI stress on the importance of improving the links between knowledge/capacity building and the needs of Mediterranean countries in a very strategic period for the regional development that requires more cooperation and more sustainability.

Therefore, the scope of the cooperation is mainly focused on the following issues: youth empowerment and employment, regional integration, inclusive growth, development of territories, environment and climate change.

CIHEAM and the CMI are firmly convinced about the need to reinforce the inter-institutional dialogue and set up synergic activities to face these important challenges for a safer future in the Mediterranean region.

First detections of honey bee pathogens in nest of the Asian hornet (*Vespa velutina*) collected in France

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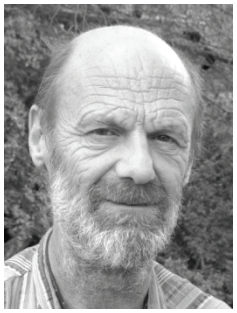
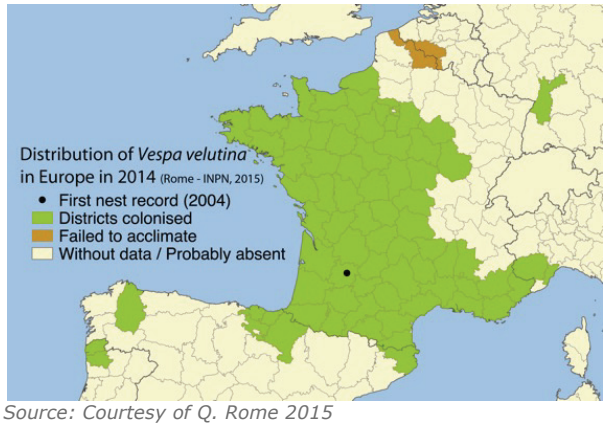


Introduction

In 2004 the Asian hornet *Vespa velutina* L. was accidentally introduced into the South West of France. Although *V. velutina* is found in tropical regions of Asia, it normally inhabits in the cooler highland or upland regions that have a climate comparable to that found in Southern Europe. To date *V. velutina* has spread across much of France and to other countries (consult the French natural history museum website for more information *http://inpn.mnhn.fr/*). This hornet has adapted well to its new environment colonising urban, sub-urban, agricultural and woody areas (Rome et al. 2011). Eradication of the species from Europe is now impossible.

In Asia, *V. velutina* is a predator that often targets on European honey bees (*Apis mellifera* L) and to a lesser extent the Asian honey bee (*Apis cerana*). *V. velutina* workers hover in front of the hive waiting for returning foragers. After catching the honey bee, the *V. velutina* forager removes the head and abdomen of *A. mellifera* and makes a meat ball of the flight muscles which is fed to its larvae back in its nest. If a honey bee colony becomes sufficiently deprived of workers, *V. velutina* will then enter the hive, feed on the honey and on the brood. The first results collected in France have shown that honey bees represent a high proportion of the *V. velutina* prey spectrum (Rome et al. 2011).

Figure 1
Spread of *V. velutina* throughout France and Europe



Source: Courtesy of Q. Rome 2015

Honey bees are affected by a whole range of pathogens: macro parasites, bacteria, fungi and viruses. Many of them are well known and have been studied for several decades. With the development of molecular techniques, viruses affecting honey bees are now better detected and often quantified (Ribière et al. 2008).

V. velutina nests are exposed to honey bee pathogens through feeding on *A. mellifera* workers. In honey bees, the worker (foragers and guards) age class has been proved to be the best carrier age for pathogens of adult bees. Moreover adult honey bees are often infected and carry pathogens, especially viruses attacking brood stages (Ribière et al. 2008).

In this study, we examined the presence of 9 honey bee pathogens in *V. velutina* adults and nests. The presence of replicative RNA forms of 2 viruses (Black queen cell virus – BQCV and Sacbrood virus – SBV) which were detected as well, was also investigated in order to determine whether these viruses could get through heterospecific barriers and replicate in this new host.

Materials and Methods

Nest collection and dissection

Some free flying *V. velutina* workers (Trap 1, Swat 1 and Swat 2) and eight nests (N1 to N8) were collected during the summer of 2008, in the South West of France with the help of Dr Gergouil. Nests were collected at different stages of development and one of them (N8) was badly damaged in the process of collection. During this sampling process, some *Vespa crabro* adults were also collected (Cra 1). All samples (whole nests and individual adults) were immediately frozen after collection and sent to the ANSES laboratory in Sophia-Antipolis (France).

All eight nests were measured and dissected in the laboratory. For each nest, aliquots of adults, nymphs and larvae were collected when available for subsequent analysis. On one occasion in N8, meconium (i.e. a black substance located on the bottom of each cell corresponding to faeces and old mounts) was also sampled. Larvae were classified as "healthy-like" or "diseased-like" using phenotypic characteristics (Fig. 2). Healthy larvae had a shiny, creamy colour, while diseased larvae exhibited wrinkled body shapes and darker colours ranging from dark pink to black.

Figure 2
Larvae of V. velutina, classified as healthy-like (b) and diseased-like (a and c), collected from seven nests in the South West of France

Detection of A. woodi and spores of Nosema spp.

Each adult hornet sample was subjected to the systematic detection of the honey bee tracheal mite *Acarapis woodi* (Acari: Tarsonemidae) and the presence of *Nosema* spp. spores (Fungi: Microsporidae). *A. woodi* mites were screened for according to approved OIE methods on thoraxes of 5 hornets. Muscle fibers were dissolved by adding lactic acid. For *Nosema* spp. spore detection, the abdomens of the same 5 hornets were triturated in water, centrifuged and the pellets re-suspended in water. The parasitic mite *Varroa destructor* could not be found in any of these *V. velutina* nests.

Molecular diagnostics

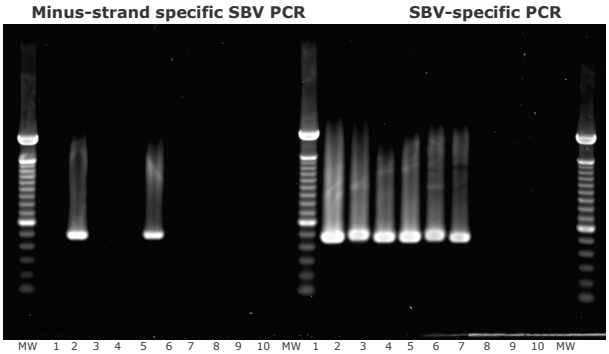
Sample preparation, RNA extraction and cDNA synthesis were performed as described previously (Blanchard et al. 2007). Molecular diagnosis (CBPV, ABPV, IAPV, DWV, SBV and BQCV) was performed by RT-qPCR (for CBPV) or RT-PCR (for other viruses), using primers pairs described previously.

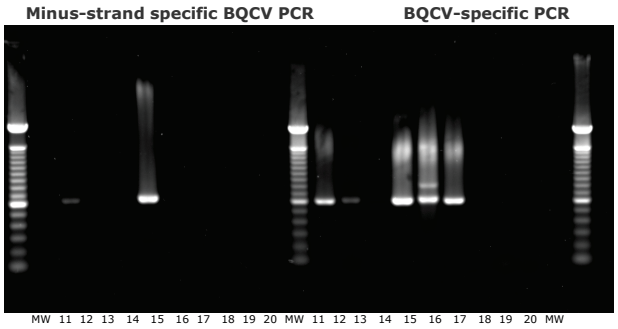
Detection of the replicative RNA forms of BQCV and SBV

To evaluate the ability of SBV and BQCV to replicate in Asian hornets, we developed a specific RT-PCR assay to assess the presence of minus-strand RNA, which is indicative of virus replication. First strand cDNA was synthesized from the extracted RNA described above. This primer consisted of a tag unrelated to SBV or BQCV (lower-case) coupled to a specific primer of SBV or BQCV (upper-case) (Fig. 3). A positive SBV and BQCV bee sample was added to confirm the efficacy of the minus-strand reverse transcription. The reverse transcription was performed as described by Ribiere et al in 2002. A minus-strand-specific PCR according to the virus sought was then performed using a forward primer corresponding to the tag sequence (Tag1) with either another SBV-specific oligonucleotide as the reverse primer (SBV2), or another BQCV-specific oligonucleotide as the reverse primer (BQCV4) (Fig. 3,. The specificity of these PCRs was checked by analysing the cDNAs obtained with random primers which gave a negative result (Fig. 3 lanes 1, 4, 11 and 14 for Minus-strand specific viruses PCR). At the same time, a control virus-specific PCR, using the primers described, was performed on these random cDNAs and gave a positive result (Fig. 3 lanes 1, 4, 11 and 14 for viruses-specific PCR).

Figure 3

Visualisation of the PCR products obtained with minus-strand specific SBV or BQCV PCR, amplifying PCR fragments of 490 bp or 627 bp respectively, and with SBV or BQCV-specific PCR, amplifying PCR fragments of 469 bp or 606 bp respectively. Lane MW: 100 bp DNA ladder (Invitrogen)





Lanes 1 to 20: see table below

Lanes 1 and 11	A. mellifera sample RT Random primers
Lanes 2 and 12	A. mellifera sample RT ms SBV/ ms BQCV
Lanes 3 and 13	A. mellifera sample RT without random primers
Lanes 4 and 14	V. velutina sample RT Random primers
Lanes 5 and 15	V. velutina sample RT ms SBV / ms BQCV
Lanes 6 and 16	V.velutina sample without random primers
Lanes 7 and 17	Negative control RT Random primers
Lanes 8 and 18	Negative control RT SBV ms
Lanes 9 and 19	Negative control RT without random
Lanes 10 and 20	Negative control PCR

Results

All nests received were relatively small, with the exception of N8, which could not be measured with accuracy although it size was bigger than the others. Wasp populations recorded in all 7 nests were variable depending on the development stage and the conditions of capture. One nest (N4) was very small. Eggs were found in 4 nests. Nymphs and larvae were numerous in all nests. Conversely, adult wasps were not found in high numbers in any of the nests, with the exception of N5. This is probably due to the method of collecting the nests.

Honey bee pathogen detection

Nosema spores and acari (*A. woodi* and *V. destructor*) were not detected in any of the adult wasp samples (n=9). SBV, BQCV and DWV were the three the most frequently found viruses in adults and larvae. CBPV and ABPV were only detected once in the same sample of adult wasp collected with the trap, and in one sample of diseased-like larvae, collected from N7. IAPV was not detected in any of the samples. None of the viruses were detected in nymphs with the exception of DWV, which was identified in 3 samples. Surprisingly, viruses (SBV, BQCV and DWV) were also detected in meconia.

In the only sample of *V. crabro* obtained, the SBV, BQCV and DWV viruses were all detected.

The appearance of the diseased *V. velutina* larvae (Fig. 2) clearly reminded some symptoms of SBV and BQCV diseases in honey bee larvae: larvae failing to pupate and changing from its usual pearly white colour to pale yellow, becoming finally dark brown from the anterior end. Contrary to sacbrood diseased honey bee larvae, the *V. velutina* larvae do not present accumulation of fluid between their body and its unshed skin, forming a sac. The replicative forms of the SBV and BQCV viruses were detected in adults and larvae of *V. velutina* independently of their appearance (diseased-like or healthy-like).

Discussion

Honey bee pathogens in V. Velutina

These results convincingly demonstrate the detection of SBV, BQCV and DWV in *V. velutina* adults, larvae and nymphs. CBPV and ABPV were also detected but to a lesser extent. It was also found that at least two of the honey bee viruses (SBV and CBPV) were able to replicate in *V. velutina* (RNA detected). The detection of the replicative form did not correlate with the diseased-like aspect of the larvae. Indeed, the replicative RNA form was detected in adults and larvae independently of their appearance.

Honey bee viruses, like other honey bee pathogens, generally persist as unapparent infection. Outbreaks of clinical infections in honey bee colonies are characterized, depending on the virus, by the occurrence of morphologically abnormal bees or brood and modified behaviours. There are two main transmission routes for honey bee viruses: vertical and horizontal transmission between bees but also vectorisation through *V. destructor*. Some of the viruses (DWV, ABPV) operate in synergy with the parasitic mite *V. destructor*, which acts as an inducer and vector of the virus. For SBV, the disease was transmitted experimentally to honey bee larvae of all ages by contaminating their food with the virus, with 2-day old larvae being the most susceptible. Although primarily a disease of larvae, SBV multiplies in adult bees without inducing obvious symptoms.

For SBV and BQCV, oral transmission from adults to larvae is thought to propagate through infection. Transmission between adult honey bees is thought to propagate through unapparent and persistent infections. Moreover, a study using molecular detection techniques to investigate BQCV in 10 individual queens and their offspring has indicated that BQCV may be transmitted vertically. Since the oral route is the most likely route of transmission in our study (no *V. destructor* were observed in any of the nests), our results have shown that numerous honey bee viruses can be transferred from one species to another merely by eating contaminated prey. Whether honey bee viruses also occur in *V. velutina* populations without close contact with infected honey bees is not presently known. So far, honey bee viruses have been considered as pathogens with high host specificity, although few studies have yet demonstrated the presence of honey bee viruses in other hosts. More work should be conducted on wild fauna in order to determine whether other insects could act as reservoirs for honey bee viruses and other pathogens. These alternative hosts could also play a role in honey bee pathogen dissemination. It is necessary to conduct more studies on honey bee virus detection and replication in alternative hosts, correlated or not with abnormalities.

Defence of honey bees against *V. velutina*

In Asia, the Eastern honey bee *Apis cerana* has developed two defensive behaviours against predation by hornets. Firstly, when a hornet starts hawking in front of the colony, the honey bee workers move out onto the surface of the hive and start performing "Mexican waves" by shimmering their wings in unison. This behaviour warns returning forgers that a hawking hornet is in the area and foraging often stops until the hornet has left. Secondly if a hornet attempts to enter a honey bee colony, the bees attack the hornet by enclosing it in a ball of vibrating honey bees and proceed to kill the hornet by raising the temperature at the centre of the ball to 45°C. These behaviours are relatively effective, as *A. cerana* colonies are less affected by *V. velutina* workers than European honey bee (*A. mellifera*) colonies that lack both behaviours. In Asia, European honey bees can form balls but these are much less efficient at killing the hornet than those of *A. cerana*. To date there have been no reports, in France, of heat-balling nor shimmering behaviours towards *V. velutina* in European honey bees.

At the moment in France, beekeepers are being encouraged to use traps with various kinds of baits in order to capture *V. velutina* foundress queens early in the season or foragers during the summer. These traps are not specific to the Asian hornets, and many others insects are killed (Rome 2011). These means of control are highly discussed and could have a significant negative impact on biodiversity (Monceau et al. 2012). The development of efficient trapping strategies with specific baits remained to be achieved although some pioneer work has been started (Couto et al. 2014). *V. velutina* is the first invasive species to have received significant media attention in Europe, probably because its preferred prey, the honeybee, is a symbol of biodiversity and because many people are afraid of wasps and hornets (Monceau et al. 2013).

In India, control strategies such as killing hornet queens in early spring, destroying hornet nests and swatting hornets at the hives entrances have been advocated, but none of these were reported to be effective. Indeed, in France similar methods have been tried with similar results.

In our study, the replicative RNA form of SBV and BQCV were identified independently from the phenotypic aspect of the larvae. This finding has to be further studied in order to confirm that the multiplication of these viruses has no visible effects on larvae, nymphs or adults of *V. velutina*. Quantitative analysis of the SBV and BQCV virus loads should be performed to investigate this hypothesis. Inapparent effects such as reducing the life span or fitness of the queens or males should also be studied. In this study, only eight nests were dissected at various developmental stages. It should be further monitored whether nests with a reduced size host honey bee viruses and their respective replicative forms and viruses loads more frequently compared with normally developed nests. More work has to be done with a larger number of *V. velutina* nests in order to better assess the potential pathogenicity of our findings to the Asian hornets.

The National Museum of Natural history has produced a leaflet to help *V. velutina* identification. The European reference laboratory for honeybee health together with the National Museum have translated the document that is currently available in 8 languages (*https://sites.anses.fr/en/minisite/abeilles/eurl-honey-bee-health*).

Conclusions and outlook

We have demonstrated that some honey bee viruses were present and reproduced in Asian hornet nests. Whether these viruses are pathogenic for *V. velutina* remains to be studied.

V. velutina is now a well-established introduced hornet species in Europe and eradication is not possible. So far other countries such as New Zealand, Australia and Hawaii, that have been invaded by wasps have failed to control their populations despite many attempts. These have included the introduction of parasitic nematodes, poison baits and entomopathogenic fungi. Following the example of other insects introduced in Europe e.g. *Encarcia sp.* and Chrisomelidae beetles, it is highly likely that *V. velutina* will continue to spread further east in France and across Europe, and even into Northern Africa. Our findings might contribute some knowledge that could be used to control this recently introduced predator.

Acknowledgements

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Bibliography / More information

- Blanchard, P., Olivier, V., Iscache, A.L., Celle, O., Schurr, F., Lallemand, P., and Ribiere, M. (2007). Improvement of RT-PCR detection of chronic bee paralysis virus (CBPV) required by the description of genomic variability in French CBPV isolates. J Invertebr.Pathol.

- Couto, A., Monceau, K., Bonnard, O., Thiery, D., and Sandoz, J.C. (2014). Olfactory attraction of the hornet *Vespa velutina* to honeybee colony odors and pheromones. PLoS.One. 9, e115943.

- Monceau, K., Bonnard, O., and Thiéry, D. (2012). Chasing the queens of the alien predator of honeybees: A water drop in the invasiveness ocean. Open Journal of Ecology 2, 183-191.

- Monceau, K., Bonnard, O., and Thiéry, D. (2013). Vespa velutina: a new invasive predator of honeybees in Europe. Journal of Pest Science.

- Ribière, M., B. Ball, and M. Aubert. 2008. Natural history and geographical distribution of honey bee viruses. Pages 15-84 in M. Aubert, B. Ball, I. Fries, R. Moritz, N. Milani, and I. Bernardinelli editors. Virology and the honey bee. European commission, Bruxelles.

- Rome, Q., Perrard, A., Muller, F., and Villemant, C. (2011). Monitoring and control modalities of a honeybee predator, the yellow-legged hornet *Vespa velutina nigrithorax* (Hymenoptera: Vespidae). Aliens 31, 7-15

- CBPV: chronic bee paralysis virus; ABPV: acute bee paralysis virus, IAPV: Israelis acute bee paralysis virus; DWV: deformed wing virus; SBV: sacbrrod virus; BQCV; black queen cell virus; RT-qPCR: quantitative reverse transcriptase polymerisation chain reaction.

Les plantes invasives : un ajustement du vivant à notre monde

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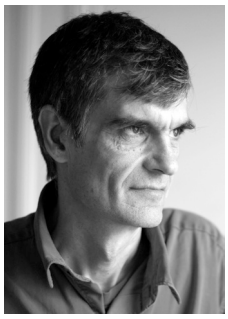

Introduction

Une population végétale dispose de trois manières de faire face à un changement des conditions environnementales. Elle peut (i) rester en place, en s'adaptant via des processus micro-évolutifs, ou bien se déplacer (ii) dans l'espace à la faveur de la dispersion de ses semences, (iii) ou dans le temps en tirant parti d'une dormance éventuelle des graines. Dans tous les cas, il s'agit de s'ajuster à une modification des conditions d'accès aux ressources trophiques. Les plantes suivent ainsi la course du monde, se mêlent et recomposent leurs assortiments, foisonnent. Elles sont assurément vivantes, jamais statiques, et leur dynamique généralement nous émerveille.

Pourtant, et de manière curieuse, une catégorie de plantes échappe à cet émerveillement et échappent même à nos valeurs, au point qu'il est recommandé par des scientifiques ou des associations de naturalistes de les détruire par arrachage manuel ou mécanique, par emploi d'herbicides, ou par brûlage localisé. Cela sans que, semble-t-il, il n'y ait lieu de s'interroger sur la légitimité d'un tel écart éthique concédant une valeur à certaines plantes, la retirant à d'autres. La légitimité d'une telle séparation reste pourtant très simple : lorsqu'on les rencontre dans la nature, les plantes indigènes sont bonnes, et les étrangères[1] y sont mauvaises.

Certes, certaines plantes étrangères, appelons-les dans ce cas *invasives*, peuvent affecter des productions agricoles, dévaloriser des pâtures, s'avérer allergènes pour l'homme ou lui causer des piqûres ou des brûlures, obstruer des voies de navigation. Dans chacune de ces situations, le bien-être humain est menacé, et il est légitime de contrôler ces populations végétales indésirables. Mais qu'en est-il pour des plantes dont on pressent qu'elles sont néfastes non plus pour l'homme mais à l'égard de l'environnement, dans des espaces dits sauvages, naturels ou semi-naturels ? Comment prendre alors la voix de la Nature pour exprimer une nuisance dont elle ne dit rien, mais que nous tentons de lire, sinon d'imaginer sur ses lèvres à grand renfort de prétention ? Comment ne pas immanquablement, en l'absence de réponse, adopter en réalité le seul point de vue de l'observateur, en référence à son propre référentiel culturel ?

C'est ainsi que s'est élaboré un discours général usurpatoire, résolument discriminatoire, bien moins fondé sur des arguments objectifs que prolongeant notre regard chargé d'émotions premières. Notre *perception* a lentement tiré la *réalité* vers elle, au point de confondre l'une et l'autre. Cela vaut la peine de s'y arrêter quelques instants.

Amalgames et métaphores et, ou comment apprendre à déconsidérer les plantes dites *invasives*

Les formes de discours employées à l'égard des plantes invasives sont rarement bienveillantes. Le terme même d'*invasives*, fortement connoté, infléchit nécessairement notre pensée. Comment une invasion pourrait-elle en effet être favorablement perçue ? Or, mal nommer les choses, disait Albert Camus, c'est ajouter au malheur du monde. Hélas, la manière dont nous parlons des espèces invasives en général est loin d'induire de la clarté.

Les amalgames vont bon train. On déverse pêle-mêle dans les médias des exemples d'espèces invasives animales et végétales, en milieu insulaire ou continental, impactant directement l'économie humaine ou accompagnant un changement environnemental. Les pires pathogènes avoisinent des espèces galopantes mais inoffensives ; les exemples des méfaits des prédateurs introduits dans les îles sont mis en avant pour justifier le contrôle d'espèces dites compétitrices, etc. Il serait vain de dresser un inventaire de ces amalgames, ou même d'en imaginer une typologie. Leur raison commune est une méconnaissance de la complexité et de la diversité des situations ainsi évoquées, qu'entretiennent une absence de recul et une emprise récurrente du registre émotionnel.

La situation est telle qu'il faut aujourd'hui démêler l'écheveau, dénouer des nœuds absurdes, mettre en évidence des contre-vérités. Ainsi, il est flagrant que dans l'esprit de chacun, une espèce invasive prend la place d'une autre. La représentation de la nature selon un jeu de chaises musicales, certes satisfaisante pour l'esprit, doit beaucoup au modèle biogéographique insulaire de MacArthur et Wilson (1967) – que l'on sait aujourd'hui erroné – laissant entendre que les immigrations étaient compensées par des extinctions.

[1] Si l'on se réfère à son étymologie latine *exoticus*, le terme *exotique* n'a en effet d'autre sens que celui d'étranger.

Partant, les plantes invasives sont accusées de réduire la biodiversité alors qu'aux échelles tangibles, voire régionales, c'est bien l'effet contraire qui est observé. D'une part, aucune extinction n'est imputable à un plante invasive, y compris dans les îles. D'autre part, la flore exotique qui s'est naturalisée dans les îles et qui y a parfois pris ses aises a non seulement accru le nombre d'espèces végétales en présence[2], mais a parfois aussi amélioré le fonctionnement des écosystèmes, comme cela a été par exemple établi à Porto Rico ou à Hawaï (Lugo, 2004).

Le choix des mots et tout particulièrement la surabondance de métaphores, symptomatique en soi d'un sujet mal compris, brouille encore davantage la perception que l'on peut avoir des plantes invasives. Le registre de la peur y est sous-jacent, sur un mode tantôt guerrier, tantôt fantasmatique, tantôt médical. L'apogée est atteinte avec le terme de « cancer » parfois rapproché des invasions végétales. Dans un hebdomadaire de Mayotte[3], on lisait récemment, de la bouche d'un expert, que les plantes invasives étaient comparables au cancer et qu'il fallait donc les détecter en amont pour vaincre le mal. Une métaphore aussi anxiogène est très efficace, et pourrait-on dire, séduisante, aussi indélicate soit-elle. Le miconia (*Miconia calvescens*) a lui-même été rebaptisé localement « cancer vert », et ce terme a été repris sur le site officiel de la Convention sur la Diversité Biologique[4]. Mais au-delà de l'usurpation intellectuelle que l'usage d'une telle métaphore représente, on ne peut que regretter ce renvoi en creux à une perception « organismique » de la nature, désormais affublé d'une santé comme s'il s'agissait d'un organisme vivant. Or, la nature, ou même un écosystème, n'ont ni gènes, ni mémoire, et ne sont d'ailleurs des systèmes que dans notre représentation mentale. Les désigner comme des organismes, c'est rendre compte non pas des avancées de l'écologie scientifique, mais de fantasmes sur le monde vivant. Le choix des métaphores avec lesquels on désigne les plantes invasives est donc loin d'être neutre, et plus encore d'être objectivement fondé. Quoiqu'il en soit, ce registre des « agressions verbales », comme le dénonçait René Squarzoni, Président du Conseil scientifique du Parc national de La Réunion[5], dessert notre vision des plantes invasives.

Plus préoccupant encore est le fait que les plantes invasives sont prisonnières de dogmes. D'une part, elles ne font pas partie des plantes indigènes, implicitement considérées comme bonnes. D'autre part, elles participent de changements au sein des écosystèmes, et sont dès lors observées d'un très mauvais œil. Le botaniste anglais John Steven Henslow avait en 1835 enfoncé un premier coin, séparant les indigènes des exotiques, même s'il n'avait manifestement rien à reprocher aux secondes.

Mais le philosophe et naturaliste américain Aldo Leopold (1948) concourut à forcer le trait, avec l'affirmation suivante « une chose est juste lorsqu'elle tend à préserver l'intégrité, la stabilité et la beauté de la communauté biotique, elle est injuste quand elle tend à l'inverse ». Or, l'intégrité n'est rien d'autre, selon Paul Angermeier[6], que la « diversité historique des populations d'espèces et de leurs effectifs interagissant au sein de communautés biotiques structurées ». Il faut donc immédiatement déduire des propos de Leopold que les espèces exotiques altèrent l'intégrité des communautés biotiques et, ce faisant, si l'on reprend son vocabulaire, ne sont pas « justes ». Mais cela ne s'arrête pas là et un troisième coup est assené par le zoologue britannique Charles Elton, ami d'Aldo Leopold, qui publie en 1958 *The Ecology of Invasions by Animals and Plants* et pourfend les espèces invasives, qu'il assimile dès le premier paragraphe à des bombes silencieuses.

À l'origine des invasions végétales

Un historique des formes d'introduction d'espèces végétales par l'homme serait ici fastidieux. Tout au plus peut-on rappeler que celles-ci ont certainement suivi de très près les activités humaines, les transports d'objets, le rayonnement progressif de sa culture… puis de l'agriculture, première grande pourvoyeuse d'introduction de plantes dont les semences se mêlaient à celles des plantes cultivées. Il n'est pas davantage besoin de rappeler combien les premières grandes navigations, d'abord polynésiennes, puis européennes, et l'explosion des transports au lendemain de la Seconde Guerre mondiale, ont considérablement multiplié les introductions d'espèces végétales, et donc les invasions qui en ont parfois résulté. Environ un quart des plantes à fleurs ont été déplacées par l'homme dans le monde.

De manière moindre, des plantes indigènes à caractère invasif se sont dispersées par leurs propres moyens, tirant parti de changements environnementaux opérés par l'homme. Ainsi, la fougère aigle (*Pteridium aquilinum*), aux spores très légères et susceptibles d'accomplir de très longs voyages, portées haut dans les airs, est devenue aujourd'hui pantropicale et occupe préférentiellement les espaces post-forestiers qui ont été parcourus par des incendies. Cet exemple rappelle en outre que l'introduction, assistée par l'homme ou naturellement réalisée, n'est qu'un élément préalable à une invasion végétale. C'est en effet le plus souvent les perturbations du milieu qui constituent les véritables moteurs des invasions végétales. Là encore, les exemples ne manquent pas mais, certains sont plus informatifs que d'autres. La jussie (*Ludwigia grandifolia*) en est un. Cette plante, il est vrai envahissante, au point que dans le sud-est et sur la façade atlantique de la France, elle obture parfois des canaux et peut s'étendre sur de larges parties d'étendues d'eau, fait l'objet d'opérations récurrentes de nettoyage par faucardage, ou par arrachage à l'aide de pelles mécaniques.

[2] En Nouvelle-Zélande par exemple, il y a aujourd'hui à peu près autant de plantes introduites naturalisées (2065 espèces) que de plantes indigènes (2014).
[3] Mayotte Hebdo n° 497, vendredi 12 octobre 2010, p. 10.
[4] https://www.cbd.int/idb/2009/about/examples/?id=1600&returnurl=%2Fidb%2F2009%2Fabout%2Fexamples%2F
[5] Le Journal de l'île de La Réunion, publié le 7 juin 2010.

[6] Écologue, professeur au Collège des Ressources Naturelles et de l'Environnement, au sein de l'Université de Virginie.

C'est saisir un problème par l'aval, en traitant le symptôme plutôt que la cause, puisque la jussie prolifère dans les sites où les ressources trophiques abondent anormalement, ce qui est le cas pour des eaux chargées d'effluents agricoles, notamment de phosphates, éléments naturellement peu abondants et limitants. Aussi arrive-t-il que les eaux « contaminées par la jussie » soient traitées pour les décharger en phosphore, plutôt que d'intervenir à la source et d'en réduire les apports. Il ne s'agit pas ici de pointer du doigt les agriculteurs, dont les pratiques sont aujourd'hui guidées davantage par les décideurs (et les consommateurs) que par eux-mêmes, mais de pointer une incohérence illustrant à quel point la posture choisie pour lutter en aval contre la jussie est à la fois illusoire et vouée à se pérenniser, en dépit des coûts qu'elle sous-tend. Une remarquable illustration est fournie par l'actualité récente du Canal de la Crau, en France. Des tonnes de jussie y ont été extirpées par des engins mécaniques et rejetées sur les berges. Or, leur décomposition achevée, celles-ci ont laissé derrière elles des tas d'immondices, prélevés en même temps, et qui rendent parfaitement compte du type de milieu profondément dégradé sur lequel elles ont proliféré…Les jussies ne sont responsables ni de l'eutrophisation des eaux par les apports de phosphates, ni de l'abondance des déchets dans les cours d'eau. Et pourtant, ce sont elles qui concentrent les regards.

L'exemple de la jacinthe (*Eichhornia crassipes*) d'eau vient quant à lui illustrer l'incohérence des points de vue sur une plante qui est utilisée aujourd'hui dans des bassins de rétention pour purifier l'eau, notamment dans les territoires français d'outre-mer en situation tropicale, mais qui est considérée comme néfaste dans des cours d'eau où sa présence est pourtant liée à une eutrophisation des eaux… dont elle participe à l'épuration. Ne pas évoquer cette part de l'invasion de la jacinthe d'eau pose question sur l'authenticité et la transparence avec laquelle nous déployons notre discours à son encontre. Mais il est vrai, comme nous allons le voir maintenant, qu'il est bien rare que l'on fasse état des vertus de plantes qu'on ne cesse au contraire de considérer comme responsables de maux dont elles ne sont pourtant pas à l'origine.

Les plantes invasives dans un monde en changement

On comprend de ce qui précède que s'en tenir à des principes, y compris de précaution, ou à des postures dogmatiques, reste peu satisfaisant. Il importe plus pertinemment d'évaluer froidement ce que sont les invasions végétales au sein d'un monde qui ressemble de moins en moins à ce que, dans les sociétés occidentales, l'on croyait encore récemment régi par un « ordre éternel ». L'essentiel est d'apprécier l'impact des plantes invasives sur les habitats qu'elles investissent. Mais une première difficulté est de sérier ce qu'il faut observer et comment procéder lorsqu'il s'agit d'un impact environnemental.

Un « torrent de questionnements » s'inscrit dans le sillage d'une telle réflexion. Quelles composantes de l'impact faut-il en effet privilégier, et comment ne pas tomber ici dans le piège de notre regard, à la fois miroir déformant et filtre de la réalité ? Comment évaluer si un changement dans l'environnement est « néfaste » ou « bon » ? À quel niveau d'interaction entre espèces faut-il se placer, sachant que des conséquences indirectes peuvent se manifester, souvent de manière inattendue ? À quelle(s) échelle(s) d'espace, mais aussi de temps, est-il judicieux et légitime de se positionner ? Et, disions-nous plus haut, lorsqu'il s'agit d'impact environnemental, comment parler à la place de cette Nature qui reste aussi désespérément silencieuse ?... En réalité, en dehors des milieux insulaires, l'évaluation de l'impact des plantes invasives et la justification d'interventions visant à contrôler leur extension demeurent souvent infondées et hasardeuses.

Qui plus est, comment penser cet impact non plus en référence à un modèle statique mais dans une dynamique recouvrant un faisceau de trajectoires possibles, mais aussi de l'incertitude ? Comment ne pas risquer d'endosser un costume d'apprenti-sorcier ? Notre regard sur les invasions biologiques est empreint de notre myopie et de notre incapacité à penser le vivant en devenir : s'ils sont aptes à prédire la course des astres les plus lointains dans mille ans, les modèles mécanistes qui structurent la biologie actuelle ne peuvent prédire le devenir d'un écosystème, même simple, et même à un horizon très court. Nous nous contentons plutôt, les réflexes médiatiques aidant, du « temps bref de la chronique[7] ». D'une vague qui passe, nous n'en scrutons que la crête, mais ne nous interrogeons pas sur son origine et son devenir. La caulerpe (*Caulerpa taxifolia*), évoquée plus haut, montre combien il est absurde de ne s'intéresser qu'au pic d'une invasion biologique.

De manière similaire, il est grotesque de ne porter le regard que sur les aspects « négatifs[8] » d'une invasion biologique, et d'en ignorer les conséquences « positives ». Selon quels sortilèges improbables, sinon par une vision réductrice de notre part, une plante invasive pourrait-elle ne présenter que des effets « négatifs » sur l'environnement ? Certes, les publications scientifiques faisant état d'effets « positifs » des espèces invasives restent rares, d'une part parce qu'elles relèvent d'études difficiles à financer, d'autre part parce que les relecteurs, le plus souvent, n'aiment guère que l'on dise du bien d'espèces dont ils pensent le plus grand mal… Ainsi, les publications faisant état d'effets « positifs » des espèces invasives sont 40 fois moins fréquentes que celles qui décrivent ou reportent des effets « négatifs ». Ce dont on ne saurait en déduire, bien entendu, que les effets « négatifs » des espèces invasives *sont* 40 fois plus élevés que leurs effets « positifs ».

[7] Cette expression est empruntée au sociologue Raphaël Larrère.

[8] Les termes « négatif » et « positif » sont ici utilisés par commodité de langage, pour faciliter la compréhension du texte. Ils n'ont pour autant aucune valeur objective et ne peuvent en réalité que brouiller le discours et la perception que l'on peut avoir des plantes invasives.

Et pourtant, de grands spécialistes des invasions biologiques ne craignent pas d'entretenir ce type de confusion (Simberloff *et al.*, 2012). En réalité, les exemples de tels effets « positifs » abondent, et certaines plantes invasives que l'on combattait encore récemment sont aujourd'hui laissées en place lorsque les gestionnaires réalisent combien elles concourent à la sauvegarde d'espèces en danger. Dans le Queensland australien, l'arbuste *Lantana camara* est aujourd'hui considéré comme une espèce clef-de-voûte dans certains habitats où la survie de certains oiseaux frugivores dépend désormais du devenir de cette plante invasive qui produit des baies en abondance et sur une grande partie de l'année.

Au-delà de ce qui précède, il apparaît surprenant que l'on puisse considérer qu'une espèce n'est pas « à sa place ». Cette expression est pourtant fréquemment utilisée pour penser les réagencements d'espèces autour de nous. Comment serait-ce possible qu'une espèce ne soit pas « à sa place » ? Que cela pourrait-il signifier, hormis le fait que nous ne lui avons pas accordé de place dans notre propre représentation du monde ? Y aurait-il une place *légitime* pour certaines espèces, et une place *usurpée* pour d'autres, coupables de transgression géographique, mais aussi de transgression morale puisque nous sommes ici sur le terrain des valeurs ? Les espèces indigènes bénéficieraient-elles d'un droit de présence à jamais hors d'atteinte des espèces introduites ? Et faut-il donc que les naturalistes se coiffent d'un képi et assurent un absurde *maintien de l'ordre* ? Comment ne pas voir ici un parallèle avec la manière dont nous envisageons les migrations humaines ? C'est que penser les espèces invasives, c'est avant tout penser l'Homme.

Vers un regard et une gestion contextualisée

Toute invasion végétale intervient dans un contexte. Elle n'est pas une bulle détachée de son milieu, échappant aux processus écologiques, non « interagissante », et qu'il suffirait de crever pour qu'un habitat passé retrouve sa place et sa forme originelle. D'une part, la vie ne remonte jamais le temps. D'autre part, toute espèce insérée dans un nouvel habitat entre immédiatement en interaction avec les autres espèces. Crever des chapelets de bulles comme on crèverait les symptômes d'une maladie ne résout rien si la cause n'est pas traitée. Penser les plantes invasives de manière décontextualisée conduit nécessairement à des erreurs liées à des défauts d'appréciation. Ils ne sont pas rares, les exemples où des invasions de plantes ont été déclenchées par des décideurs considérant que l'éradication d'une espèce animale invasive ne pouvait être que bénéfique. L'Ile d'Amsterdam, dans les Kerguelen, est ainsi aujourd'hui soumise à la prolifération d'une herbacée exotique qui a bénéficié de l'éradication du mouflon, espèce introduite qui en assurait la régulation.

On peut aussi s'interroger sur ces chantiers d'arrachage orchestrés par des responsables d'associations naturalistes en quête d'actions collectives. Les bénévoles alors mobilisés, croyant faire bonne œuvre de leurs efforts et du temps mis à disposition, n'ont alors connaissance que d'une présentation simplifiée de l'espèce à combattre. L'argumentaire écologique justifiant de telles actions reste succinct, essentiellement fondé sur une posture visant à « conserver » un habitat, et sans accorder de réflexion suffisante sur ce que la *conservation* signifie dans un monde en plein changement. En de telles situations, le volontaire retourne chez lui satisfait d'avoir fait œuvre de dépollution. Lorsqu'il s'agit par exemple de la jussie, évoquée plus haut, dont on sait que le développement est précisément induit par la pollution, on peut s'interroger sur le sens de telles actions et sur leur caractère didactique à l'égard des bénévoles mobilisés. Participer à des chantiers d'arrachage n'est en outre pas anodin du point de vue de la sensibilisation à la nature lorsqu'il s'agit de prôner la destruction du vivant. Cela représente une forme d'*écart éthique* implicite, de sorte que les orchestrateurs de tels chantiers irriguent une nouvelle morale environnementale, sorte de « patriot act » qui autorise des écarts aux valeurs de la société, mais dont on se demande sur quels fondements légitimes elle s'appuie.

Cet écart éthique est particulièrement patent lorsqu'il s'agit de recourir à des pesticides pour contrôler l'extension d'une espèce invasive. De manière surprenante parce que paradoxale, la légitimité de l'usage d'herbicides au sein d'habitats voués à la protection ne semble pas remise en question. Aussi, en Californie par exemple, les deux tiers des gestionnaires d'espaces naturels ont-ils recours à des herbicides pour juguler la prolifération de plantes invasives. Pourtant, le discours environnemental mettant en avant l'impact des pesticides sur la faune et la flore, mais aussi sur notre propre santé, est activement relayé par les naturalistes eux-mêmes ! La seule manière de résoudre un tel paradoxe est donc, de fait, d'autoriser un tel « écart éthique » considérant que toutes les espèces vivantes ne jouissent pas des mêmes droits. Quel effet didactique une telle posture peut-elle avoir sur le grand public ?

Pourquoi ne pas plutôt voir une invasion végétale comme l'expression ultime d'un contexte, d'une série de facteurs situés plus en amont, véritables causes de la situation observée, et dont nous sommes tous, par nos modes de vie et de consommation, les vrais responsables ? Pourquoi ne pas voir plutôt les plantes invasives comme des indicatrices, comme cela est le cas pour les adventices des cultures ? Pourquoi les envisager comme des boucs-émissaires en leur octroyant des responsabilités qu'elles n'ont pas ? Et pourquoi poursuivre sans plus de discernement ce discours invariablement lancinant, positionnant les espèces invasives comme l'une des causes premières de l'érosion de la biodiversité ? D'une part, aucune extinction d'espèce n'a été imputée à une quelconque plante invasive[9].

[9] Les extinctions d'espèces liées aux invasions biologiques ne se produisent que si ces dernières sont représentées par des espèces

D'autre part, les extinctions d'espèces, pour 80 % d'entre elles, se manifestent sur les îles (95 % pour les oiseaux, 90 % pour les reptiles) qui ne représentent elles-mêmes que 3 % des surfaces émergées. Les extinctions sont donc localisées, et c'est heureux. Aussi, brandir la « menace érosive » lorsqu'il s'agit d'évoquer l'impact des plantes invasives dans une région continentale, quelle qu'elle soit, est-il absurde.

Conclusion

Tout discours ou toute posture visant à rejeter ou ostraciser une forme d'altérité vivante méritent d'être considérés avec beaucoup d'attention et de responsabilité. L'actualité méditerranéenne, parsemée de vagues quotidiennes de migrants rejetés des côtes selon un « écart éthique » que bien des nations semblent aujourd'hui s'autoriser, nous invite à reconsidérer notre regard, étrangement similaire, sur les plantes étrangères « dangereusement » mobiles et proliférantes.

Repenser les plantes invasives, les voir comme indicatrices de maux sociétaux, politiques et économiques plus profonds, les envisager comme des formes d'ajustement du vivant à un monde en plein bouleversement, peut-être cela pourrait-il nous aider, en les observant d'un œil davantage bienveillant, à reconsidérer nos semblables *étrangers* de manière résolument positive.

Bibliography / More information

- Elton, C.S., 1958. The ecology of invasions by animals and plants. The University of Chicago Press, Londres, Royaume-Uni.
- Leopold, A. (1948). Almanach d'un comté des sables, trad. fr., Paris, Aubier, 1995
- Lugo, A.E., 2004. The outcome of alien tree invasions in Puerto Rico. Frontiers in Ecology and the Environment 2, 265-273.
- MacArthur, R.H., Wilson, E.O., 1967. The theory of island biogeography. Princeton University Press. Oxford, Royaume-Uni.
- Simberloff, D., Souza, L., Nunez, M.A., Barrios-Garcia, N., Bunn, W., 2012. The native are restless, but not often and mostly when disturbed. Ecology 93, 598-607.

animales, le plus souvent des espèces prédatrices, ou par des organismes pathogènes.

Activities
in the 4 CIHEAM Institutes

News from CIHEAM Bari

Measuring the empowerment of rural women (GEMAISA)

Organized by MAECI-DGCS at Expo Milano, Cascina Triulza on 29 May 2015, the seminar took place at Cascina Triulza in EXPO MILANO and was organized by the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) in the framework of their Expo Calendar.

Following a brief introduction to the main theme of the works by Marco Zupi, Scientific Director at CeSPI (*Centre for International Policy Studies*, Rome), the Seminar consisted in several presentations made by representatives of international organizations including the IFAD, WFP and FAO and from areas of international cooperation.

The new Post-2015 Development Agenda, of which the key elements are the Sustainable Development Goals (SDGs), identifies 17 development goals, supported by target figures which will require ongoing worldwide monitoring. This obliges governments, NGOs and international organizations to comprehensively rethink the methods employed for collecting and processing data.

Main subject of the discussion were the challenges faced by the national statistical systems and how data collection methods could be unified in order to measure the empowerment of women in rural areas, with particular emphasis on programmes and policies, along with the issue on how the theme of gender find its place within the post-2015 agenda currently being finalized.

Particularly useful for this purpose were the presentations made by the keynote speakers of "*lessons learned from experience*" that provided operational guidelines for the practice of measuring the empowerment, from the identification of strengths and weaknesses of various methods, techniques or indicators proposed.

Rosanna Quagliariello presented her contribution speaking about the actions of Bari Institute on gender related programmes, with a particular focus on GEMAISA Project (Enhancing gender mainstreaming for sustainable rural development and food security), NOWARA Observatory in Lebanon, WE-E Project (Developing the hand/crafts skills and enhancing the economic status of women in Upper Egypt), and the collection of Best Practices on Gender within Feeding Knowledge Programme.

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Med Diet Expo 2015: *"Does the Mediterranean Diet Still Exist?"*

The International event "*Med Diet Expo 2015*" was held at EXPO Centre in Milan on May 14, 2015. One of the main outcomes of the event is the launch of the "MED DIET EXPO 2015 CALL: TIME TO ACT" (*http://goo.gl/2jEJ5Q*).

The aim of the CALL is to collect inputs and contributions to develop concrete and innovative actions on the Mediterranean Diet in the Mediterranean area in order to revitalize it as a sustainable dietary pattern and to promote its cultural heritage. In particular, the CALL aims to raise the awareness of citizens and institutions with a twofold objective: to spread the concept of sustainable food systems and diets, and to promote sustainable lifestyles. The ultimate goal of the Call is to activate a participatory interest from the general public of EXPO and a collective engagement in the four clusters identified by the Charter of Milan (i.e. citizens, companies, associations and institutions).

The event included the launch by the International Foundation of the Mediterranean Diet (IFMeD), CIHEAM and the Forum on Mediterranean Food Cultures (FMFC) of the "new" Mediterranean Diet "*Med Diet 4.0*"; an innovative approach to the historic food pyramid, which is updated and redefined through four dimensions: health, culture, environment and economy. "*Med Diet 4.0*" is more than a dietary pattern, it is a contemporary lifestyle.

Knowledge of the "*Med Diet 4.0*" will be disseminated through communication activities for the general public, where each of the four sides of the Mediterranean Diet Pyramid will express a sustainability dimension. In September will be dedicated at Expo a week to the Mediterranean diet and its values. The horizon of the debate is the Charter of Milan, the legacy of Expo Milan 2015. As the Charter is a universal message there was a call to ensure that it also includes the sustainable model of the Mediterranean diet.

The event was organized by CIHEAM, the Italian National Research Council (CNR-Disba), the Italian Agricultural Research Council (CRA), the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and the FMFC in collaboration with IFMeD.

www.meddietexpo2015.com

For more information: capone@iamb.it

News from CIHEAM Chania

LIFE project "Junicoast" selected as one of the Best Life Nature Projects for the year 2014

The European LIFE program entitled "Actions for the protection of coastal dunes with Juniperus spp in Crete and the South Aegean (Greece)" (JUNICOAST) was chosen by the European Commission as one of the thirteen best projects across Europe, cofinanced by the European LIFE program and completed in 2014. The European LIFE program is the principal financial instrument of the European Union (EU) to reinforce the effort of each member - state for nature conservation and protection of Europe's natural environment. The JUNICOAST project belongs to the category of LIFE Nature projects, which focus on the protection and conservation of species and habitats in the framework of implementing EU directives on species and habitats as well as the long-term sustainability of NATURA 2000 areas.

The JUNICOAST program was evaluated among 46 programs in the LIFE Nature category, completed in the European Union in 2014. The evaluation was made by the European Commission and highlighted the 13 best. The award ceremony took place in Brussels on 4 June 2015. It is worth mentioning that the 13 best projects are now competing in the emergence of the three «Best of the Best» LIFE Nature 2014 projects as excellent examples to maintain the biodiversity and the natural environment in terms of their design.

The success of JUNICOAST was mainly due to the actions implemented and the excellent cooperation between the associated entities: CIHEAM-Chania, the National University of Athens - Department of Biology - Department of Botany, the Forest Directorates of Chania and Lassithi. The coordination of the project was conducted by CIHEAM-Chania.

The JUNICOAST project was an innovative effort to protect and preserve the priority habitat of coastal dunes with a rare species of Cedar, and the beautiful habitat of particular importance for the Cretan nature. The program dealt with all areas of Cretan habitat found within the NATURA 2000 network which were located in: Falassarna, Kedrodasos in Elafonissi, Sarakiniko, Agios Ioannis and Lavraka in Gavdos and Hrisi Island in Lasithi.

The primary purpose of the program was to promote and enable the long-term protection and conservation of the habitat of coastal dunes with cedar species in Greece. The specific objectives were: the consolidation and dissemination of knowledge for the protection, restoration, monitoring and evaluation of habitat (i); understanding, identifying and preventing natural and man-made threats which lead to long-term deterioration of the habitat (ii); designing and implementing actions for the long-term protection and restoration of the habitat, and d) providing support for better environmental management in Natura 2000 areas through participation and education stakeholders (iii).

Implementation of the program initially included the recording of the existing situation, the labelling of threats and risks and studying various environmental and social parameters. The protective measures concerning the demarcation of the habitat were then applied: removal of waste, enhancing regeneration of cedar, restoring the composition and structure of flora habitats, stabilizing the front dunes, management of visitors, installation notices, and ex situ conservation and fundamental species.

A large part of the program concerned the information and sensitization of local communities, stakeholders and visitors while considerable effort was made for environmental education in schools with visits to project sites and visits made by schools at CIHEAM Chania, held for 4 consecutive years.

The knowledge gained and practices applied in Crete were transferred to areas of the Southern Aegean with the same type of habitat. For this purpose workshops were organized in Naxos and Rhodes for training relevant stakeholders and to inform and sensitize the residents and students. From the knowledge and experience gained during the program the following key conclusions were arrived at:

- The success for the preservation and protection of nature largely depends on the information and sensitization of visitors, residents and institutions, as people are more willing to accept restrictions or bans when they know the reasons for which they are levied.

- The successful implementation of various protection measures within the Natura 2000 network areas requires the active participation of all those living or working in these areas and all those involved.

- Existing national and European legislation is not considered a problem, but rather the lack of its implementation.

- The management of the natural environment and tourism should not be competing activities but compatible and complementary.

The award for «Best LIFE Nature project» is recognition by the European Commission of the effort made through the JUNICOAST work to protect and preserve our natural heritage. This proves once again that with proper planning and design, love for work and good cooperation, we can be competitive at a European level aiming at protecting and preserving our unique natural environment.

More information on www.junicoast.gr

Photo Contest: Chania, a City for Students

CIHEAM Chania in association with the Municipality of Chania, the Technical University of Crete, the School of Applied Sciences -TEI of Crete and the Centre for Mediterranean Architecture (KAM) organized a Photo Contest entitled "*Chania: A City for Students*". The contest was addressed towards students from all the higher educational institutes based in Chania (Technical University of Crete, School of Applied Sciences-TEI of Crete and Mediterranean Agronomic Institute of Chania).

Through this initiative the students were given the opportunity to express themselves in a creative manner and furthermore, to share their view/aspect on the city they live and study in. The subject of the contest concerned images of minor or major moments of student life in Chania. The approach of the contest's theme was subjective and could be accomplished through any symbolization referring to thoughts, experiences, relationships and feelings that students come across in their daily life. Winning photos along with other entries were featured in the Photo Contest Exhibition in KAM, Grand Arsenal, Chania, from 25 to 30 April 2015.

News from CIHEAM Montpellier

Accréditation française des diplômes Master

La Loi d'avenir pour l'agriculture, votée en France fin 2014, a offert au CIHEAM-Montpellier la possibilité de s'inscrire dans le processus d'accréditation des établissements d'enseignement supérieur français pour délivrer des diplômes nationaux de Master. Le dossier d'accréditation est composé de trois grandes parties qui décrivent la stratégie de l'établissement, l'organisation et la gestion des enseignements, et l'offre de formation.

Première étape : dès janvier 2015 le dossier du CIHEAM-Montpellier a pu être soumis et examiné par le Ministère de l'agriculture et le Ministère de l'enseignement supérieur et de la recherche. La deuxième étape a été, durant les mois d'avril et mai 2015, l'examen du dossier par les experts du Ministère de l'enseignement supérieur et de la recherche. La troisième et dernière étape est l'audition devant deux conseils nationaux, celui de l'Enseignement supérieur et de la recherche agricole, agroalimentaire et vétérinaire et celui de l'Enseignement supérieur et de la recherche (juin 2015).

L'offre de formation présentée à l'accréditation couvre les domaines de compétences du CIHEAM-Montpellier : le développement territorial et l'ingénierie des projets ; la gestion des exploitations agricoles, l'économie des ressources naturelles et les chaînes de valeur agroalimentaires. Elle se décline en quatre parcours de Masters : un parcours organisé par l'Institut seul, deux parcours co-organisés par l'Institut et les Universités de Montpellier, et un parcours co-organisé par l'Institut, l'Université de Montpellier et Montpellier SupAgro. A cette offre en France s'ajoute un cinquième parcours co-organisé par l'Institut et la Faculté d'agronomie de l'Université libanaise, dans le cadre de la stratégie de développement des Masters en partenariat international avec les établissements d'enseignement supérieur en Méditerranée.

A ce jour, ces cinq parcours ont fait l'objet d'avis positifs des experts de la DGESIP (direction générale de l'enseignement supérieur et de l'insertion professionnelle). L'accréditation du CIHEAM-Montpellier à délivrer le diplôme national de Master devrait être effective pour la rentrée 2015-2016.

Démarrage du programme « Création d'emploi dans le sud tunisien »

Le projet proposé par le CIHEAM Montpellier en réponse à l'appel à proposition fait par la Délégation de l'Union européenne en Tunisie a été accepté. Il a officiellement démarré en novembre 2014 et ses premiers résultats sont encourageants. Ce projet se donne comme objectif de contribuer à la création d'emploi dans les secteurs de l'agriculture, des services ruraux et de l'artisanat et de promouvoir la « professionnalisation » de la main d'œuvre agricole. Il est conduit en étroit partenariat avec trois coopératives du Gouvernorat de Médenine qui sont partenaires à part entière dans le pilotage et la conduite du programme. Après six mois d'activités, des premiers résultats laissent augurer d'un bon déroulement du programme.

- Les trois coopératives partenaires s'impliquent activement, de manière autonome et responsable. Ayant joué un rôle décisionnel dans la sélection du premier groupe de jeunes porteurs de projets agricoles (22 candidats sélectionnés), elles se sont chacune engagées dans l'accompagnement et le suivi. Elles ont également accepté de s'impliquer financièrement, en complément à la subvention accordée par le programme (maximum de 30% du coût). Cet apport se fait, soit en numéraire, soit en garantissant un approvisionnement en aliments du bétail à crédit durant une période définie, variable en fonction des projets.
- Trois services manquants dans la région ont été identifiés par les coopératives : un centre de lavage de la laine, une pépinière arboricole et un abattoir cunicole. Un appel d'offre sera publié prochainement pour sélectionner un promoteur en mesure de mettre en œuvre ces idées de projet.
- Un coaching personnalisé a été mis en place par l'équipe de coordination pour accompagner les jeunes candidats sélectionnés dans le développement de leur idée de projet ainsi que dans le montage financier et technique de ces projets et les premières subventions pour la réalisation des projets devraient être débloquées bientôt.
- Concernant le volet "Artisanat", un travail d'identification, d'animation et de dialogue a été conduit par l'équipe de coordination. Il a abouti à la formalisation d'un partenariat entre un commerçant de Djerba et cinq artisanes. Depuis 10 jours elles disposent d'un espace de vente dédié dans un des magasins de ce commerçant. Elles y proposent à la vente certains produits typiques de la région. Les marges de chacun ont été fixé de manière concertée et si cette expérience réussie, elle sera étendue aux quatre autres points de vente du commerçant.

News from CIHEAM Zaragoza

Agricultural Higher Education in the 21st century was discussed at CIHEAM-Zaragoza

The CIHEAM-Zaragoza together with the Union for the Mediterranean (UfM), the Union for the Mediterranean, the Association for European Life Science Universities (ICA), the Global Confederation of Higher Education Associations for Agricultural and Life Sciences (GCHERA), the Centre for Agricultural Research of the Hungarian Academy of Sciences (MTA-ATK) and the with the financial support of the OECD Co-operative Research Programme on Biological Resource Management for Sustainable Agricultural Systems has organized in Zaragoza from 15 to 17 June 2015 the International Conference on "Agricultural Higher Education in the 21st century.

A global challenge in knowledge transfer to meet world demands for food security and sustainability." The goal of this conference was to bring together experts from around the world to carry out a reflection and launch ideas about the growing problems associated with agricultural higher education on a global and local level.

This International Conference has been opened by Dr. Masum Burak, President of the CIHEAM Governing Board. In his speech, he said "*the main topics of your conference are central and crucial when considering the evolution of an Institution like ours that, in partnership with the main regional institutions and beyond, offers 20 Master programmes every year, in an international and multicultural framework as well as a wide array of specialized advanced training activities in fields such as Food production and quality management, Environment and natural resources management, Economics, management and development policies, Fisheries and aquaculture*."

The conference has been attended by more than 80 officials, mainly Rectors, Deans and Directors of Agricultural Colleges and Research Institutions from 27 countries on five continents (Albania, Algeria, Australia, Belgium, Canada, China, Costa Rica, USA, Egypt, Spain, France, Holland, India, Ireland, Israel, Japan, Lebanon, Mexico, Malta, Pakistan, Poland, Portugal, Romania, United Kingdom, Sweden, Tunisia and Turkey).

Throughout these days, discussion focused mainly on:

- Identification of the main challenges of higher agricultural education both globally and locally;
- The changing patterns of education and necessary innovations to be brought in curricula;
- Globalization and Partnerships for International Cooperation.

An issue of *Options Méditerranéennes* will be published with the presentations.

The main outcomes of the Conference will be available on *http://www.iamz.ciheam.org/educagri2015*

Three more CIHEAM Master of Science Degrees officially accredited

The CIHEAM Masters of Science in *integrated planning for rural development and environmental management* and in *Plant Breeding* co-organized with the University of Lleida and the Master in *Animal breeding and reproduction biotechnology* co-organized together with the Polytechnic University of Valencia and the Autonomous University of Barcelona has been positively accredited by the Spanish Quality Assurance authorities. The Plant Breeding MSc has received a quality label, which is not a common distinction.

CIHEAM
International Centre for Advanced Mediterranean Agronomic Studies

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Communication Policy

The Watch Letter is dispatched electronically to more than **20,000 recipients** in the Euro-Mediterranean World (decision makers, ministers, journalists, researchers, students, documentation and research centres, universities, etc.).

Constant efforts are made to ensure a wide variety of contributor profiles in both geographic and professional terms. In the 33 issues published so far, we have published **236 articles** involving **399 authors.**

Contributing to the Watch Letter

We invite persons who have relevant expertise in Agriculture, Food and Rural Development Areas (teachers, researchers, students, decision makers, etc.) and wish to contribute to the Watch Letter to contact us at the following email: abis@ciheam.org

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