ENDURE

European Network for Durable Exploitation of crop protection strategies

Project number: 031499

Network of Excellence
Sixth Framework Programme

Thematic Priority 5
FOOD and Quality and Safety

Deliverable DR1.21

Field vegetable case study: Report on gaps of knowledge on methods to control soil-borne diseases through soil biofumigation and/or soil steaming and insects through landscape management and suggestions to fill these gaps

Due date of deliverable: M40

Actual submission date: M42

Start date of the project: January 1st, 2007 **Duration**: 48 months

Organisation name of lead contractor: INRA

Revision: V3

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)	
Dissemination Level	
PU Public	**PU**
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services)	
CO Confidential, only for members of the consortium (including the Commission Services)	

Table of contents

Glossary

ENDURE European Network for Durable Exploitation of crop protection strategies

IPM: Integrated Pest Management

PPPs: Plant protection products

Bt: Bacillus thuringiensis

BCAs: Biocontrol agents

Definitions

Summary

Objectives:
To give a summary of gaps of knowledge for IPM in field vegetable cropping systems and proposals for filling in this gaps

Rationale:
Analyze of the different contributions from partners. Synthesis of the main conclusions. Indications on needs for further research and development.

Teams involved: Synthesis made by INRA from material provided by other partners (Agros, AU, CIRAD CNR, JKI, SSSUP, IRTA/UdL, PPO, through deliverables DR1.17 and DR1.20.

Geographical areas covered: CH, DE, DK, ES, FR, IT, NL, West Indies and Reunion Island

1. Characteristics of field vegetable production systems and challenges for crop protection in Europe

According to Eurostat[1] statistics, fresh vegetables occupy 2% of the arable crops (EU-27, 2005) while accounting for a share of 8.9% of the overall output value (producer prices, 2006) of the agricultural industry. As a comparison, cereals account for 56% of the arable land and for 9.6% of the overall output value of the agricultural industry. Fresh vegetables cover a wide range of crops grown in fields or under shelter

In Italy, 476 400 ha were devoted to fresh vegetable production in 2006. Spain ranks second with 397 900 ha (2005 figure), France third with 254 500 ha. These three main producers are followed by Poland (197 900 ha), Greece (116 000 ha), UK (111 800 ha), Germany (106 400 ha, 2005 figure), Hungary (91 100 ha) and The Netherlands (81 200 ha)[2]. According to UMS (Union Maraîchère Suisse) about 11 000 ha are dedicated to fresh vegetables in Switzerland (2006).

Thus, this is an important economic sector for Europe and within Europe as 81% of the importations by the different member states origin from other EU countries (*vs* 63 % for fruits)[3]. In 2007, 7 701 000 tons of vegetables where exchanged within the EU, while 1 781 000 t were exported and 1 217 000 t imported. Tomato accounted for 26% of the importation from outside the EU[4].

Main characteristics of the vegetable production in Europe are:

- a great diversity of vegetables grown in production basins from highly specialized on a few crops, to very diversified with many different crops,
- high value crops with a strong market demand on visual aspect (perfect outer appearance), bringing a high pressure on growers for an efficient control pests, weeds and diseases.
- availability of crop protection methods vary from one country to the other, although crop products are exchanged within Europe and may appear on the same market shelf.

2. A need for harmonization on PPPs available to growers within EU

Field vegetable case study deliverable DR1.17 illustrated the diversity of PPPs registered for use on five crops (cabbage, carrot, leek, lettuce, onion) within seven European countries[5] (CH, DE, DK, ES, FR, IT, NL). As vegetables from different geographical origins within Europe can end in the same customer bag, and for all vegetable growers to be in a fair competition there is a need for harmonization in crop protection methods that are registered at the European level. One conclusion from DR1.17 was expressed as following ““It is important that the harmonisation of the registration and marketing of pesticides occurs

[1] *Source:* http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-ED-08-001/EN/KS-ED-08-001-EN.PDF
[2] *Source:* http://agreste.agriculture.gouv.fr/IMG/File/plant_production.pdf
[3] *Source:* http://ec.europa.eu/agriculture/agrista/2008/table_en/index.htm
[4] *Source :* http://www.coleacp.org/fr/system/files/file/coleacp/ApercuEchangesHorticolesACP.pdf
[5] *See also “Vegetable study reveals PPP situation” in Endure newsletter dated march 18, 2010 :* http://www.endure-network.eu/fr/nouvelles/dernieres_nouvelles/vegetable_study_reveals_ppp_situation

between countries, although there might be room for specificities as some pests may be important in one country and secondary in another". This should be achieved thanks to the new regulation on placing plant protection products on the market (Regulation n°1107/2009). The Directive provides for mutual recognition of authorisations granted by the Member States, provided that the plant health, agricultural and environmental conditions are comparable in the regions concerned.

3. Reinforce studies on IPM to enrich IPM-tool box and design methods to build-up efficient IPM strategies adapted to local conditions.

Another conclusion drawn from DR1.17 was that "A common effort between European countries to develop common and new methods of control for vegetable crops appears to be necessary. Considering that the pesticide industry is not expected to produce many new products in the years ahead, the investment for research must be on alternative methods and Integrated Pest Management (IPM). Having such an objective should also be a way to respond to the need for healthy products."

DR1.20 illustrated what is going on in terms of research and what has been achieved so far to propose alternatives to the use of pesticide in field vegetable cropping systems. The entries for analyze were two-fold: weeds and soil-borne pests and diseases though physical and biological soil disinfection, and aerial pests through field margins and landscape ecology.

Following are the main gaps of knowledge that can be identified from these studies, and some proposal to fill in these gaps

3.1. Extending the diversity of available alternatives

There are already a significant number of methods not relying on the use of pesticides for controlling weeds, pests and diseases of field vegetable crops, as shown in DR1.17 and DR1.20. Some are based on application of biocontrol agents (BCAs, e.g. Trichoderma, Bt, ….), others use natural products (e.g. pyrethrins, copper, …), involve cultural practices (e.g. hoeing, soil steaming, …) or management of the environment (field margins, flower strips, …).

If some are generic and can be applied to different vegetable crops, others (BCAs, natural products) are more specific and need registration to be marketed for use on a given combination crop*pest. As vegetables grown in Europe are very diverse, ***there is a need for developing new methods of control (including methods relying on the use of pesticides with low environmental impact)***.

Researches on BCAs need to be maintained and even reinforced with probably more emphasis on environmental conditions for efficacy. A trend has been to consider application of BCAs in the same way than application of a pesticide. If the BCAs have to survive for some time in order to be fully efficient, one have to consider the necessary environmental conditions (***which means emphasis on population and community ecology***), and management measures which are necessary to meet these conditions.

As far as natural products are concerned, ***more investment in chemical ecology*** should provide new molecules that could be used either through raw materials in which they are produced (e.g; cruciferas or other plants for biofumigation), from extraction of active ingredient (e.g; oil extracts), or via *de novo* synthesis (e.g. semiochemicals).

3.2. Improving the efficacy of alternatives?

Although some alternative methods to pesticides give good efficacy, most of them show partial efficacy, making them less reliable and more complex to perform, compared to pesticides. Thus they tend to be ignored by end-users waiting for researchers to improve them.

If improving efficacy *per se* of the methods must remain an objective, more can probably be achieved through looking for best combinations of partial efficacy methods including preference for pesticides showing the best toxicity and environmental profile. Although more complicated to perform, one may expect that combining partial efficacy methods will exert less selection pressure on target organisms. Added to the fact that combinations will be based on methods having different modes of actions on target organisms, this should provide more durable strategies of control.

Coming to that requires ***enhancing researches in epidemiology and population dynamics, taking into account all processes responsible for pests, diseases and weeds dynamics at the relevant scales for these dynamics*** (time: crop succession for weeds and soil-borne pests and diseases, space: landscape for aerial pests and diseases). This would enable identifying key and complementary entries to slow down pests, weeds and diseases dynamics, means that can be used for that and space and time scales at which they have to be implemented. For this objective ***development in modelling will be essential***.

3.3. Adapting alternatives to local conditions

It has been shown in DR1.17 and DR1.20 that quite a diversity of methods of crop protection are available or are being tested in different regions, from within continental Europe to outermost regions. Beyond the exchange on these methods, there is a need for adapting them to local conditions when appropriate. This is particularly important for field margins and landscape management designed to preserve pest-enemies habitats or for implementing push-pull strategies.

As for 3.2 above, this means ***reinforcing studies on functional and landscape ecology***, for a better understanding of pests and pest-enemies behaviour, and build-up crop protection strategies using concepts of agro-ecology.

3.4. Integrating alternatives for local IPM strategies

Although based on shared general concepts and basic knowledge (system approaches, epidemiology and population dynamics, ecology and agronomy), design and validation of IPM strategies will have to be local. This is both a condition for efficacy and for acceptance by end-users.

Experimentations in field vegetable growing production will be necessary, an added value being bringing these experimentations in an ***IPM European network*** allowing comparative analysis of success and failures with respect to the specificity of production situations.

The economic evaluation of proposed measures (would there be individual or as a whole in an IPM strategy) is an important aspect which has not always been taken in account in the past. Some evaluations can be done on experimental sites during the course of designing new methods (e.g. reducing the cost of needed energy for soil steaming) or of testing new combinations of methods (e.g. band steaming, inter-row hoeing, biological activation). ***There is also a need for an economic evaluation of the most promising crop protection systems on farm*** (thus serving also as an ultimate practical evaluation of their efficacy).

Conclusion

The big challenge for field vegetable production is to respond to apparent opposite demands such as high quality aspect, food safety, and environmentally-friendly production in a context of reduction of registered PPPs.

There is a need for a strong research investment, based on agro-ecological concepts in order to reduce the vulnerability of current cropping systems to weeds, pests and diseases and their dependency to pesticides. This research effort must be connected to production situations, thus associating general concepts for redesigning, to local and specific actions for build-up and evaluation of innovative IPM strategies. Partnerships between research, advisory service and end-users are then necessary.

However there will still be a need for new PPPs. Research and innovation in that direction will have to be developed, either based on functional ecology (new BCAs), or on chemical ecology (new molecules), for example.

Although not addressed in this case study, the economic and social impact on IPM in vegetable production, especially regarding the requirement for high quality aspect for the product to be marketed, need to be further analyzed.