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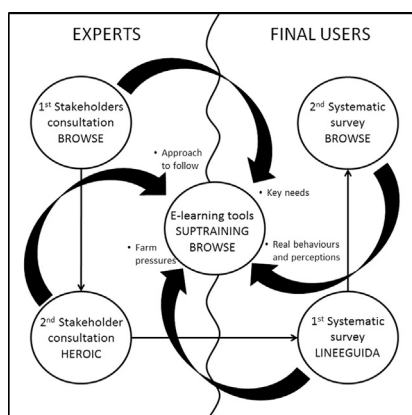
Link practical-oriented research and education: New training tools for a sustainable use of plant protection products

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HIGHLIGHTS

- Operator training plays a key role in achieving the sustainable use of pesticides.
- Outcomes of different European and national research projects were merged together.
- Stakeholders and socio-behavioural factors influencing exposure were considered.
- Two complementary e-learning tools for operator training were developed.
- The work highlights the need of collaboration between educators and researchers.

GRAPHICAL ABSTRACT



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ABSTRACT

In the Horizon 2020 work programme 2016–17 it is stated that in 2010, 71% of European farm managers were operating on the basis of practical experience only. Education levels greatly vary depending on country, farm managers' age and gender, or farm structures, and this can hamper innovation. Transition towards a more sustainable agriculture requires a renewal and strengthening of the technical skills of all the actors involved and – as a consequence – of the educational system. The EU Directive on the sustainable use of pesticides (EU, 128/2009/EC) requires European Member States to develop training activities targeting occupational exposure to pesticides. The objective of this study is to develop new training tools for operators, addressing the new legal requirements and taking into account what is already available. For this reason, the outcomes of different European and national research projects developed by the Opera Research Centre were used, involving stakeholders in the decision making process, but also considering the real behaviours and perceptions of the final users. As a result, an e-learning tool able to build personalized training programmes, by collecting and integrating existing training material on Plant Protection Products use was developed, together with an e-learning course, with the aim to help operators, advisors and distributors to get prepared for their national certificate test. This work highlights the opportunity to create long-term added value through enhanced collaboration between educators and researchers, and identifies a common set of priorities that has to be taken into account in order to nudge the changes required to achieve a more sustainable use of pesticide and, more in general, sustainable development.

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1. Introduction

Over the last 50 years, agriculture has deeply changed. The Green Revolution has contributed significantly to alleviate hunger and poverty. However, the intensification that came with the Green Revolution also had negative social, environmental and economic consequences. Intensification aimed to increase yields through investment in technologies, fertilisers and pesticides. The resulting practices have increased environmental pressure and also has negative effects on human health and well-being (Pingali, 2012).

In addition Plant protection products (PPPs) are used in very complex environments, which are heterogeneous in terms of conditions of use, social conditions, and cultural backgrounds. A professional pesticide user is a single individual and therefore feels emotions, is subject to biases and heuristics in thought processes, has a set of preferences, and is ultimately responsible for his/her actions. The operator decides the time of the treatment and the way to operate.

Most PPPs in the use phase can lead to substantial environmental and health risks, especially if not used in accordance with safety advice (Pimentel et al., 1992). Previous works (Damalas and Eleftherohorinos, 2011 and Calliera et al., 2013) explored existing evidence that environmental and occupational exposure could occur in the use phase due to accidents while mixing, loading, or applying PPPs, or through contact with treated crops. Exposure risk increases when professional users ignore safety instructions on how to properly use PPPs, as well as the guidelines on the use of personal protective equipment (PPE) and the adoption of sanitation practices (Damalas and Eleftherohorinos, 2011 and Remoundou et al., 2014). For this reason, PPPs control and the sustainability of their use are one of the most important subjects for political regulatory intervention.

In 2009, the Council of the European Union adopted Directive 128 (EU 128/EC, 2009) on Sustainable Use of Pesticides (SUD). As a consequence, Member States (MSs) are required to develop specific measures to minimize environmental and also occupational exposure to PPPs, as well as communication programmes aimed at raising awareness among residents and bystanders about PPPs exposure risks. In particular, MSs shall ensure that all the so-called professional users, distributors and advisors (including operators, technicians, employers and self-employed in agriculture and other sectors) have access to “appropriate training by bodies designated by the competent authorities” (Art. 5).

In the Horizon 2020 work programme 2016–17 it is stated that in 2010, 71% of European farm managers were operating on the basis of practical experience only. Education levels greatly vary depending on country, farm managers' age and gender, or farm structures, and this can hamper innovation. Transition towards a more sustainable agriculture, requires a renewal and strengthening of the technical skills of all actors involved, and - as a consequence - of the educational system. A crucial challenge is also to remove bottlenecks to the delivery of practice-oriented research to end-users (European Commission, 2016).

Thus, training should be implemented taking into account the various roles and responsibilities, and should ensure that users, distributors and advisors acquire sufficient knowledge regarding the subjects listed in Annex 1. In particular, training for professional users (Art 5, 9, 13) should be focused on risks for operators, residents, bystanders, people using treated areas; measures to minimize risks for humans; procedures for storage, handling and disposal of PPPs; procedures for preparing PPPs application equipment; and use of equipment. Training for operators (Art 8) should include hand-held equipment and knapsack-sprayer maintenance, specific risks and the proper use of PPPs.

On the other hand, over the last decades many efforts have been made to reduce the distance between science and society. This has led to a European approach in Horizon 2020, called Responsible Research and Innovation, and also to support participatory research and innovation proposals that foster transdisciplinary research, including

the understanding of challenges and opportunities for interoperability of research data (European Commission, 2016). Evidence shows that European citizens appreciate science and want to be more informed and more science education. A more responsive science education can promote broader participation in knowledge-based innovation that meets the highest ethical standards and helps ensure sustainable societies in the future (ESERA, 2015).

The objective of this study is to contribute to the development of new training tools for PPPs use addressing the new legal requirements and taking into account what is already available. For this reason, the outcomes of different European and national research projects developed by the Opera Research Centre (www.operaresearch.eu) were used, involving stakeholders in the decision making process but also considering real behaviours and perceptions of the final users.

As a result, two free complementary innovative on-line tools were produced:

- An on-line tool able to build personalized training programmes for operators collecting and integrating existing training material on PPPs use;
- An e-learning course to help operators, advisors and distributors to get prepared for their national certificate test on the sustainable use of PPPs.

Both instruments merged together in OpenTEA (Open Training & Education Association platform, www.opentea.eu), a web platform promoted by Opera Educational and Training association (www.operaresearch.eu) together with the academic spin-off Aeiforia (www.aeiforia.it).

2. Material and methods

The framework used in this study (see Fig. 1) is mainly focused on the use of the results of different but interconnected research projects (BROWSE,¹ HEROIC,² LINEE GUIDA³ and SUPTRAINING⁴). They include two stakeholder consultation processes as well as two systematic surveys performed in a stepwise process, in order to develop training materials for different final users (i.e. operators).

The first consultation process was implemented in the frame of the BROWSE project. It involved all relevant stakeholders, drawn from academia, policy community, industry, and NGOs, in order to identify their opinions regarding subjects to prioritise, factors influencing PPPs exposure to focus on, and the most suitable formats to develop new operator training material for a sustainable use of PPPs. Stakeholders were asked to take into account the SUD requirements and the training material already existing in their own country. In the frame of BROWSE, two workshops were organised in 2011 involving 63 key experts at the European level (Sacchetti et al., 2012a).

A second stakeholder consultation process was performed in the frame of HEROIC to elicit stakeholder views and priorities regarding the identification of socio-behavioural factors influencing the effectiveness of the risk analysis process in the use of PPPs. An exploratory

¹ BROWSE project, FP7 Theme: Environment (including climate change), Bystanders, Residents, Operators and Workers Exposure models for plant protection products, Grant agreement no: 265307, Project start date: 1st January 2011, Project end date: 31st December 2013, www.browseproject.eu.

² HEROIC project, FP7 Theme: Research, technological development and demonstration, Health and Environmental Risks: Organisation, Integration and Cross-fertilisation of Scientific Knowledge, Grant agreement no: 282,896, Project start date: 1st October 2011, Project end date: 30th September 2014, www.heroic-fp7.eu.

³ LINEE GUIDA project, national programme focused on the development of Guidelines for Sustainable Use of Pesticide in a multi-stakeholder process. The project targets to develop instruments for the easy identification of the areas to reduce or mitigate risks and to provide the appropriate solutions at farm level.

⁴ SUPTRAINING project, Programme Erasmus + key action 2 “Strategic Partnership”, Development of an e-learning platform for the sustainable use of pesticides, Project reference: 2014-1-FR01-KA202-008754, www.sup-training.eu.

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