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TECHNICAL REPORT submitted to EFSA

COLLECTION AND EVALUATION OF RELEVANT INFORMATION FOR THE DEVELOPMENT OF A NEW GUIDANCE DOCUMENT ON EMISSIONS OF PLANT PROTECTION PRODUCTS FROM PROTECTED CROPS (E.G. GREENHOUSES AND CROPS GROWN UNDER COVER)[1]

Lot 2 – data collection for four study regions in the Southern zone as defined in the new regulation on "Placing Plant Protection Products on the Market"

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Abstract

Ce.R.S.A.A. was charged by the EFSA Panel on Plant Protection Products and their Residues (PPR) with conducting a survey on the protected crop systems in Southern Europe. A first data collection on this subject had been previously done, providing information about the distribution of crop protection structures in Southern Europe.

This Second survey had the aim to obtain a very realistic and detailed picture of the situation of Mediterranean greenhouses features. In order to provide these data, Ce.R.S.A.A. visited, directly or through partners selected as subcontractors, a significant number of farms in Southern European Member States (particularly Italy, Greece, Spain and France).

Summary

In order to develop a new EU guidance document on emissions of PPPs from protected crops, EFSA needed a very realistic picture of the situation of the crop protection structures existing in Europe.

The First Data Collection in Southern Europe provided an analysis of the existing data concerning the distribution of crop protection structures in these Countries.

The Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) of Albenga (Savona, Italy), was charged with carrying out the Second Data Collection. The aim if this work was to gathered more detailed and up-to-date data, by conducting a complete survey at country level. Ce.R.S.A.A. has availed itself of the contribution of a Spanish agricultural services company and a Greek institution: Agricultura y Ensayo (A&E) of Seville (Spain) and the National Agricultural Research Foundation (N.AG.RE.F.) of Athens (Greece).

In order to collect the requested data five Study Regions, well-representative of all the different types of Mediterranean protected structures, have been chosen, in agreement with EFSA, as recipients for the survey:

- Liguria (Albenga area – Savona Province; Sanremo area – Imperia Province) and Lombardy (Bergamo and Brescia Provinces) in the North-Western Italy;
- Sicily (Ragusa, Agrigento and Caltanissetta Provinces);
- Andalucía (Almeria and Huelva areas) and Murcia Region (Murcia and Cartagena areas) in the Southern Spain;

- Crete (Ierapetra area) in Greece;
- Languedoc-Roussillon (Perpignan area), Provence (Nice, Antibes and Frejus areas) and Aquitaine (Bordeaux area) in the Mediterranean France.

The data collection was carried out by preparing a questionnaire concerning structure types and covering materials, the number/year of pesticide treatments and application methods, growing media, ventilation and climate control systems, the presence of pest blocks, irrigation techniques, the methods to calculate the needed amount of water and the quality of the water source.

In order to fill in the questionnaires, the contractor and his partners went in each of the selected regions and interviewed growers and technicians, thanks to the collaboration of their contact points present *on-site*. According to EFSA's suggestion, both big and small farms were chosen as subjects for the interviews, so as to ensure diversity in the responses information and to obtain a very realistic picture of the situation of the Mediterranean greenhouses features. On the base of contractor and partners' knowledge about the territories, all the different structures existing in the Study Regions were described. Each questionnaire was fulfilled with data regarding only one kind of cropping system, i.e. one species under a given protection structure. Totally, 523 questionnaires were collected: 146 in North-Western Italy, 164 in Sicily, 32 in France, 98 in Spain and 83 in Greece.

On the base of Coding Manual's specification, the collected data were put into a database provided by EFSA, and so standardized and added to the data previously gathered.

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Background

On April 1st, 2008 the EFSA Executive Director requested the Scientific Panel on Plant Protection Products and their Residues (PPR) to develop a new EU Guidance Document on emissions from protected crop systems (greenhouses and crops grown under cover) since scientific knowledge in this field has evolved in recent years. In this context, the Working Group (WG) Emissions from protected crop systems / Fate has been created to fulfill the Terms of Reference.
Concerning Southern Europe, a previous work has been already done on this issue: on October 18^{th,} 2009 the final report of the 1st data collection has been published. This work consisted on preliminary analysis of existing data provided by EUROSTAT and other sources at national or regional level. This analysis provided the required information about the acreage of selected crops or crop groups in each country with limited or no data about the diffusion of specific growing systems (e.g. open and closed soilless growing systems) and/or pesticide application methods.
Holding that the data were mainly provided by public services, they can be characterized as valid, but they do not cover all the points that EFSA was interested on.
Therefore, it was assumed the necessity to conduct a complete survey, at a country level, in order to gathered more detailed and up-to-date data.

On April 2010 EFSA published a Scientific Opinion on emission of PPPs from greenhouses and crops grown under cover. The main point of this Opinion was that emissions from protected cropping systems may not necessarily differ from emissions from open fields. In the Opinion, protected crops have been defined as <<*cultivations carried out under any kind of permanent or temporary shelter covering the entire crop with the aim of enhancing its productivity*>>, a definition that is substantially different from the one reported for *greenhouse* in the Regulation (EC) 1107/2009 (Article 3, Paragraph 27: <<*greenhouse means a walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products into the environment*>>). It is obvious that EFSA's definition includes several kinds of protected cropping structures, each one with a different situation concerning the PPPs emission routes (air, groundwater and surface water).

The Panel drafted a general decision scheme to distinguish between open field and protected crop risk assessment (Fig. 1), but recognizes that further research, including scenario studies, are necessary to complete the scheme.

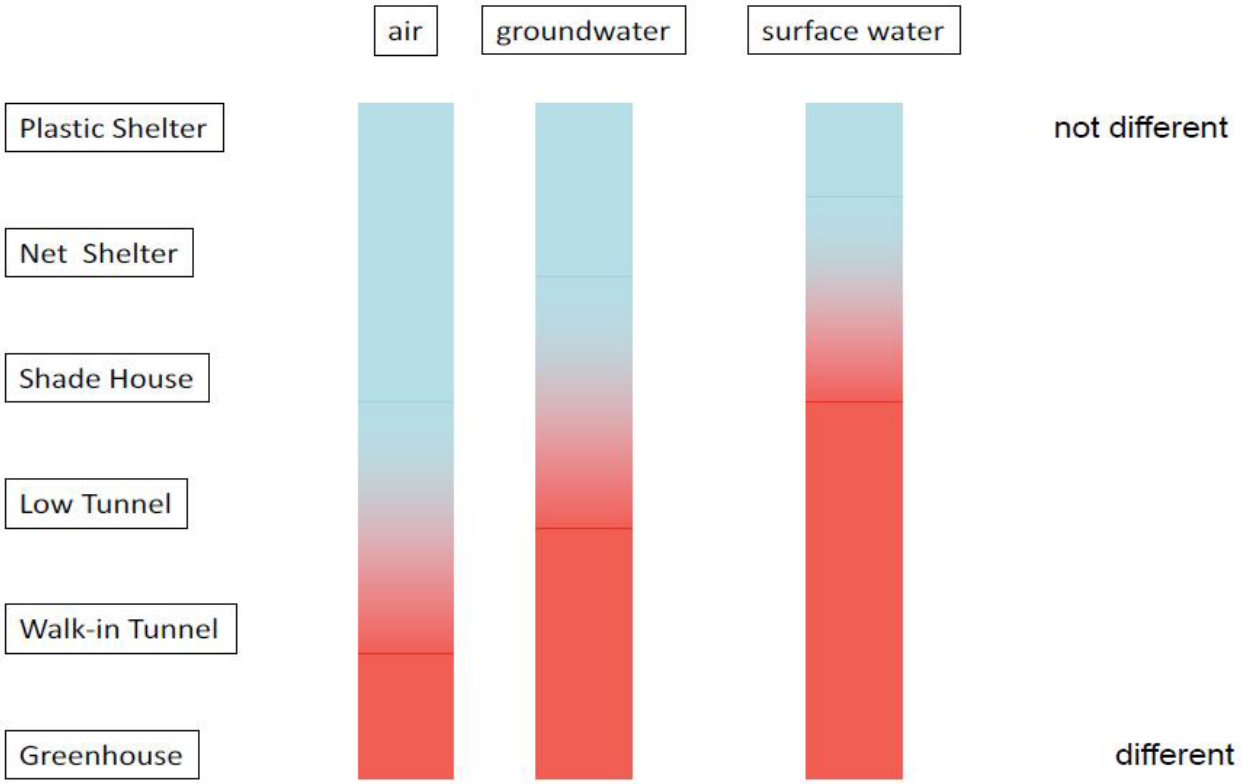

Figure 1: Example of decision rules to distinguish between open field and covered crop assessment. The order in which the construction types are given is not necessarily correct. Colours: blue means not different, red different; the transition means that further investigation is needed. (Source: EFSA, 2010).

Terms of Reference

In order to develop a guidance document on emissions of PPPs from protected crops, EFSA needed detailed and up-to-date information concerning the crop protection structures existing in Europe. On June 29th, 2010 EFSA charged Ce.R.S.A.A. with a Collection and Evaluation of Relevant Information for the Development of a New Guidance Document on Emissions of Plant Protection Products from Protected Crops (e.g. greenhouses and crops grown under cover), with the aim to obtain a very realistic picture of the situation of the Mediterranean greenhouses features.

Acknowledgements

This contract was awarded by EFSA to the Regional Centre of Experimentation and Technical Assistance (Centro di Sperimentazione e Assistenza Agricola - Ce.R.S.A.A.) of Albenga (SV, Italy) on 29 June 2010.

CONTRACTOR

Ce.R.S.A.A. is a special agency of Chamber of Commerce, Industry, Handicraft and Agriculture of Savona. Greenhouses, plastic houses and open fields used for trials, demonstration and extension cover 40,000 m^2. Two laboratories are involved in analysis mainly on plant pathogens and pesticides residues on vegetables offering a service to technicians and farmers operating in the Albenga area and even in the Savona province. The Centre is actively involved in experimental and demonstration activities, funded by public bodies, about environmentally friendly control strategies of plant pathogens, soil disinfestations techniques, management and disease control of ornamental and vegetable key crops, water recycling in soilless cultivation, dosage of fertilizers, quality of substrates for potted plants, evaluation of new species or cultivars of flowers. More recently the field of interest has broadened to renewable energy sources, being approved demonstrative projects about solar and wind energy. In particular, in the last years more than 50 national and European projects were carried out, with strong attention to the extension of the results and with specific tasks including data collection and management. The main ones were funded by EU:

- LIFE04 ENV/IT463 “BIOMASS” (coordinator);
- LIFE07 ENV/GR/000280 “PROSODOL”: Strategies to improve and protect soil and water quality from the Disposal of Olive oil mills’ wastes in the Mediterranean (partner);
- INTERREG IIIC WEST PROMSTAP “MYCOMON” (coordinator) and “GEOQUALITY” (partner):
- INTERREG IIIA – ALCOTRA “SALVIE” (partner);
- INTERREG IIIA – ALCOTRA “AROMA” (partner);
- INTERREG MARITTIMO “PYRGI” (coordinator);
- “AGRICULTURA NEWS”, funded by DG AGRI (coordinator);
- Territorial Monitoring and Service Supply in the Agro-environmental Sector (partner).

The Centre can rely on a strong connection with extensionists, growers and their local association. Eventually, it is active in the dissemination of the results of its activity, publishing papers on national and international journals (more than 400 in forty years of activity) and organizing courses and workshops.

SUBCONTRACTORS

The National Agricultural Research Foundation (N.AG.RE.F.) is the national body responsible for agricultural research and technology in Greece, functioning as a Legal Private Entity sponsored by the Ministry of Agriculture. It was established in 1989 under the Decree 1845/1989 entitled "Development and Exploitation of Agricultural Research and Technology". N.AG.RE.F. is also in charge of research for technological improvement and development in agricultural, forestry, and fishery production, it is concerned with topics of veterinary, management of marine resources, soil science, land reclamation, processing and preservation of agricultural products, as well as agricultural economy and sociology. N.AG.RE.F. is administered by an eleven member Administrative Council, whereas the planning of its scientific and research activities is carried by the Scientific Council. The personnel belonging to the Soil Science Institute of Athens participated to several EU projects in the last years, with specific tasks including data collection and management. Among them it is possible to cite:

- LIFE07 ENV/GR/000280 PROSODOL: Strategies to improve and protect soil and water quality from the Disposal of Olive oil mills' wastes in the Mediterranean (coordinator);
- GS SOIL: Assessment and strategic development of INSPIRE compliant Geodata – Service for European Soil Data, Call for tender "Framework contract for the provision of policy relevant studies in support of ESDAC" JRC, EU (7^{th} FP);
- FOOTPRINT: Functional Tools for Pesticide Risk Assessment and Management (partner);
- A piloting study for estimation of soil fertility of farmers parcel in the intensive agricultural area by Nestani Arkadia (Greece) using GIS (coordiantori).

Agricultura y Ensayo (A&E) is an agricultural service company, dedicated mainly to activities related to the research and development of agrochemical products. Created in 1997, A&E consists of highly qualified personnel with wide experience and it is certified under GLP (Good Laboratory

Practices) for pesticide evaluation (efficacy, residues, and side effects). The strategy of A&E is based on three fundamental principles:

- To guarantee the quality of work.: to achieve this, A&E has quality assurance unit, which makes sure that the trials are done following the Standard Operating Procedures (SOP);
- To make good use of team work experience, an aspect which allows to attain optimum trial conditions;
- Constant modernization of technical equipment and test facilities, so as to be always able to offer the most modern service using the latest technologies.

Thanks to a strong connection with the territory A&E has gained reliable expertise and contacts in Southern Spain in the sector of protected crops, having Almeria as one the most important working area.

CONTRACT

Collection and Evaluation of Relevant Information for the Development of a New Guidance Document on Emissions of Plant Protection Products from Protected Crops (e.g. greenhouse and crops grown under cover).

Tender code: NP/EFSA/PPR/2010/01.

Deadlines are shown in Tab. 1.

Table 1: Item Deadlines for delivery.

	Item	Deadline
1	**Draft questionnaire and written project plan**	**Within one month from the start of activities.**
2	**Final questionnaire**	**Within two months from the start of activities.**
3	**Interim report**	**Within four months from the start of activities.**
4	**Final report**	**Within six months from the start of activities.**

Introduction and Objectives

INTRODUCTION

The following report refers to the second data collection on the protected cultivations in Southern Europe.

The first data collection in Southern Europe provided an analysis of the existing data concerning the distribution of crop protection structures in these Countries. The data were gathered through EUROSTAT and other public sources at national or regional level, but they did not cover all the points EFSA was interested on. Therefore, it was assumed the necessity to conduct a complete survey, at a country level, in order to gather more detailed and up-to-date data.

The Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) of Albenga (SV, Italy), was charged with conducting the survey. It has availed itself of the contribution of a Spanish agricultural services company and a Greek institution: Agricultura y Ensayo (A&E) of Seville (Spain) and the National Agricultural Research foundation (N.AG.RE.F.) of Athens (Greece).

OBJECTIVES

The aim of the project was to obtain a very realistic picture of the situation of the Mediterranean greenhouses features. What diversifies this collection from the previous one is that the survey will be conducted *on-site*, with the direct help of growers and technicians.

The data gathered will be ownership of EFSA, which will use them to compile a comprehensive guidance document on pesticide emissions from protected crop systems.

Materials and Method

In order to collect the requested data, the selection of few areas in the Southern European MS was necessary. Basing on their high concentration of greenhouses, five Study Regions, well-representative of all the different types of Mediterranean protected structures, have been chosen as recipients for the survey (Fig. 2):

- Liguria (Albenga area – Savona Province – and Sanremo area – Imperia Province) and Lombardy (Bergamo and Brescia Provinces) in the North-Western Italy;
- Sicily (Ragusa, Agrigento and Caltanissetta Provinces);
- Andalucía (Almeria and Huelva areas) and Murcia Region (Murcia and Cartagena areas) in the Southern Spain;
- Crete (Ierapetra area) in Greece;
- Languedoc-Roussillon (Perpignan area), Provence (Nice, Antibes and Frejus areas) and Aquitaine (Bordeaux area) in the Mediterranean France.

Figure 2: Maps of Southern Europe. The Study Regions objects of the survey are marked with a red circle.

MATERIALS

The data collection has been carried out by preparing a questionnaire (see Appendix A) on the basis of Tender's specification and of the Coding Manual provided by EFSA. The Coding Manual has been developed by EFSA in order to support storing data from different sources in a harmonized structure. In this way, all the different data providers are able to fully describe their samples in a comparative manner.

The questions stated in the questionnaire concern both the characteristics of the protection structure and the growing conditions of the crops. In particular, data have been gathered about:

- structure types and covering materials;
- number/year of pesticide treatments and application methods;
- growing media;
- ventilation and climate control systems;
- presence of pest blocks;
- irrigation techniques, methods to calculate the needed amount of water and quality of the water source.

Attention has been paid both on the state of the art and on the possible future development of the set up and management of protected growing systems.

Coding Manual

The comparison of several surveys in Europe showed many differences about the information available and about data structures and quality. In order to establish a common inventory, a harmonized data model has to be defined.

In the Coding Manual sixteen data elements were identified to describe the area used to grow a specific crop protected by a specific structure. These standardized elements can be used both for the recoding of existing data and for the collection of new ones.

The standard descriptions also include a controlled terminology for each element. This is a finite set of terms to convey information in a clear and unambiguous way.

The main description is the combination of the crop type and the structure category. The protection structure is described by growing media, water system, water source, ventilation, climate control, pest blocks, treatments, application method, treatments frequency, irrigation method, irrigation amount.

The Coding Manual elements are briefly described below:

- Crop area: if the area is used within the year for several crops, the main crop (in time, if not unique additional in economic value) should be considered. For small protection structures (e.g. low tunnels) the area of the field is relevant for the measurement.
- Crop type: identification of the category (fruits, vegetables, leafy vegetables, fruiting vegetables, cut flowers, pot ornamental, propagation material, other) and of the type (see EC Regulation 178/2006).
- Structure category: as shown in Fig. 3, different kinds of crop protection structures exist.

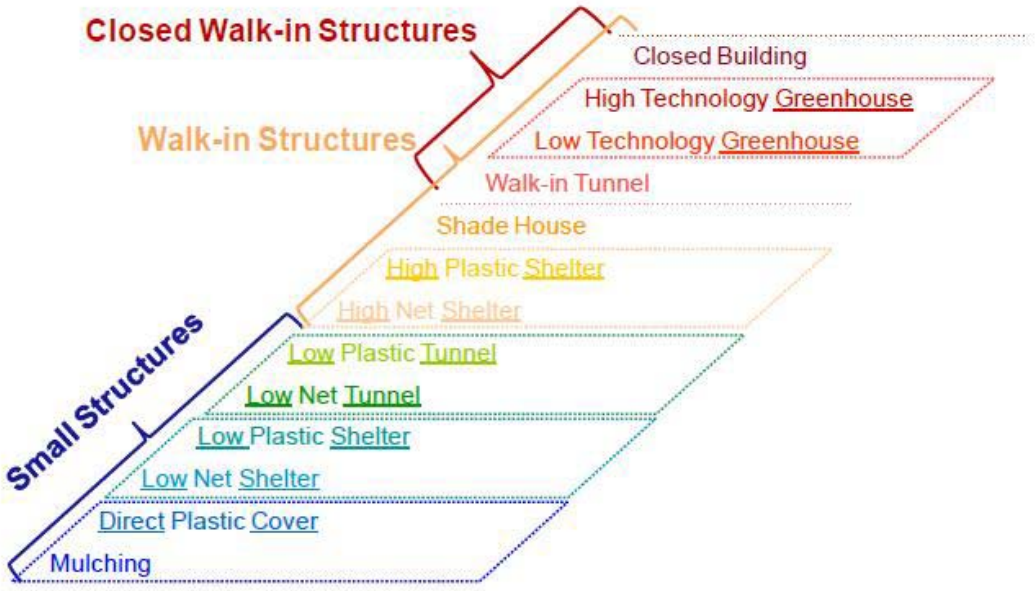

Figure 3: Categorization of crop protection structures.

Low Net Shelter: shelter made out of net (woven) material, used to cover parts of cultivated plants, especially fruit crops, in order to protect them against sun, hail or birds. (in accordance to EFSA, 2008).

Low Plastic Shelter (Fig. 4): shelter made out of plastic (continuous, non-woven) material, used to cover cultivated plants, especially fruits crops such as table grapes, in order to protect them against cold or rain and to extend the harvest period (to anticipate or postpone fruiting). In some cases the cover is discontinuous, that is the shelter is placed only above the row (in accordance to EFSA, 2008).

Low Net Tunnel (Fig. 5): simple net cover generally associated to mulching. It is a temporary cover, removed some weeks before the harvest. The covering may be provided by woven fabric (in accordance to EFSA, 2008).

Low Plastic Tunnel (Fig. 6): simple plastic cover generally associated to mulching. It is a temporary cover, removed some weeks well before the harvest (in accordance to EFSA, 2008).

High Net Shelter (Fig. 7): shelter made out of net (woven) material, used to protect cultivated plants, especially ornamentals, from excessive heat and/or light and against animals; not closed on all sides (in accordance to EFSA, 2008).

High Plastic Shelter: shelter made out of plastic (continuous, non-woven) material, used to protect cultivated plants, especially ornamentals, from excessive heat and/or light and against animals; not closed on all sides (in accordance to EFSA, 2008).

Shade House (Fig. 8): closed shading net in the shape of a tunnel or a small greenhouse, the only difference consisting on a permeable cover fabric, namely a net in different colors (generally black) and shade percentage (up to 80% and more) (in accordance to EFSA, 2008).

Walk-In Tunnel (Fig. 9): unheated structure used for growing plants; it consists usually on a single layer of plastic film supported by plastic or metal arches or hoops, large enough to walk and work in. Generally, they are temporary shelters, removed at the end of cultivation (only the coverings or entirely) (in accordance to EFSA, 2008).

Low Technology Greenhouse (Fig. 10): walk-in, static, closed place of crop production with a transparent outer shell (glass or plastic roof and frequently glass or plastic walls). The size ranges from small sheds to very large buildings, generally without automatic controlled climate management systems (in accordance to EFSA, 2008).

High Technology Greenhouse (Fig. 11): high-tech production facility for vegetables or flowers with a translucent outer shell (glass, or in some areas plastic materials), equipped with climate management systems automatically controlled by a computer (in accordance to EFSA, 2008).

Closed Building: closed place of plant production with a non-translucent outer shell (e.g. for production of mushrooms or witloof).

Figure 4: Low plastic shelters on table grape (Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 5: Low net tunnels on melon in Campo de Cartagena (Murcia, Spain)). (Source: Ce.R.S.A.A., 2010)

Figure 6: Low plastic tunnels on strawberry in Huelva (Spain). (Source: Ce.R.S.A.A., 2010)

Figure 7: High net shelter on ornamental plants (Albenga, Liguria, Italy). (Source Ce.R.S.A.A., 2010)

Figure 8: Shade-house (Sanremo, Liguria, Italy). (Source Ce.R.S.A.A., 2010)

Figure 9: Walk-in tunnel (Licata, Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 10: Low-tech greenhouses (Gela, Sicily, Italy). (Source Ce.R.S.A.A., 2010)

Figure 11: *Poinsettia* in a high-tech greenhouse (Frejus, Provence, France). (Source: Ce.R.S.A.A., 2010)

- Growing Media:

  Soil culture (Fid. 12): cultivation in natural soil, which constitutes the surface layer of the cultivation ground. The surface layer is usually appropriately prepared, or natural soil is transported from other places and applied as top layer on the cultivation ground.

  Soilless with substrate (Fig. 13): cultivation in natural (e.g. peat) or artificial (e.g., perlite, rock wool) growing media other than soil; the substrate is generally contained in pots, boxes, bags, benches etc.

  Soilless without substrate (hydroponics) (Fig. 14): cultivation with bare-rooted plants immersed in recirculating or stagnant nutrient solution (e.g. NFT, floating system, aeroponics).

- Water systems:

  Non-Recirculating Water System: soil or soilless system without recirculation of drainage water or leaching water / nutrient solution. This system is called open-loop: the water leached from the soil or drained from the substrate (in soilless culture) is not recovered and re-used.

  Recirculating Water System: soilless system with recirculation of drainage water or leaching water / nutrient solution. This system is called closed-loop: the drainage water is captured and reused after nutrient replenishment and, possibly, disinfection (by heat, UV light, slow sand filtration, etc.) in order to minimize the risks of root borne diseases (Fig. 15).

- Quality of irrigation water source:

  High Quality Water (Fig. 16): water as good as tap water (or better); it is natural and comes from rainfall, lakes, rivers, out of the ground or from condensation.

  Brackish Water (Low Quality Water): it is usually the groundwater near the seashore (Fig. 17), which is salty to an extent that is marginal for use in agriculture.

  Water from Reverse Osmosis: water originating from poor or marginal sources, which is improved by reverse osmosis.

  Water from Multiple Sources: water derived by several different water sources.

- Ventilation systems:

  Unregulated Ventilation (Fig. 18): ventilation by size openings that are not changeable and no fans or other devices to enlarge it.

Manually Regulated Ventilation (Fig 19 and 20): ventilation by size openings that can be manually changed. (Small structures and open walk-in tunnels, from which the cover is (partly) removed during the hot months, are not considered as having manually regulated ventilation.)

Forced Ventilation (Fig. 21 and 22): the air exchange is governed by fans that are manually switched on/off.

Controlled Ventilation (Fig. 23): ventilation is connected to a computer and the air exchange rate is continuously adapted, either by regulating the size of the openings or by adapting the velocity of fans for forced ventilation.

- Climate Control: when the climate is influenced by other means than the cover itself, i.e. heating or cooling processes are practiced. Heating may be by burning fossil or renewable fuels in direct air heating (air heaters, Fig. 24) or through water heat exchangers (pipe-heating, Fig. 25). Cooling can be done in different ways: either based on evaporation of water (with fogging or wet pads) or with water heat exchangers operating backwards. Fogging nozzles can be attached to circulators or spread on a high pressure net in natural or forced ventilation.

Figure 12: Lamb's lettuce grown in soil in Brescia Province (Lombardy, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 13: *Ranunculus* spp. culture in peat based substrate in bags (Sanremo, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 14: Hydroponic culture (floating system) of basil in Tuscany (Italy). (Source: Ce.R.S.A.A., 2010)

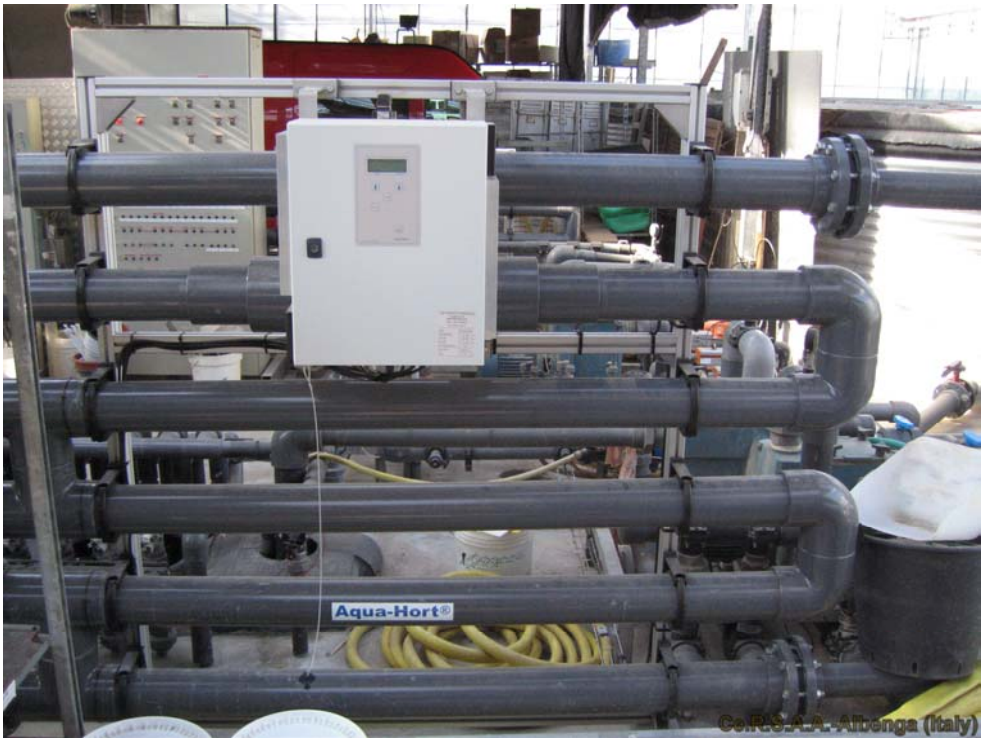

Figure 15: Disinfection system for nutrient solution recycled in a close-loop system (Frejus, Provence, France). (Ce.R.S.A.A., 2010)

Figure 16: Artificial basin for collecting the water for irrigation (high quality water) in Ragusa Province (Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 17: Well in Vittoria (Sicily, Italy), near the seashore (brackish water). (Source: Ce.R.S.A.A., 2010)

Figure 18: Unregulated ventilation (holes in the plastic film) in walk-in tunnels (Licata, Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 19: Manually regulated ventilation in a walk-in tunnel (Nice, Provence, France). (Source: Ce.R.S.A.A., 2010)

Figure 20: Device for the manual regulation of the openings (Vittoria, Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 21: Fan (forced ventilation) in a greenhouse (Nice, Provence, France). (Source: Ce.R.S.A.A., 2010)

Figure 22: Air extractor for forced ventilation in a greenhouse in Murcia (Spain). (Source: Ce.R.S.A.A., 2010)

Figure 23: Openings on the greenhouses' roof controlled by a computer (Albenga, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 24: Air-heater (Brescia, Lombardy, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 25: Pipe-heating on benches in a greenhouse in Celle Ligure (Savona, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Pest blocks (Fig. 26): blocking systems in walk-in structures that prohibit insects (and sometimes small animals) to move inside the greenhouse from outside (e.g. plastic nets of appropriate mesh or even air curtains). The Coding Manual only takes into account pest block systems that influence the ventilation of the structure: nets that cover the opening of side windows and/or top windows impede free air exchange and lower ventilation. Double entrance doors are also necessary to block pests when personnel move in and out of the greenhouse (Fig. 27).

- Pesticides Application Method:

  Spraying (Fig. 28): application of a chemical solution, at any pressure, through atomizing nozzles, onto the foliage of plants, for pest or disease control.

  Fumigation (Fig. 29): Application of canned chemicals that have a vaporizing agent (or heat may be used to release it) and are opened in closed walk-in structures for pest control.

  Fogging: application of chemical solutions using high pressure nozzles or high air speed to atomize it in fine particles (less than 10 microns) and to produce a mist.

  Through Irrigation System (Fig. 30): chemical applications for root pest control (or systemic chemical) through irrigation water drippers of open systems or into the recirculating water of closed water systems.

  Soil Injection (Fig. 31): application of a chemical (usually disinfectant) at a certain depth into the soil, using special equipment (mixing may occur afterwards); usually done before sowing or planting.

  Soil Treatment: spray application of a chemical onto the soil and mixing through the soil immediately after application.

- Irrigation Method:

  Drip Irrigation (Fig. 32 and 33): water is conveyed under pressure through a pipe system, where it drips slowly onto the soil through emitters or drippers located close to the plants. Only the immediate root zone of each plant is wetted.

  Overhead Sprinkler (Fig. 34): water is pumped through a pipe system and then sprayed onto the crops through sprinkler heads (the effect is similar to natural rainfall).

  Furrows or Gullies in the Soil: small channels which carry the water down the land slope between the crop rows; water infiltrates into the soil while it moves along the slope.

  Nutrient Solution in soilless culture (Fig. 35): irrigation through recirculating or stagnant nutrient solution in soilless cultivation systems without substrate (hydroponics).

Sub Irrigation (Fig. 36): plants are grown in a porous substrate that transports water and nutrients to the roots by a capillary action from a shallow nutrient solution or from a capillary mat saturated with nutrient solution. In the former case, the pots are placed in gullies with an intermittent flow of nutrient solution or in ebb-and-flow benches flooded periodically with a thin layer of nutrient solution that is then drained back into the main reservoir.

- Irrigation Amount Calculation:

  On Basis of Grower's experience: the irrigation amount is set according to the grower's knowledge of crop requirements.

  On Basis of Calculated Crop Requirements: the irrigation amount is calculated with an analytical or numerical model based on climatic conditions.

  On Basis of Soil Moisture Measurements (Fig. 37): the irrigation amount is calculated or estimated basing on measured soil moisture tension, or a given amount of irrigation water is supplied when the soil moisture tension exceeds a preset value.

  On the Basis of Visible Water Stress: a given amount of irrigation water is supplied when there is a sign of water stress.

  In Large Excess: water is supplied in excess of crop requirements.

Figure 26: Partial pest blocks in greenhouses in Sicily (Italy). (Source: Ce.R.S.A.A., 2010)

Figure 27: Double door for pest blocks (Almeria, Spain). (Source: Ce.R.S.A.A., 2010)

Figure 28: Manual spraying on ornamental plants in a greenhouse in Albenga (Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 29: Sulphur sublimation (fumigation) in a protected pepper cultivation in Murcia (Spain). (Source: Ce.R.S.A.A., 2010).

Figure 30: Drip fumigation in a greenhouse in Sicily (Gela, Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 31: Soil injection in Albenga (Liguria, Italy). (Source: Ce.R.S.A.A., 2010).

Figure 32: Drip irrigation in pot ornamentals in Albenga (Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

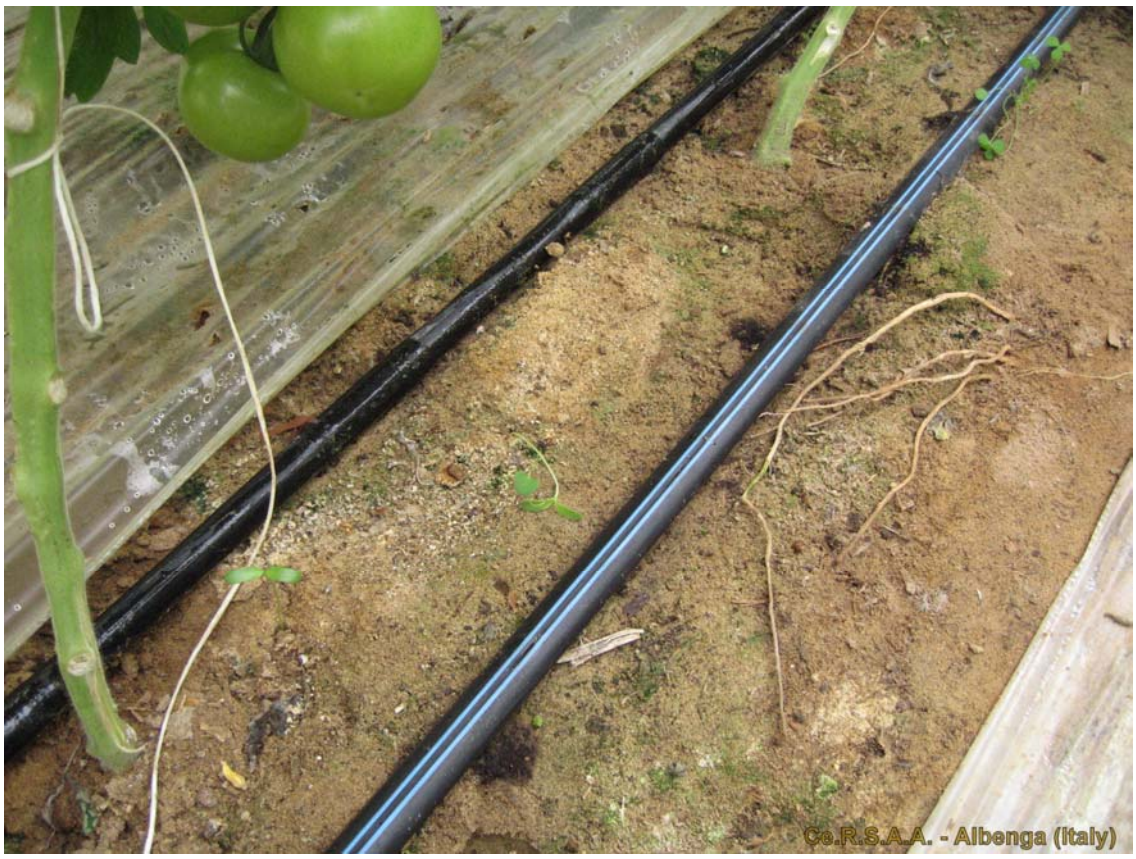

Figure 33: Drip irrigation in tomato in Scicli (Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 34: Overhead sprinkler in a greenhouse (Albenga, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

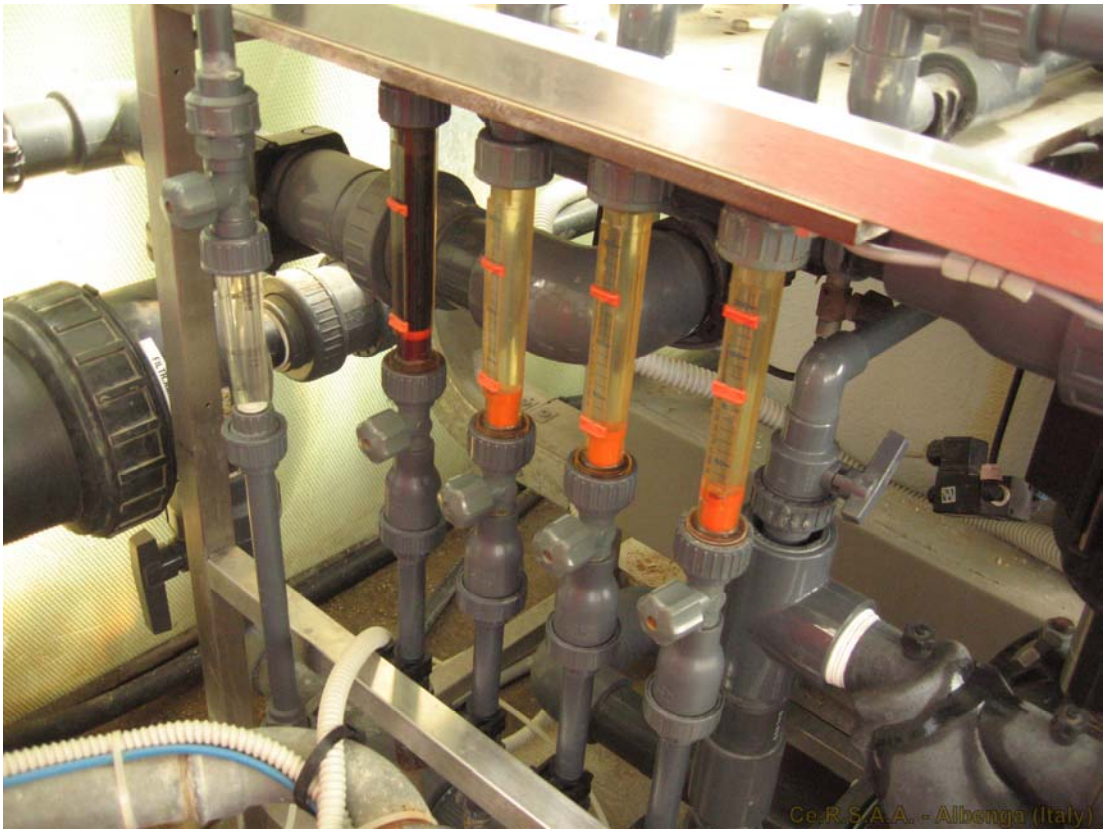

Figure 35: Fertilizers injection system for distribution of nutrient solution in soilless culture (Sanremo, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Figure 36: *Poinsettia* grown over a cement pavement designed for sub-irrigation (Frejus, Provence, France). (Source: Ce.R.S.A.A., 2010)

Figure 37: Tensiometer for the measurements of the soil moisture (Albenga, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

METHODS

In order to fill in the questionnaires, the contractor and his partners went in each of the selected regions and interviewed growers and technicians, thanks to the collaboration of their contact points present *on-site*. Both big and small farms have been chosen as subjects for the interviews, so as to ensure diversity in the responses information and to obtain a very realistic picture of the situation of the Mediterranean greenhouses features. On the basis of contractor and partners' knowledge about the territories, all the different structures existing in the Study Regions were described.

Each questionnaire was fulfilled with data regarding only one kind of cropping system, i.e. one species under a given protection structure.

On the basis of Coding Manual's specification, the collected data have been put into a database provided by EFSA, and so standardized and added to the data previously gathered.

Action of contractor

Ce.R.S.A.A. prepared the questionnaire in English, along with a motivational letter (see Appendix B) that was showed to the interviewed people in order to explain the aims of the survey. Then Ce.R.S.A.A. translated them in Italian (Appendix C and D) and French (Appendix E and F).

After EFSA's approval of the questionnaire and of the letter, and after a quick test of the survey in Liguria, Ce.R.S.A.A. started the interviews in the Albenga area, followed by Sicily, Sanremo area, Lombardy and France. About 39 questionnaires were fulfilled in the Albenga area, 65 in Sanremo area, 23 in other areas of Liguria (Prà and Celle Ligure), 19 in Lombardy (for a total of 146 in the North-Western Italy) and 164 in Sicily. 13 questionnaires were completed in the Provence area, 14 in Languedoc-Roussillon Region and 5 in Aquitaine Region, for a total of 32 in France.

The Albenga area includes farms located in Albenga, Ceriale, Loano, Toirano and Andora municipalities, while Sanremo area includes Sanremo, Camporosso, Riva Ligure, Taggia, Arma di Taggia and Cipressa municipalities. In these areas almost all the protected crops considered in the survey are represented by aromatic (fresh herbs) and ornamental plants. The area of Prà and Celle Ligure were chosen because of the presence of important D.O.P. basil growers.

In Sicily, Ce.R.S.A.A. interviewed growers located in Gela, Licata, Butera, Scicli, Acate, Santa Croce Camerina, Scoglitti, Vittoria and Mazzarone municipalities. Here, the horticulture is largely predominant if compared to other cultures, being tomato the most important crop.

In Lombardy the areas of interest were Bergamo and Brescia Provinces, where the protected agriculture is strictly aimed to the *IV Gamma*[2] market, and salads are the most spread crops (lamb's lettuce, lettuce, rocket, wild rocket, spinach and beet).

In France, the farms taken into account were located in the neighborhood of Nice, Antibes, Frejus (Provence), Perpignan, Nimes (Languedoc-Roussillon) and Bordeaux (Aquitaine) municipalities. As a general consideration, French protected agriculture is more developed in comparison with the other Mediterranean Countries, having mostly glassy greenhouses and soilless cultures.

After having gathered all the data, Ce.R.S.A.A. added them in EFSA Database, following the instruction stated in EFSA Coding Manual (the actions of Contractors are shown in Tab. 2)

Table 2: Actions of contractor (Ce.R.S.A.A.) and subcontractors (A&E and N.AG.RE.F.).

Action of Ce.R.S.A.A.	Action of A&E	Action of N.AG.RE.F.
Set up of the questionnaire and the motivational letter in English		
Translation of the questionnaire and the motivational letter in Italian		
Translation of the questionnaire and the motivational letter in French	Translation of the questionnaire and the motivational letter in Spanish	Translation of the questionnaire and the motivational letter in Greek
Test of the survey in Liguria		
Interviews in Study Region 1 (146 questionnaires)	Interviews in Study Region 3 (98 questionnaires)	Interviews in Study Region 4 (83 questionnaires)
Interviews in Study Region 2 (164 questionnaires)		
Interviews in Study Region 5 (32)		
Addition in the Database of the data from all the 5 Study Regions		

Action of subcontractors

Agricultura y Ensayo worked on the Spanish translation of the questionnaire (Appendix G) and of the motivational letter (Appendix H), and made the interviews in the Spanish Study Region. 30 questionnaires have been fulfilled in the Almeria area, 30 in the Huelva area (Andalucía) and 38 in Murcia Region. Thanks to the mild climate conditions, in Spain the crop protection structures are very simple (tunnels are the most spread category). Here, the horticulture is centered particularly on strawberry, table grape, pepper and tomato cultivation.

[2] IV Gamma products are minimally processed vegetables: the name is referred particularly to fresh fruits and vegetables that are washed and cut and packaged and sealed in bags or tubs before sale.

N.AG.RE.F. worked on the Greek translation of the questionnaire (Appendix I) and of the motivational letter (Appendix J), and made the interviews in the Greek Study Region. 83 questionnaires have been fulfilled in Ierapetra area, in Crete, where tomato, pepper and cucumber are the most important crops grown under protection. (The actions of subcontractors are shown in Tab. 2)

Results

ITALY

Study Region 1

Liguria

Greenhouses in the Albenga neighborhood (Liguria) are very close to the town (Fig. 38). This area is particularly dedicated to ornamental crops, but vegetable and aromatic (fresh herbs) crops are also present (Fig. 39).

Here, the survey involved farmers growing the following species: basil, cyclamen, daisy (potted plants and cuttings), *Fuchsia*, lavender, *Lantana*, tomato, rosemary and zucchini, in the percentages shown in Fig. 40.

In this area the existing crop protection structures are represented by high net shelters, shade-houses, walk-in tunnels, low-tech and high-tech greenhouses (Tab. 3). Ornamental plants are grown mostly in peat based substrates (potting mixes), while vegetables are grown in soil (Tab. 4). The close-loop system is not common yet, but some growers are getting interested in it (Tab. 4).

The water for irrigation in this area is mainly provided by the Water Consortium; alternatively, farms have their own well. In some cases rainwater is recycled. Generally, water quality is good, except for the areas next to the sea shore (Fig. 41).

Controlled ventilation system and heating and/or cooling systems are pretty spread in the Albenga area, even if cheaper not-computerized structures are still present (Tab. 5 and Fig. 42).

Concerning pest control, the use of pest blocks is not common (Tab. 6), and High Volumes spraying is the most used pesticide application method. Application through irrigation systems and soil treatments are also well used (Tab. 6). Some farms adopt Organic Crop Protection methods or Integrated Pest Management (IPM).

Drip irrigation and overhead sprinkler are the most common irrigation methods adopted; rarely, also sub-irrigation is used (Tab. 7). The water amount is usually set according to grower's experience (Tab. 7), sometimes with the support of temperature and light detections.

Figure 38: Greenhouses in the Albenga neighborhood (Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

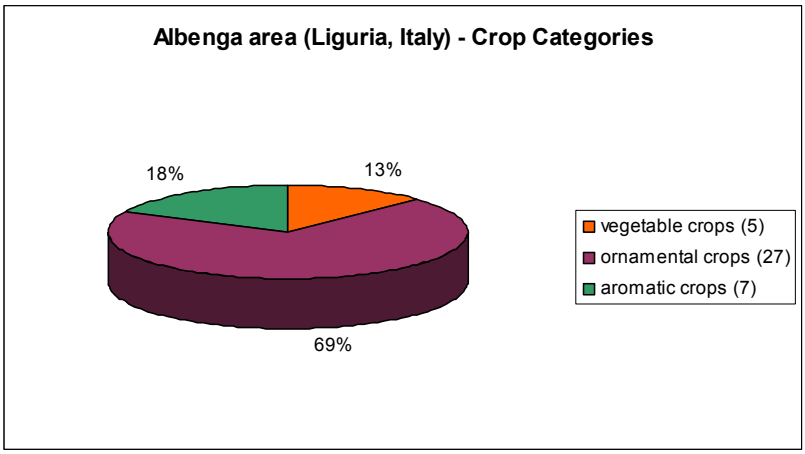

Figure 39: Crop categories grown in the farms interviewed in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected). In brackets, the number of questionnaires for each category.

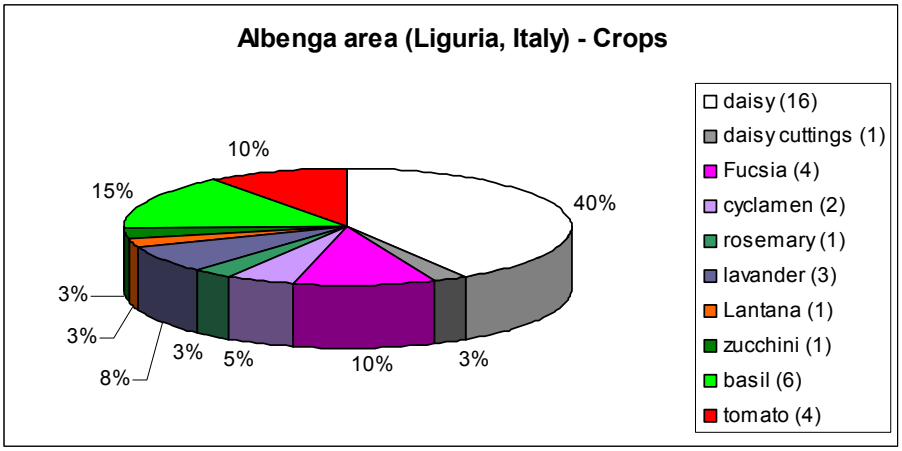

Figure 40: Crops grown in the farms interviewed in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 3: Crop protection structures existing in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected).

Albenga Area (Liguria, Italy) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter	**2**	**5,1**
high plastic shelter		
shade-house	**1**	**2,6**
walk-in tunnel	**1**	**2,6**
low-tech greenhouse	**13**	**33,3**
high-tech greenhouse	**22**	**56,4**
closed building		

Table 4: Growing media and water recirculation systems existing in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected).

Albenga Area (Liguria, Italy) - Growing Media	Number	Percentage (%)
soil	**11**	**28,2**
soilless with substrate	**28**	**71,8**
soilless without substrate		
Water Recirculation System		
open-loop	**36**	**92,3**
close-loop	**3**	**7,7**

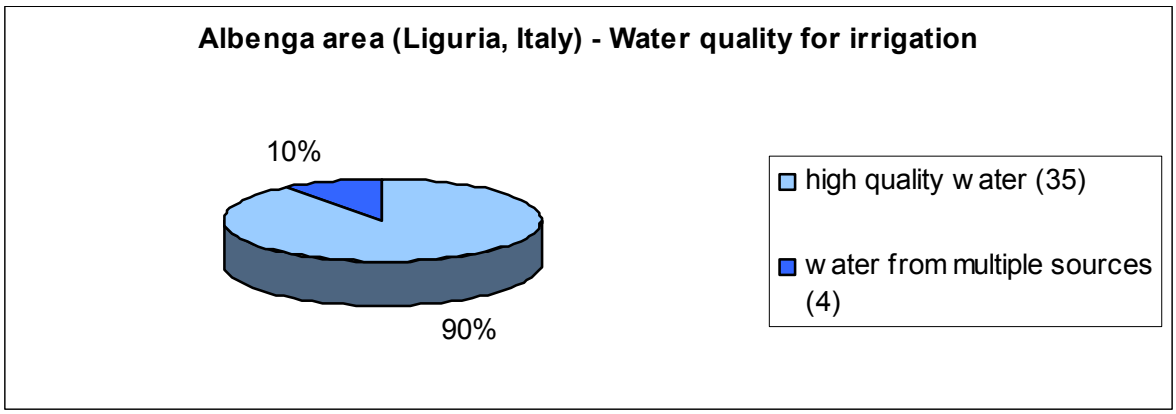

Figure 41: Quality of the water used by the growers interviewed in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 5: Ventilation systems existing in the crop protection structures in the Albenga area percentages are calculated out of the 39 questionnaires totally collected).

Albenga Area (Liguria, Italy) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**3**	**7,7**
manually regulated ventilation	**12**	**30,8**
forced ventilation	**6**	**15,3**
controlled ventilation	**18**	**46,2**

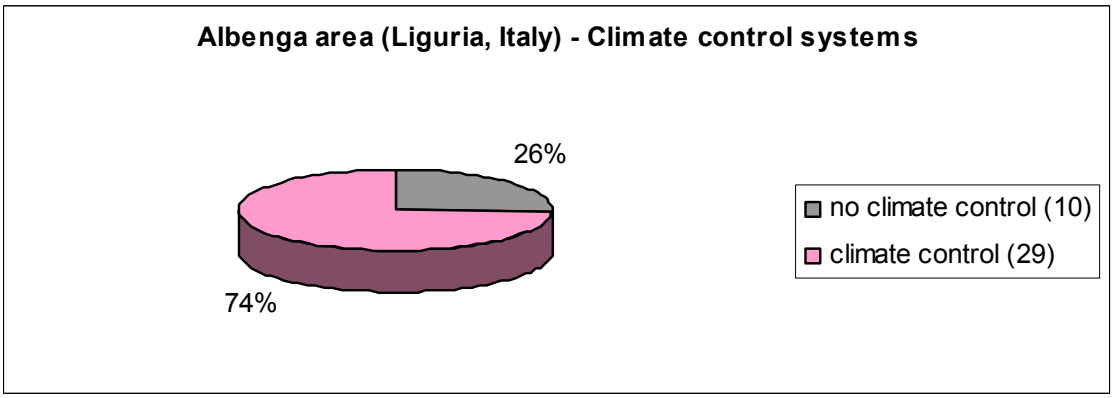

Figure 42: Presence of climate control systems in the crop protection structures taken into account in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 6: Pest blocks presence and pesticide application methods adopted in the farms taken into account in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected).

Albenga Area (Liguria, Italy) - Pest Blocks	Number	Percentage (%)
no pest block	**35**	**89,7**
partial pest block	**4**	**10,3**
full pest block		
full pest block with double door		
Pesticide Application Method		
spraying	**39**	**100,00**
fogging/fumigation		
through irrigation system	**5**	**12,8**
soil injection		
soil treatment	**4**	**10,3**
none		

Table 7: Irrigation methods and water amount calculation systems used by the growers interviewed in the Albenga area (percentages are calculated out of the 39 questionnaires totally collected).

Albenga Area (Liguria, Italy) - Irrigation Method	Number	Percentage (%)
drip irrigation	**32**	**82,1**
overhead sprinkler	**16**	**41,0**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation	**3**	**7,7**
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**33**	**86,6**
on basis of calculated crop requirements	**6**	**15,4**
on basis of soil moisture measurements		
on basis of visible water stress		
in large excess		
other or none		

Sanremo area (Liguria) is famous for cut flowers and green foliage cultivations: *Alstroemeria*, Asian buttercup, *Asparagus plumosus*, carnation, *Euphorbia fulgens*, freesia, *Limonium sinuatum* and *L. sinensis*, *Lisianthus*, rose and *Ruscus* are the species grown in the farms involved in the survey (Fig. 43).

In this area the crop protection structures are usually built on slopes and very close to the houses (Fig. 44); they are high net and plastic shelters, shade-houses, low-tech and high-tech greenhouses (Tab. 8). The growing media used are both soil and substrate mix with elements like peat, pumice, perlite, coconut fiber (Tab. 9). The close-loop system is still not common, but some growers are getting interested in it (Tab. 9).

The water for irrigation in this area is mainly provided by the Water Consortium; alternatively, farms have their own well; in one case the water is obtained by a river next to the farm. Generally, the water quality is high (Fig. 45).

Controlled ventilation system and heating and/or cooling systems are quite spread in the Sanremo area, although cheaper not-computerized structures are still well present (Tab. 10 and Fig. 46).

Concerning pest control, the use of pest blocks is not common (Tab. 11). High Volumes spraying, soil treatments and soil drip fumigation are the most used application methods. In one case the fumigation, and particularly sulphur sublimation, is also adopted. Sometimes soil injection, as a method for soil disinfection, is used (Tab. 11). Some farms apply Organic Crop Protection methods or Integrated Pest Management (IPM).

The most common irrigation methods adopted are drip irrigation, overhead sprinkler and sprinkler at soil level (Tab. 12). The water amount needed is set according to grower's experience; in few cases, the grower is supported by light meter detections and soil moisture measurements (Tab. 12).

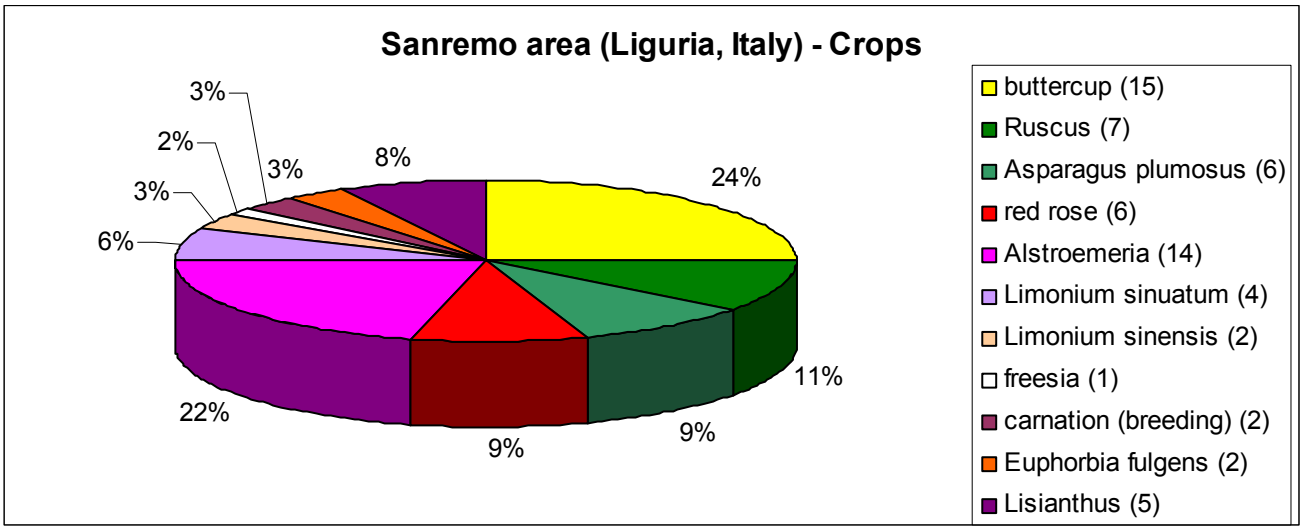

Figure 43: Crops grown in the farms interviewed in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected). In brackets, the number of questionnaires for each crop

Figure 44: Greenhouses in Arma di Taggia neighborhood (Sanremo area, Liguria, Italy). (Source: Ce.R.S.A.A., 2010)

Table 8: Crop protection structures existing in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected).

Sanremo Area (Liguria, Italy) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter	**2**	**3,1**
high plastic shelter	**15**	**23,1**
shade-house	**7**	**10,8**
walk-in tunnel		
low-tech greenhouse	**6**	**9,2**
high-tech greenhouse	**35**	**53,8**
closed building		

Table 9: Growing media and water recirculation systems existing in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected).

Sanremo Area (Liguria, Italy) - Growing Media	Number	Percentage (%)
Soil	**48**	**73,8**
soilless with substrate	**17**	**26,2**
soilless without substrate		
WATER RECIRCULATION SYSTEM		
open-loop	**59**	**90,8**
close-loop	**6**	**9,2**

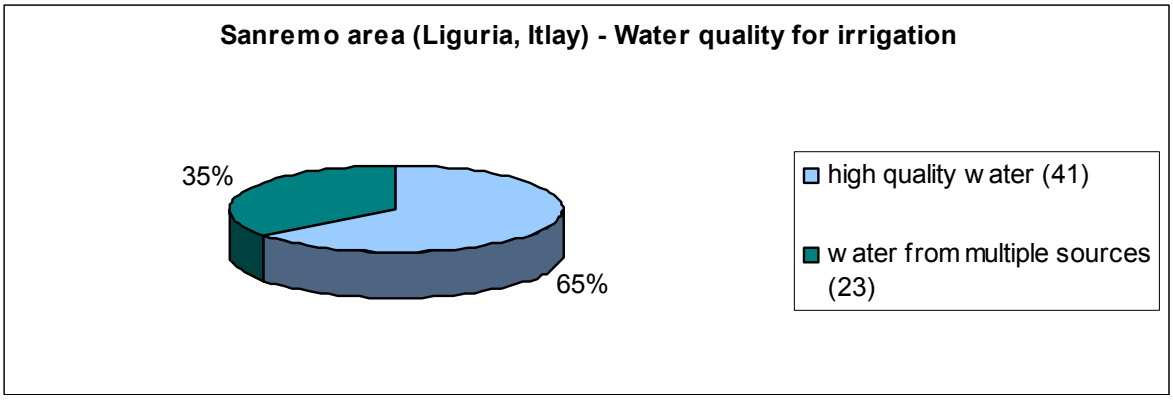

Figure 45: Quality of the water used by the growers interviewed in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 10: Ventilation systems existing in the crop protection structures in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected).

Sanremo Area (Liguria, Italy) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**29**	**44,6**
manually regulated ventilation	**5**	**7,7**
forced ventilation		
controlled ventilation	**31**	**47,7**

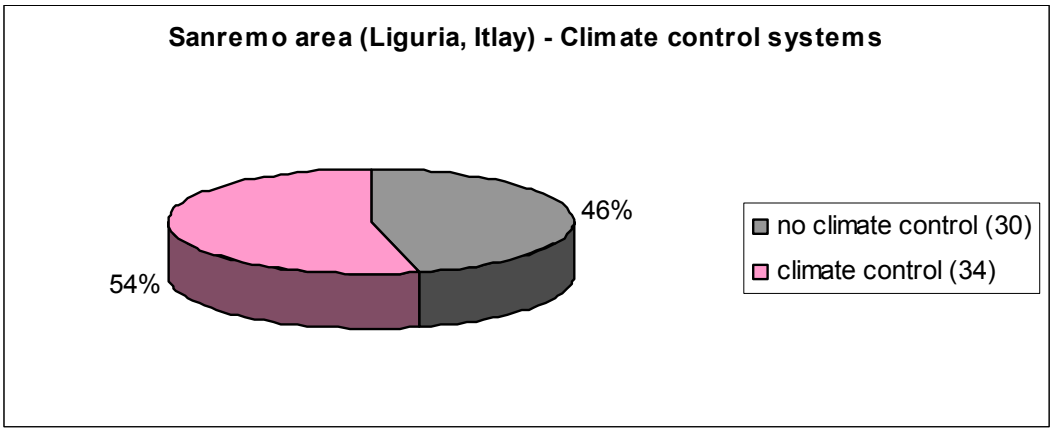

Figure 46: Presence of climate control systems in the crop protection structures taken into account in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 11: Pest blocks presence and pesticide application methods adopted in the farms taken into account in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected).

Sanremo Area (Liguria, Italy) - Pest Blocks	Number	Percentage (%)
no pest block	**58**	**89,2**
partial pest block	**7**	**10,8**
full pest block		
full pest block with double door		
PESTICIDE APPLICATION METHOD		
spraying	**59**	**90,8**
fogging/fumigation	**6**	**9,2**
through irrigation system	**8**	**12,3**
soil injection	**7**	**10,8**
soil treatment	**40**	**61,5**
none		

Table 12: Irrigation methods and water amount calculation systems used by the growers in the Sanremo area (percentages are calculated out of the 65 questionnaires totally collected).

Sanremo Area (Liguria, Italy) - Irrigation Method	Number	Percentage (%)
drip irrigation	**29**	**44,6**
overhead sprinkler	**36**	**55,4**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none	**33**	**50,8**
IRRIGATION AMOUNT CALCULATION		
on basis of grower's experience	**62**	**95,4**
on basis of calculated crop requirements	**3**	**4,6**
on basis of soil moisture measurements	**3**	**4,6**
on basis of visible water stress		
in large excess		
other or none		

In Prà and Celle Ligure basil is grown in high-tech greenhouses (Tab.13), both in soil or in peat based substrates (soilless growing media are not allowed for the DOP) (Tab. 14). Holding that for the DOP cultivation in soil is mandatory, the close-loop system does not exist in this area. The visited greenhouses have forced ventilation or a controlled ventilation system (Tab.15), modern heating systems (Fig. 47) and no pest blocks. Between the visited farms, there were some exceptions: low-tech greenhouses, with manually regulated ventilation and no heating system; but this structure are disappearing. Concerning irrigation, the water quality is high, overhead sprinkler is used and the water amount is set according to growers' experience. Pesticides are applied through High Volume spraying or they are not applied at all, thanks to the very fast crop cycle (Tab.16).

Table 13: Crop protection structures existing in the Genoa area (percentages are calculated out of the 23 questionnaires totally collected).

Genoa Area (Liguria, Italy) - Crop Protection Structured	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel		
Low-tech greenhouse	**1**	**4,3**
high-tech greenhouse	**22**	**95,7**
closed building		

Table 14: Growing media existing in the Genoa area (percentages are calculated out of the 23 questionnaires totally collected).

Genoa Area (Liguria, Italy) - Growing Media	Number	Percentage (%)
soil	**9**	**39,1**
soilless with substrate	**14**	**60,9**
soilless without substrate		

Table 15: Ventilation systems existing in the crop protection structures in the Genoa area (percentages are calculated out of the 23 questionnaires totally collected).

Genoa Area (Liguria, Italy) - Ventilation System	Number	Percentage (%)
unregulated ventilation		
manually regulated ventilation	**1**	**4,4**
forced ventilation	**10**	**43,5**
controlled ventilation	**12**	**52,1**

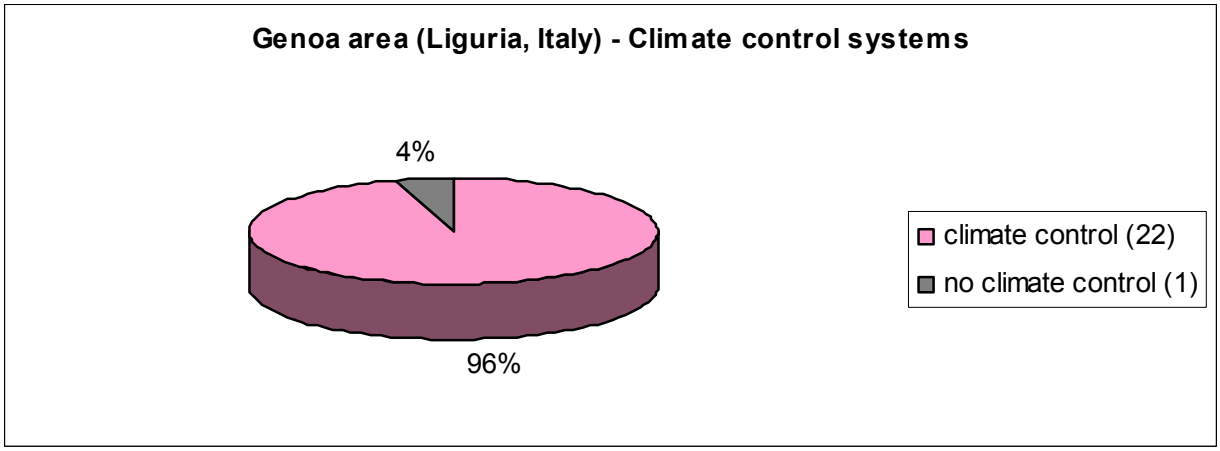

Figure 47: Presence of climate control systems in the crop protection structures taken into account in the Genoa area (percentages are calculated out of the 23 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 16: Pesticide application methods adopted in the farms taken into account in the Genoa area (percentages are calculated out of the 23 questionnaires totally collected).

Genoa Area (Liguria, Italy) - Pesticide Application Method	Number	Percentage (%)
spraying	**11**	**47,8**
fogging/fumigation		
through irrigation system		
soil injection		
soil treatment		
none	**12**	**52,2**

Lombardy

In Bergamo and Brescia Provinces protected cultivation is completely dedicated to salads under multi-span low-tech greenhouse or walk-in tunnel (Tab. 17), aimed to the minimally-processed vegetables (IV Gamma) market. Lamb's lettuce, lettuce and rocket (both rocket and wild rocket) are the species of salads grown in the area.

In this area the protection structures do not vary very much: soil crops, open-loop system, manually regulated ventilation in the greenhouses and unregulated in the tunnels (Tab. 18), no climate control systems and no pest blocks.

Water for irrigation is obtained by wells located in the farm property.

The common scheme for pesticides distribution is represented by one soil injection treatment per year, aimed at the application of soil fumigants, followed by some High Volume spraying treatments. Sometimes, soil injection is replaced with soil drench (Tab. 19).

Irrigation is carried out through overhead sprinkler and the water amount needed is set according to grower's experience.

Table 17: Crop protection structures existing in Bergamo and Brescia Provinces (percentages are calculated out of the 19 questionnaires totally collected).

Lombardy (Italy) - Irrigation Method	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel	**5**	**26,3**
low-tech greenhouse	**14**	**73,7**
high-tech greenhouse		
closed building		

Table 18: Ventilation systems existing in the crop protection structures in Bergamo and Brescia Provinces (percentages are calculated out of the 19 questionnaires totally collected).

Lombardy (Italy) - Ventilation System	Number	Perecentage (%)
unregulated ventilation	**5**	**26,3**
manually regulated ventilation	**14**	**73,7**
forced ventilation		
controlled ventilation		

Table 19: Pesticide application methods adopted in the farms taken into account in Bergamo and Brescia Provinces (percentages are calculated out of the 19 questionnaires totally collected).

LOMBARDY (ITALY) - PESTICIDE APPLICATION METHOD	NUMBER	PERCENTAGE (%)
spraying	**19**	**100,00**
fogging/fumigation		
through irrigation system		
soil injection	**15**	**78,9**
soil treatment	**4**	**21,1**
none		

Study Region 2

Sicily

In Sicily vegetable crops are largely predominant, with protected cultivations of tomato (the most important crop in Ragusa province), zucchini, melon, table grape and eggplant (Fig. 48). In the coastal areas, and particularly in Ragusa Province, there is a very high concentration of greenhouses (Fig. 49).

In this area the crop protection structures are usually very simple: high-plastic shelter, walk-in tunnels and low-tech greenhouses (Tab. 20). Crops are grown everywhere in soil, thus the close-loop system is not of interest. However, there are some high-tech greenhouses, under which tomato is grown soilless, in coconut fiber or in others media (Tab. 21).

Concerning irrigation, all the farms taken into account have their own well. In Ragusa Province the water used for irrigation is usually salty, or even brackish. This is not necessary a negative aspect, since, for example, tomato growers prefer salty water, as a tool for improving tomato's quality. Where salty water represents a problem, farmers have set up systems for the recycling of rain water, reverse osmosis or decantation basins (Fig. 50). On the contrary, in Mazzarone area, that is farer from the coast, the water is usually high quality.

Greenhouse ventilation is manually regulated everywhere, with the exception of tunnels and high shelters, where the ventilation is not regulated; in the high-tech greenhouses ventilation is controlled (Tab. 22). Climate control systems are not commonly used; only the high-tech greenhouses are provided with them, and in some cases growers have set up an aid heating system (Fig. 51).

Most of the farms have net on the openings (Tab. 23), having the function of blocking insects or birds (this is the case of table grape in low-tech greenhouse). Usually, soil drip fumigation is done once a year, followed by pesticide treatments through High Volume spraying; in some cases, the drip fumigation is replaced with soil injection. Only one eggplant growers use also fogging (Ultra Low Volume spraying) (Tab. 23).

Each farm adopts drip irrigation, which is sometimes coupled with overhead sprinkler. The water amount needed is set according to grower's experience, sometimes with the support of temperature and air humidity detections or soil moisture measurements (Tab. 24).

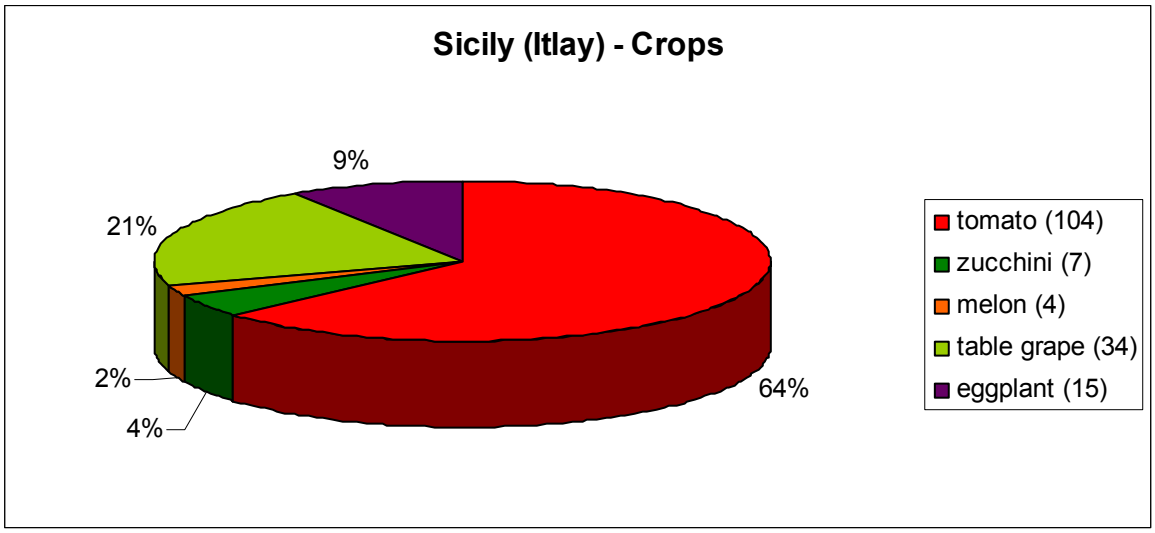

Figure 48: Crops grown in the farms interviewed in Sicily (percentages are calculated out of the 164 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Figure 49: Greenhouses in Scoglitti area (Ragusa, Sicily, Italy). (Source: Ce.R.S.A.A., 2010)

Table 20: Crop protection structures existing in Sicily (percentages are calculated out of the 164 questionnaires totally collected).

Sicily (Italy) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter	**5**	**3,0**
shade-house		
walk-in tunnel	**12**	**7,3**
low-tech greenhouse	**142**	**86,6**
high-tech greenhouse	**5**	**3,05**
closed building		

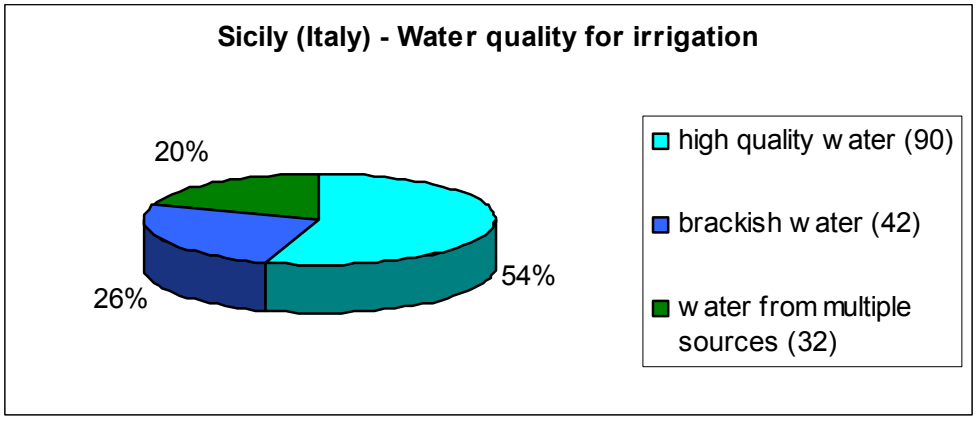

Figure 50: Quality of the water used by the growers interviewed in Sicily (percentages are calculated out of the 164 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 21: Growing media used in Sicily (percentages are calculated out of the 164 questionnaires totally collected).

Sicily (Italy) - Growing Media	Number	Percentage (%)
soil	**157**	**95,7**
soilless with substrate	**7**	**4,3**
soilless without substrate		

Table 22: Ventilation systems existing in the crop protection structures in Sicily (percentages are calculated out of the 164 questionnaires totally collected).

Sicily (Italy) – Ventilation System	Number	Percentage (%)
unregulated ventilation	**17**	**10,3**
manually regulated ventilation	**143**	**87,2**
forced ventilation		
controlled ventilation	**4**	**2,4**

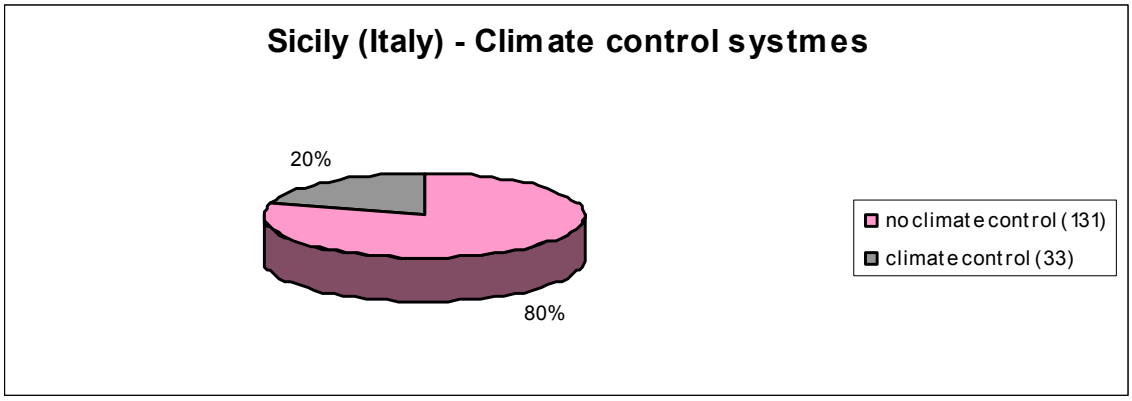

Figure 51: Presence of climate control systems in the crop protection structures taken into account in Sicily (percentages are calculated out of the 164 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 23: Pest blocks presence and pesticide application methods adopted in the farms taken into account in Sicily (percentages are calculated out of the 164 questionnaires totally collected).

Sicily (Italy) Pest Blocks	Number	Percentage (%)
no pest block	**21**	**12,8**
partial pest block	**142**	**86,6**
full pest block	**1**	**0,6**
full pest block with double door		
Pesticide Application Method		
spraying	**164**	**100,00**
fogging/fumigation	**4**	**2,4**
through irrigation system	**115**	**70,1**
soil injection	**15**	**9,2**
soil treatment		
none		

Table 24: Irrigation methods and water amount calculation systems used by the growers in Sicily (percentages are calculated out of the 164 questionnaires totally collected).

Sicily (Italy) - Irrigation Method	Number	Percentage (%)
drip irrigation	**164**	**100,00**
overhead sprinkler	**57**	**34,8**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**156**	**95,1**
on basis of calculated crop requirements	**8**	**4,88**
on basis of soil moisture measurements	**1**	**0,6**
on basis of visible water stress		
in large excess		
other or none		

SPAIN

Study Region 3

Andalucía

In the Spanish Study Region, protected agriculture is dedicated exclusively to vegetable and fruit crops. In the Almeria area (Andalucía) the survey involved farmers growing table grape, pepper, zucchini, cucumber, watermelon, melon, tomato and eggplant, according to the percentages shown in Fig. 52.

In this area the protected crops are grown mostly under low-tech greenhouses, sometimes under high-tech greenhouses (Tab. 25). The cultivations are done in soil, with only few exceptions of tomato and cucumber in soilless with substrate culture. The close-loop system does not exist at all (Tab. 26).

The water for irrigation in this area is generally of high quality (Fig. 53).

Greenhouse ventilation is manually regulated and there are no heating or cooling systems. Each greenhouse is equipped with a full pest block net with double door. Pesticides are applied only by spraying. The soil disinfestation is carried out once every two years through drip fumigation.

Irrigation is done everywhere through drip and the amount of water needed is set according to grower's experience or using soil moisture measurement tools (Tab. 27).

In the Huelva area (Andalucía) small fruits and berries are largely predominant in protected agriculture, with particular regards to strawberry, but also raspberry and blueberry are cultivated (Fig. 55). They are grown in soil in removable low plastic tunnel or walk-in tunnel (Fig. 54 and Tab. 28). Such very simple structures have not regulated ventilation and any climate control system. Holding that the soilless culture is not used at all, the close-loop system is not of interest.

Some of the tunnels taken into account in the survey have a full pest block net, even if usually tunnels are not provided by any pest block (Tab. 29). Pesticide treatments are carried out only through spraying. The soil disinfestation is done once every two years through drip fumigation.

In this area the water for irrigation is of high quality.

Irrigation is done everywhere through drip and the amount of water needed is set according to grower's experience or using soil moisture measurement tools (Tab. 30).

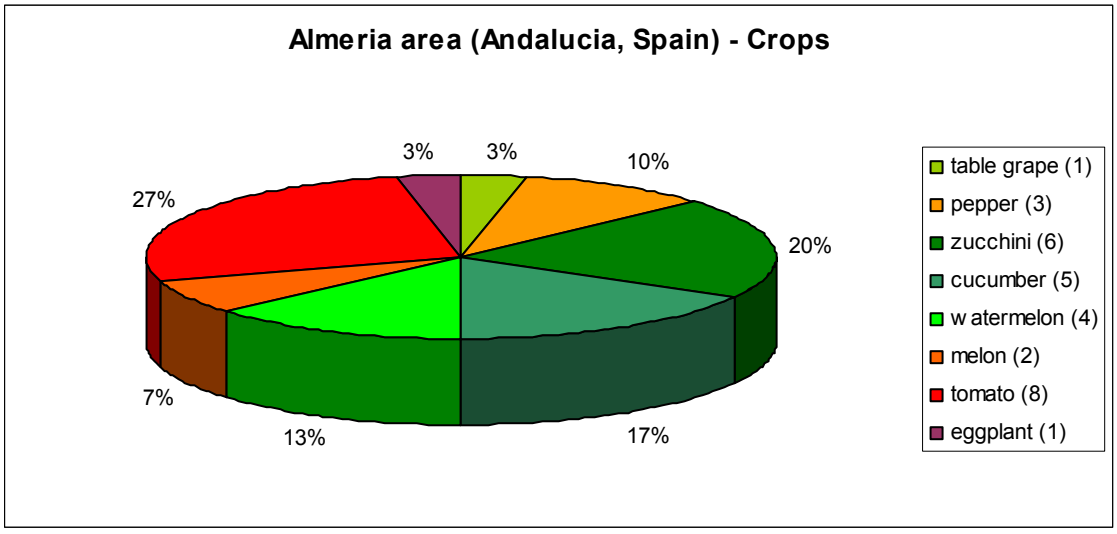

Figure 52: Crops grown in the farms interviewed in the Almeria area (percentages are calculated out of the 30 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 25: Crop protection structures existing in the Almeria area (percentages are calculated out of the 30 questionnaires totally collected).

Almeria Area (Andalucía, Spain) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel		
low-tech greenhouse	**27**	**90,0**
high-tech greenhouse	**3**	**10,0**
closed building		

Table 26: Growing media and water recirculation systems existing in the Almeria area (percentages are calculated out of the 30 questionnaires totally collected).

Almeria Area (Andalucía, Spain) - Growing Media	Number	Percentage (%)
soil	**27**	**90,0**
soilless with substrate	**3**	**10,0**
soilless without substrate		
Water Recirculation System		
open-loop	**30**	**100,0**
close-loop		

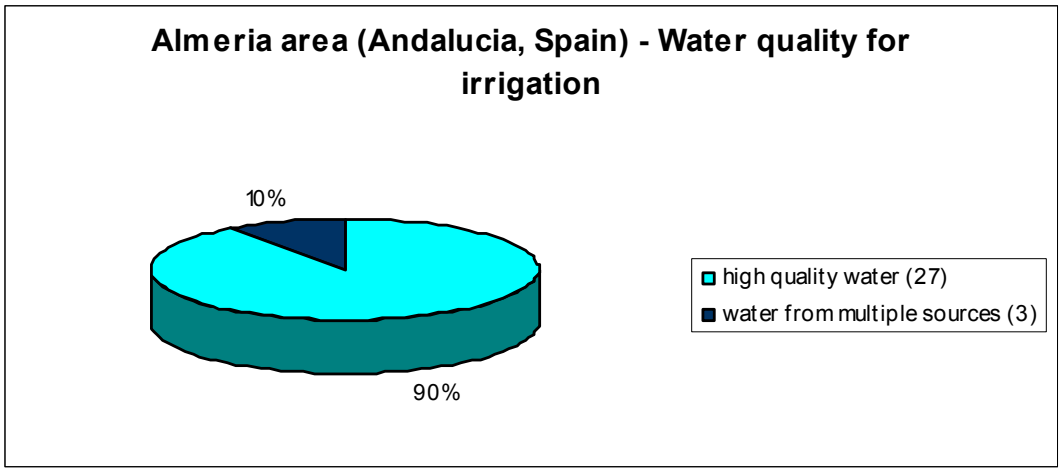

Figure 53: Quality of the water used by the growers interviewed in the Almeria area (percentages are calculated out of the 30 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 27: Irrigation methods and water amount calculation systems used by the growers in the Almeria area (percentages are calculated out of the 30 questionnaires totally collected).

Almeria Area (Andalucía, Spain) - Irrigation Method	Number	Percentage (%)
drip irrigation	**30**	**100,0**
overhead sprinkler		
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**16**	**53,3**
on basis of calculated crop requirements		
on basis of soil moisture measurements	**14**	**46,7**
on basis of visible water stress		
in large excess		
other or none		

Figure 54: Low and walk-in tunnels in Huelva area (Spain). (Source: Ce.R.S.A.A., 2010)

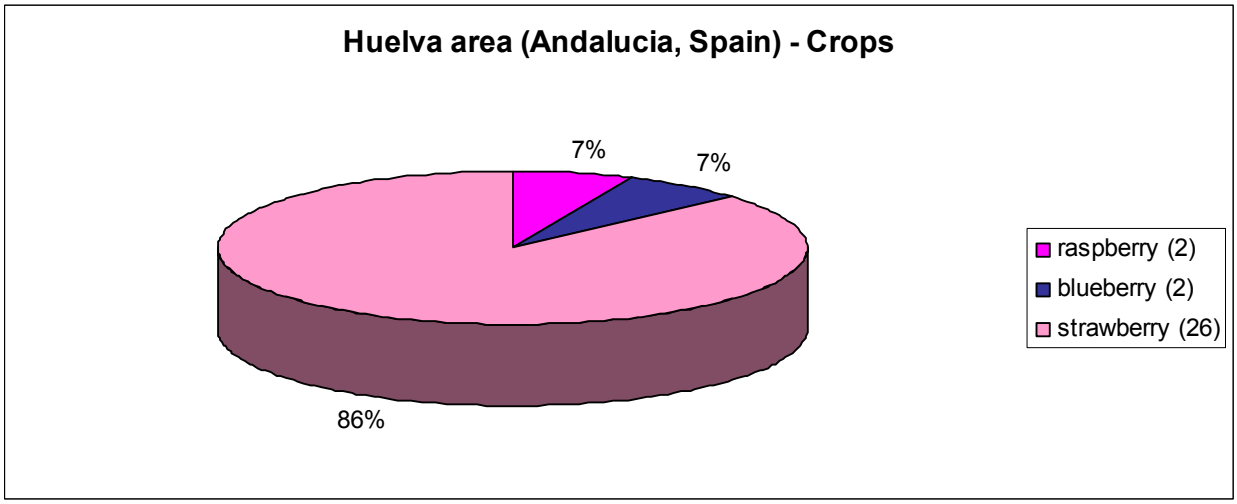

Figure 55: Crops grown in the farms interviewed in the Huelva area (percentages are calculated out of the 30 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 28: Crop protection structures existing in the Huelva area (percentages are calculated out of the 30 questionnaires totally collected).

Huelva Area (Andalucía, Spain) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel	**1**	**3,3**
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel	**29**	**96,7**
low-tech greenhouse		
high-tech greenhouse		
closed building		

Table 29: Pest blocks presence in the farms taken into account in the Huelva area (percentages are calculated out of the 30 questionnaires totally collected).

Huelva Area (Andalucía, Spain) - Pest Blocks	Number	Percentage (%)
no pest block	**27**	**90,0**
partial pest block		
full pest block	**3**	**10,0**
full pest block with double door		

Table 30: Irrigation methods and water amount calculation systems used by the growers in the Huelva area (percentages are calculated out of the 30 questionnaires totally collected).

Huelva Area (Andalucía, Spain) - Irrigation Method	Number	Percentage (%)
drip irrigation	**30**	**100,0**
overhead sprinkler		
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**27**	**90,0**
on basis of calculated crop requirements		
on basis of soil moisture measurements	**3**	**10,0**
on basis of visible water stress		
in large excess		
other or none		

Murcia Region

In Murcia Region the protected cultivation area is mainly dedicated to table grape grown under shelter and to pepper and tomato in greenhouse; there are also cultivations of watermelon (Fig. 56). In particular, the protection structures existing in this region are low plastic shelters, high net shelters, low-tech and high-tech greenhouses (Tab. 31).

In this area usually the crops are grown in soil; only few cases of pepper in soilless culture have been found, and very rarely the close-loop system is practiced (Tab. 32).

In this Region, and particularly in Campo de Cartagena area (Torre Pacheco, San Javier, Fuente Alamo), irrigation water is salty; thus, in order to reach the needed amount and quality, it is usually obtained by several sources (for example from river and desalinator) (Fig. 57).

Low-tech greenhouses have a manually regulated ventilation system, while in the shelters the ventilation is unregulated and they have not any climate control system. On the contrary, in the high-tech greenhouses the ventilation is forced or controlled by a computer (Tab. 33), but only in few cases heating system is used (Fig. 58).

The shelters have not any pest block, while some of the greenhouses are provided with full pest block net, sometimes also with double door (Tab. 34). The application method for pesticides is spraying or fogging/fumigation (Tab 34). The soil disinfestation is carried out once every two years through drip fumigation.

Irrigation is carried out everywhere through drip and the amount of water needed is set according to grower's experience or using soil moisture measurement tools (Tab. 35).

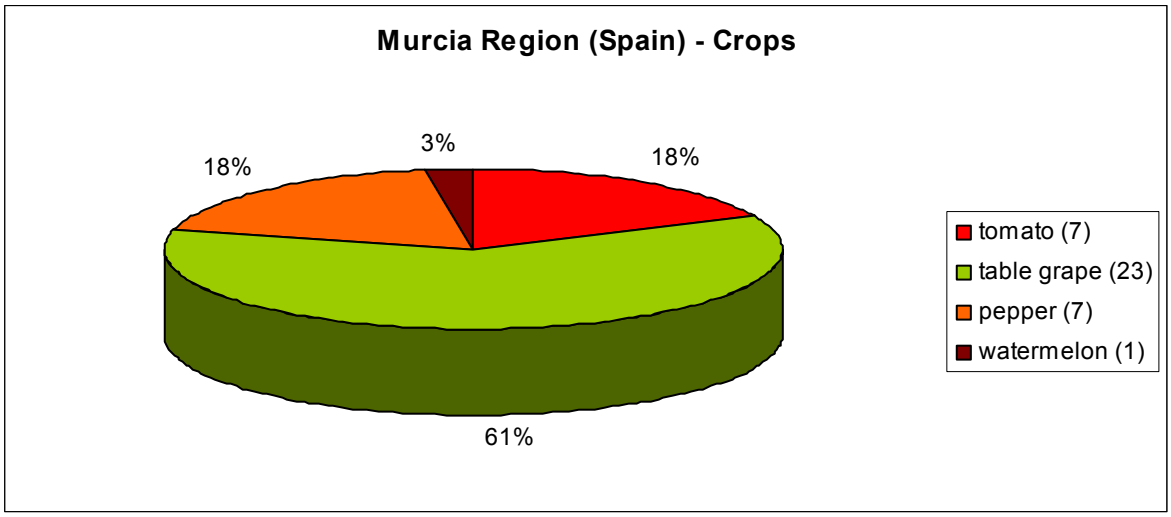

Figure 56: Crops grown in the farms interviewed in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 31: Crop protection structures existing in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected).

Murcia Region (Spain) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter	**1**	**2,6**
low net tunnel		
low plastic tunnel		
high net shelter	**21**	**55,3**
high plastic shelter		
shade-house	**3**	**7,9**
walk-in tunnel		
low-tech greenhouse	**6**	**15,8**
high-tech greenhouse	**7**	**18,4**
closed building		

Table 32: Growing media and water recirculation systems existing in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected).

Murcia Region (Spain) - Growing Media	Number	Percentage (%)
soil	**35**	**92,1**
soilless with substrate	**3**	**7,9**
soilless without substrate		
Water Recirculation System		
open-loop	**37**	**97,4**
close-loop	**1**	**2,6**

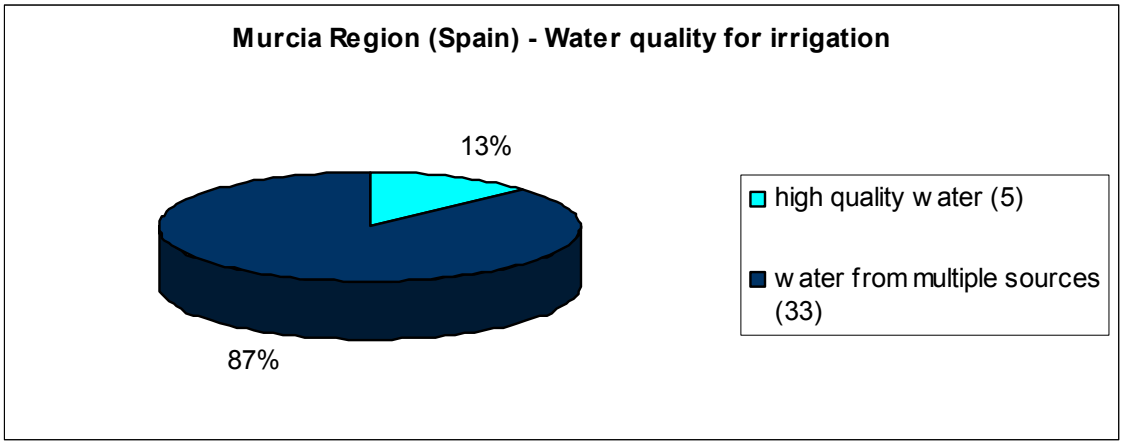

Figure 57: Quality of the water used by the growers interviewed in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 33: Ventilation systems existing in the crop protection structures in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected).

Murcia Region (Spain) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**21**	**55,3**
manually regulated ventilation	**10**	**26,3**
forced ventilation	**4**	**10,5**
controlled ventilation	**3**	**7,9**

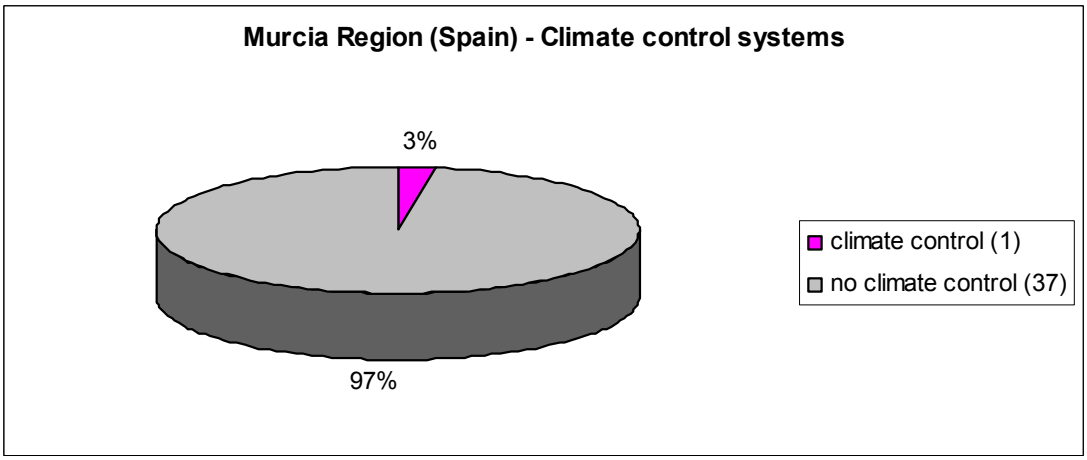

Figure 58: Climate control systems used in the farms taken into account in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 34: Pest blocks presence and pesticide application methods adopted in the farms taken into account in the Murcia Region (percentages are calculated out of the 38 questionnaires totally collected).

Murcia Region (Spain) - Pest Blocks	Number	Percentage (%)
no pest block	**22**	**57,9**
partial pest block		
full pest block	**8**	**21,0**
full pest block with double door	**8**	**21,0**
Pesticide Application Method		
spraying	**10**	**26,3**
fogging/fumigation	**28**	**73,9**
through irrigation system		
soil injection		
soil treatment		
none		

Table 35: Irrigation methods and water amount calculation systems used by the growers in Murcia Region (percentages are calculated out of the 38 questionnaires totally collected).

Murcia Region (Spain) - Irrigation Method	Number	Percentage (%)
drip irrigation	**38**	**100,0**
overhead sprinkler		
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**25**	**65,8**
on basis of calculated crop requirements		
on basis of soil moisture measurements	**13**	**34,2**
on basis of visible water stress		
in large excess		
other or none		

GREECE

Study Region 4

Crete

In Crete protected agriculture is located around Ierapetra city. In this area vegetable crops are strictly predominant over ornamentals (Fig. 59) and the most important species are pepper, tomato and cucumber, followed by eggplant (Fig. 60).

The crop protection structures do not vary very much: low tech greenhouse with plastic film (Tab. 36), manually regulated ventilation and no climate control systems (Fig. 61). In some cases the ventilation is unregulated, in others there are fans (forced ventilation) (Tab. 37). Rarely low-tech greenhouses are heated. Also some high-tech greenhouse exist here, usually used for flowers or nursery; these structures are provided by controlled ventilation, but not always by a heating system.

Usually, crops are grown in soil, and consequently there is no water recycling. Some of the farms taken into account use soilless culture with substrate, sometimes coupled with the close-loop system (Tab. 38).

The water for irrigation is often too salty, although it is taken from an artificial lake, and sometimes, in order to improve water quality, rainwater is recycled or the reverse osmosis is applied (Fig. 62). Irrigation is almost everywhere done by drip, and the water amount needed is usually set according to the growers' experience, sometimes with the support of climatic parameters detections or soil moisture measurements(Tab. 39).

Pest blocks, partial or full, are quite spread. Pesticides are applied through High Volume spraying (Tab. 40). Soil disinfestation is carried out once a year through drip fumigation. The number of treatments/year is usually very high, but it is remarkable that the compliance with the Integrated Crop Management disciplinary and the interest in the Organic Farming practices are in quick expansion.

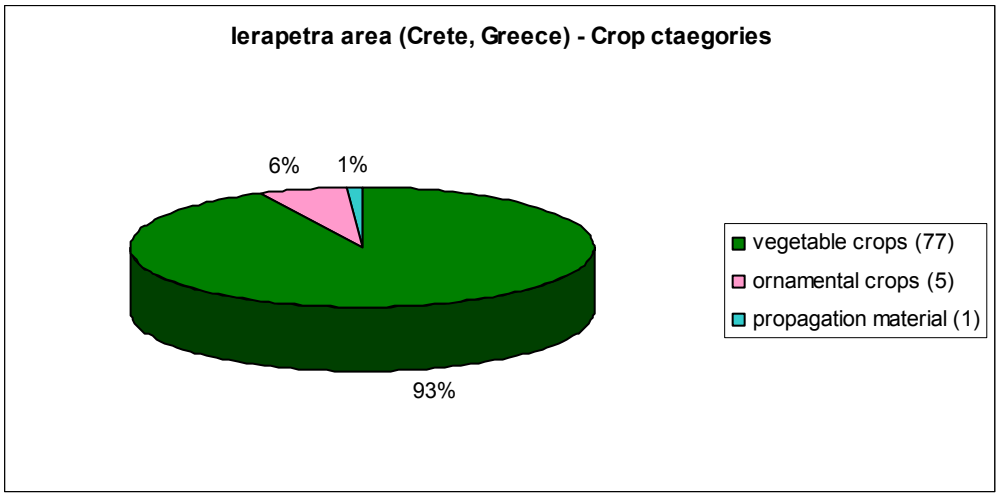

Figure 59: Crop categories grow in the farms interviewed in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected). In brackets, the number of questionnaires for each category.

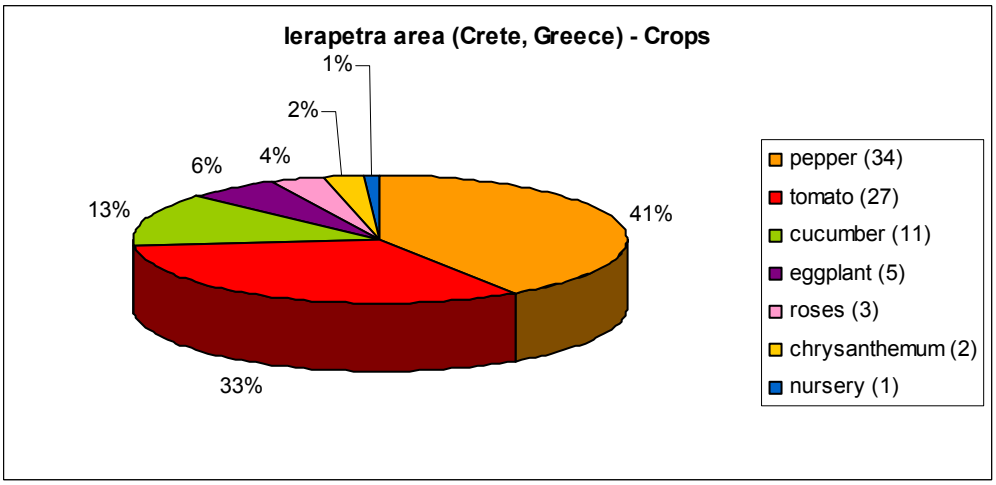

Figure 60: Crops grow in the farms interviewed in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 36: Crop protection structures existing in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected).

Ierapetra Area (Crete, Greece) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel		
low-tech greenhouse	**76**	**91,6**
high-tech greenhouse	**7**	**8,4**
closed building		

Table 37: Ventilation systems existing in the crop protection structures in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected).

Ierapetra Area (Crete, Greece) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**1**	**1,2**
manually regulated ventilation	**67**	**80,7**
forced ventilation	**8**	**9,6**
controlled ventilation	**7**	**8,4**

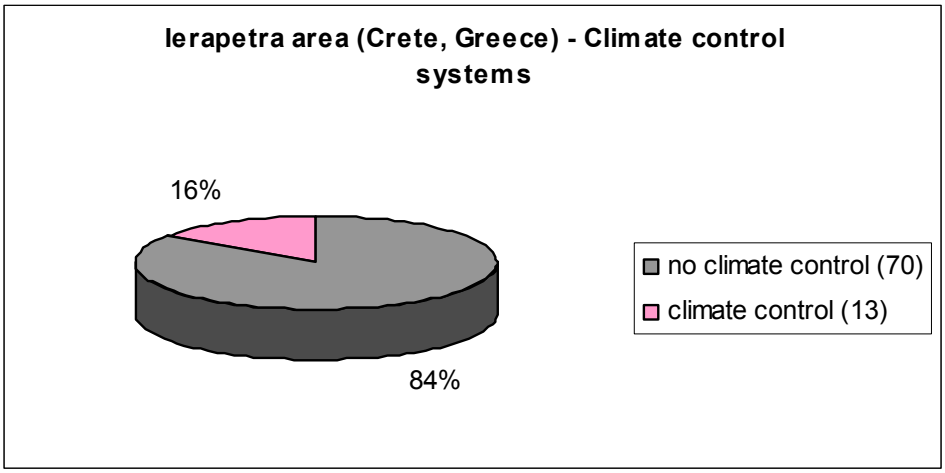

Figure 61: Presence of climate control systems in the crop protection structures taken into account in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected). In brackets, the number of questionnaires for each category).

Table 38: Growing media and water recirculation systems existing in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected).

Ierapetra Area (Crete, Greece) - Growing Media	Number	Percentage (%)
soil	**74**	**89,2**
soilless with substrate	**9**	**10,8**
soilless without substrate		
Water Recirculation System		
open-loop	**79**	**95,2**
close-loop	**4**	**4,8**
partial close-loop		

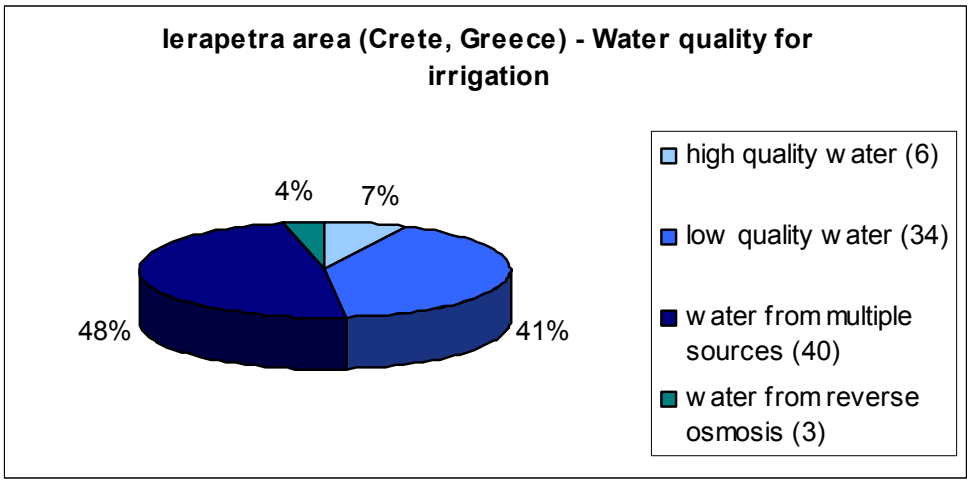

Figure 62: Quality of the water used by the growers interviewed in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 39: Irrigation methods and water amount calculation systems used by the growers in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected).

Ierapetra Area (Crete, Greece) - Irrigation Method	Number	Percentage (%)
drip irrigation	**81**	**97,6**
overhead sprinkler	**4**	**4,8**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**77**	**92,7**
on basis of calculated crop requirements	**4**	**4,82**
on basis of soil moisture measurements	**2**	**2,4**
on basis of visible water stress		
in large excess		
other or none		

Table 40: Pest blocks presence and pesticide application methods adopted in the farms taken into account in the Ierapetra area (percentages are calculated out of the 83 questionnaires totally collected).

Ierapetra Area (Crete, Greece) - Pest Blocks	Number	Percentage (%)
no pest block	**18**	**21,7**
partial pest block	**30**	**36,1**
full pest block	**35**	**42,2**
full pest block with double door		
Pesticide Application Method		
spraying	**81**	**97,6**
fogging/fumigation	**1**	**1,2**
through irrigation system	**83**	**100,0**
soil injection		
soil treatment	**1**	**1,2**
none		

FRANCE

Study Region 5

Provence-Alpes-Côte d'Azur

The departments interested by the survey were the Dep. des Alpes-Maritimes, and particularly the area around Nice, and the Dep. du Var (Frejus area).

Here, protected cultivation is dedicated both to vegetable and ornamental crops (Fig. 63); the survey involved farmers growing tomato, strawberry, raspberry and roses, green foliages and potted ornamentals (Fig. 64)

In this area the existing crop protection structures are represented by walk-in tunnels, low-tech and high-tech greenhouses (Tab. 41). Strawberry and high value ornamental crops (like rose) are usually grown in media as coconut fiber or peat based substrates, while tomato, raspberry and sometimes green foliage (it depends on the species) are grown in soil (Tab. 42). The close-loop system is common both in strawberry and ornamental cultivations (Tab. 42).

The water for irrigation in this area is mainly provided by a well in the farm's area and it is of high quality.

High-tech greenhouses are provided by controlled ventilation, while in the low-tech greenhouses it is manually regulated; walk-in tunnel has unregulated or manually regulated ventilation (Tab. 43). Heating systems are always used for ornamental crops, and sometimes also for vegetables (Fig. 65).

Concerning pest control, the use of pest blocks is not common; spraying is the most used pesticide application method (High, Middle or Reduce Volume spraying), but sometimes also fogging is used (Ultra Low Volume spraying) (Tab. 44).

Drip irrigation is the most common irrigation method adopted, sometimes coupled with overhead sprinkler; in few farms (mostly dedicated to pot ornamental) sub-irrigation is used (Tab. 45). The water amount is set according to grower's experience, rarely with the support of solar integrators (Tab 45).

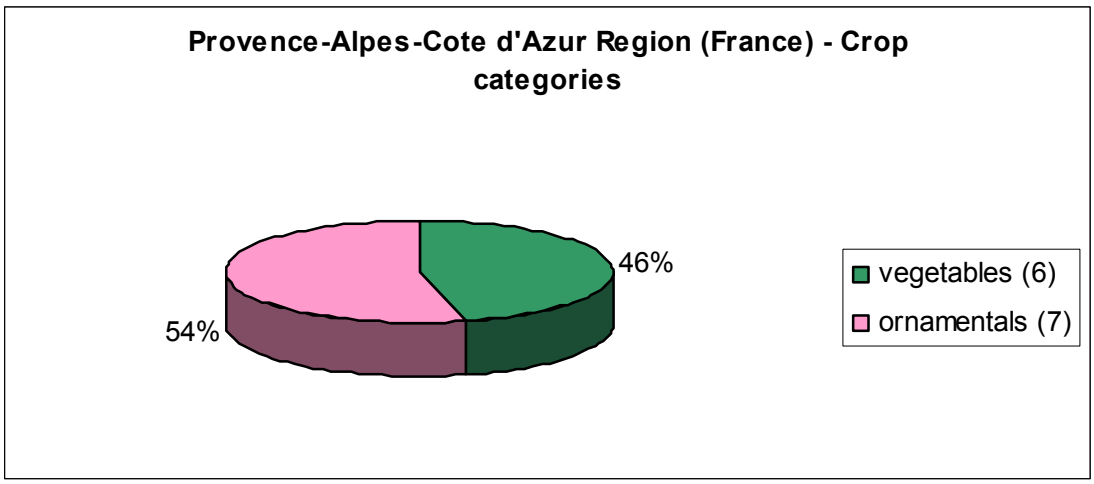

Figure 63: Crop categories grow in the farms interviewed in Provence area (percentages are calculated out of the 13 questionnaires totally collected). In brackets, the number of questionnaires for each category.

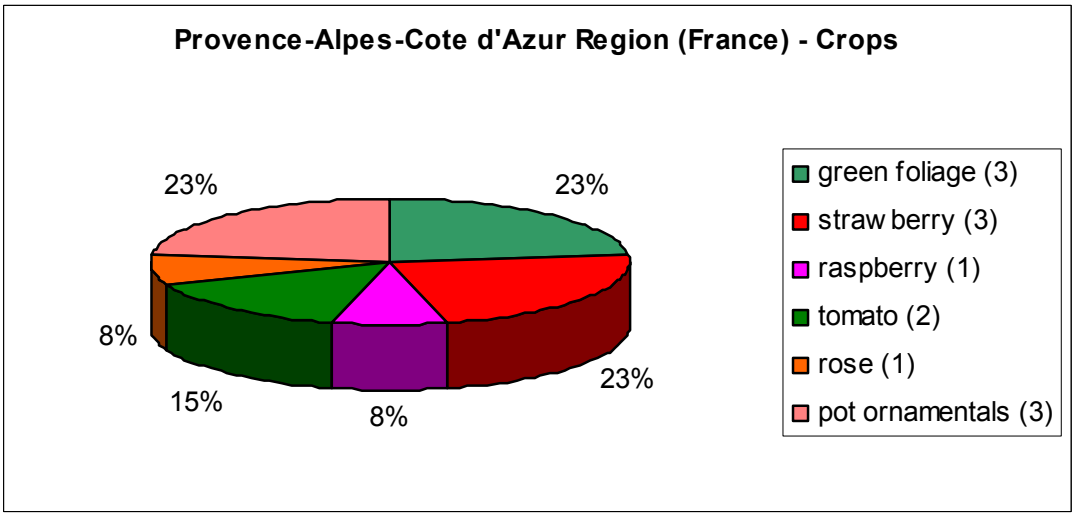

Figure 64: Crops grow in the farms interviewed in Provence area (percentages are calculated out of the 13 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 41: Crop protection structures existing in Provence area (percentages are calculated out of the 13 questionnaires totally collected).

Provence-Alpes-Côte d'Azur Region (France) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel		
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel	**4**	**30,8**
low-tech greenhouse	**3**	**23,1**
high-tech greenhouse	**6**	**46,1**
closed building		

Table 42: Growing media and water recirculation systems existing in Provence area (percentages are calculated out of the 13 questionnaires totally collected).

Provence-Alpes-Côte d'Azur Region (France) - Growing Media	Number	Percentage (%)
soil	**5**	**38,5**
soilless with substrate	**8**	**61,5**
soilless without substrate		
Water Recirculation System		
open-loop	**10**	**76,9**
close-loop	**3**	**23,1**

Table 43: Ventilation systems existing in the crop protection structures in Provence area (percentages are calculated out of the 13 questionnaires totally collected).

Provence-Alpes-Côte d'Azur Region (France) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**2**	**15,38**
manually regulated ventilation	**5**	**38,46**
forced ventilation		
controlled ventilation	**6**	**46,15**

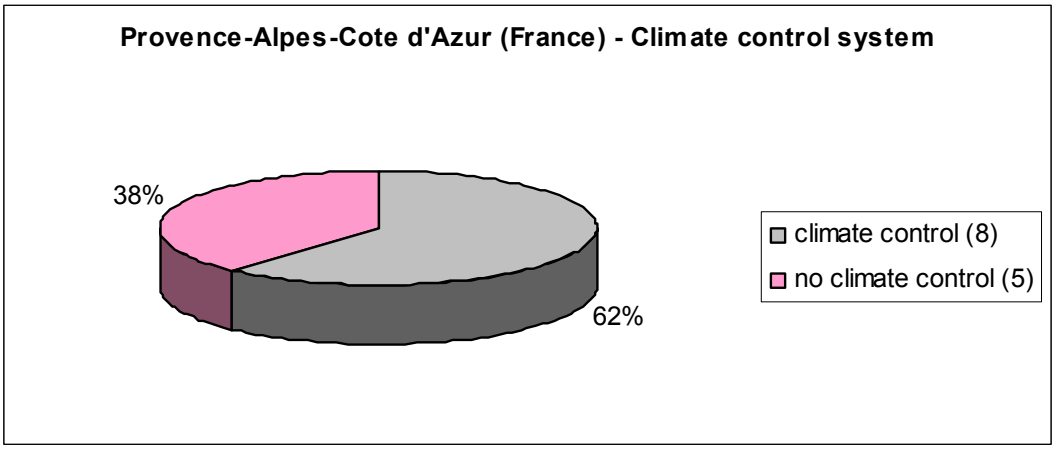

Figure 65: Presence of climate control systems in the crop protection structures taken into account in Provence area (percentages are calculated out of the 13 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 44: Pesticides application methods adopted in the farms taken into account in Provence area (percentages are calculated out of the 13 questionnaires totally collected).

Provence-Alpes-Côte d'Azur Region (France) - Pesticides Application Method	Number	Percentage (%)
spraying	**12**	**92,3**
fogging/fumigation	**3**	**23,1**
through irrigation system		
soil injection		
soil treatment		
none	**1**	**7,7**

Table 45: Irrigation methods used by the growers in Provence area (percentages are calculated out of the 13 questionnaires totally collected).

Provence-Alpes-Côte d'Azur Region (France) - Irrigation Method	Number	Percentage (%)
drip irrigation	**12**	**92,3**
overhead sprinkler	**3**	**23,1**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation	**1**	**7,7**
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**12**	**92,31**
on basis of calculated crop requirements	**1**	**7,69**
on basis of soil moisture measurements		
on basis of visible water stress		
in large excess		
other or none		

Languedoc-Roussillon

In this Region vegetables, and particularly tomato, are the most important crops grown under protection structures, but there are also some aromatic plants (Fig. 66). The survey involved farmers growing aromatic herbs, cucumber, eggplants, lettuce and other salads, melon and tomato (Fig. 67). Here, crop protection structures are very variable: low plastic tunnel, walk-in tunnel, low-tech and high-tech greenhouses (Tab. 46). Tomato is usually grown in substrate media like coconut fiber or rock wool, sometimes using also close-loop system, while the other crops are grown in soil (Tab. 47). High-tech greenhouses are provided with controlled ventilation and climate control systems; the other structures have manually regulated ventilation (unregulated in the case of low plastic tunnels) and, sometimes, heating systems (Tab. 48 and Fig. 68).

The use of pest blocks is not common and pesticides are usually applied through spraying (Tab. 49). In the cases of the crops grown in soil, also a soil disinfection is carried out once (or more) a year, through irrigation system, soil treatments or solarization. Water quality is high and irrigation is carried out through drip or overhead sprinkler. The water amount needed is calculated basing on substrate moisture measurements or on grower's experience; rarely, water is supplied in large excess (Tab. 50).

Aquitaine

In this Region only 5 tomato growers were interviewed and the features of the crop protection system are exactly the same described for tomato grown in soilless culture in Languedoc-Roussillon area.

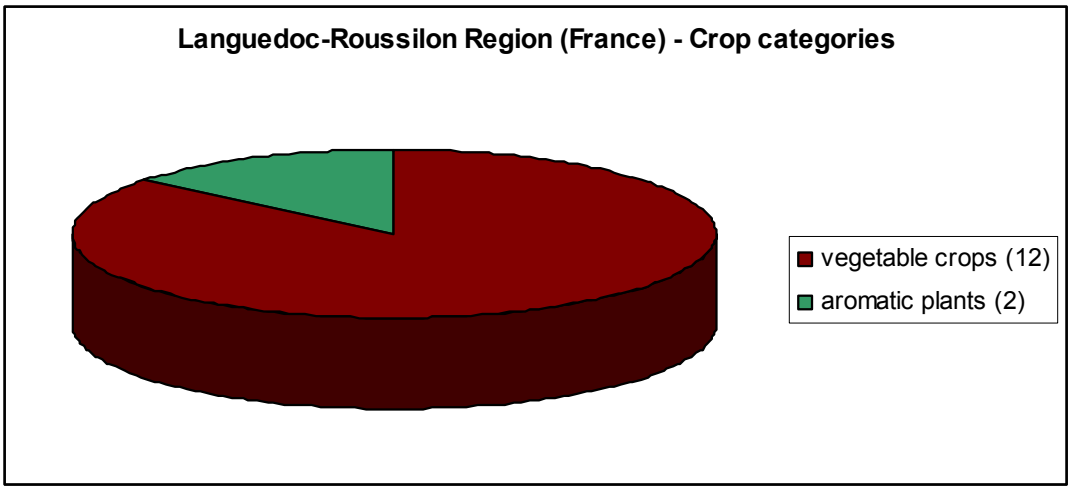

Figure 66: Crop categories grow in the farms interviewed in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected). In brackets, the number of questionnaires for each category.

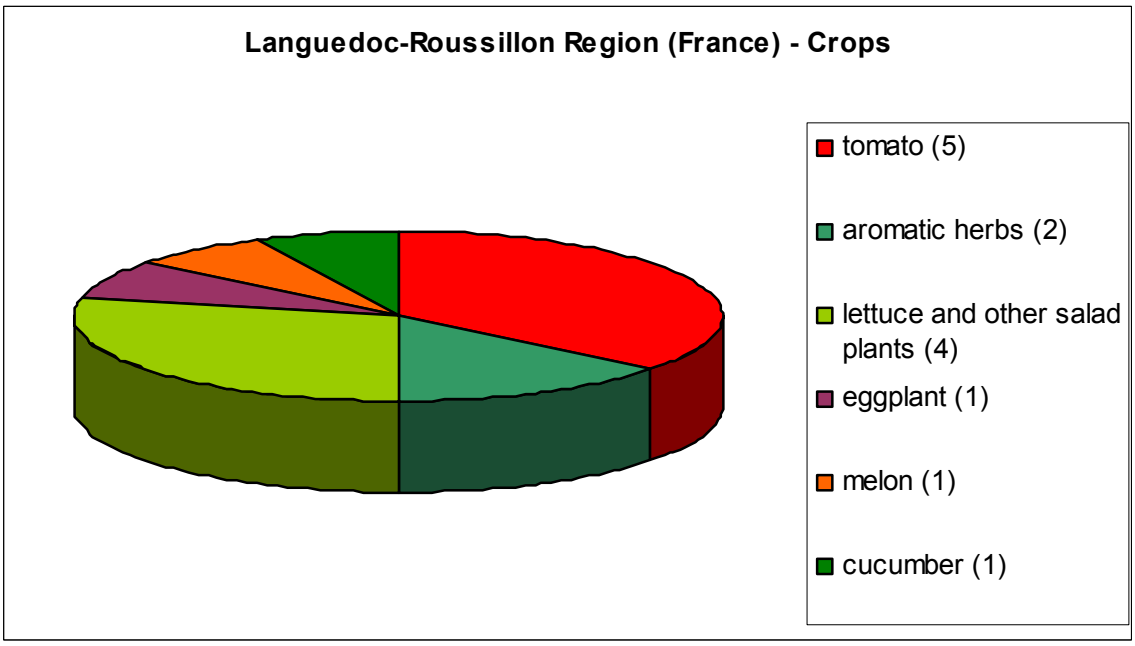

Figure 67: Crops grow in the farms interviewed in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected). In brackets, the number of questionnaires for each crop.

Table 46: Crop protection structures existing in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected).

Languedoc-Roussillon Region (France) - Crop Protection Structures	Number	Percentage (%)
low net shelter		
low plastic shelter		
low net tunnel		
low plastic tunnel	**1**	**7,1**
high net shelter		
high plastic shelter		
shade-house		
walk-in tunnel	**3**	**21,4**
low-tech greenhouse	**3**	**21,4**
high-tech greenhouse	**7**	**50,0**
closed building		

Table 47: Growing media and water recirculation systems existing in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected).

Languedoc-Roussillon Region (France) - Growing Media	Number	Percentage (%)
soil	**10**	**71,4**
soilless with substrate	**4**	**28,6**
soilless without substrate		
Water Recirculation System		
open-loop	**12**	**85,7**
close-loop	**2**	**14,3**

Table 48: Ventilation systems existing in the crop protection structures in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected).

Languedoc-Roussillon Region (France) - Ventilation System	Number	Percentage (%)
unregulated ventilation	**1**	**7,1**
manually regulated ventilation	**7**	**50,0**
forced ventilation		
controlled ventilation	**6**	**42,9**

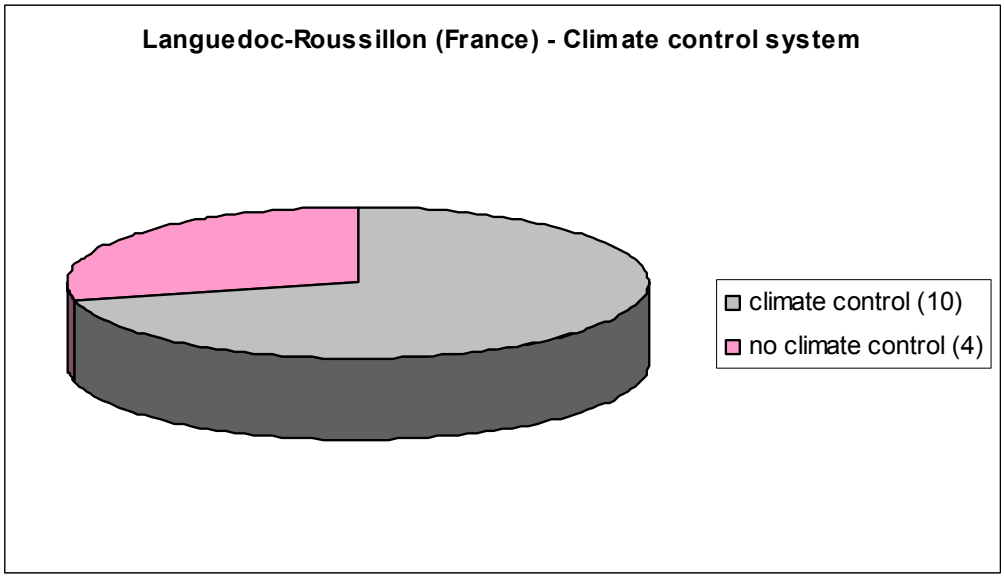

Figure 68: Presence of climate control systems in the crop protection structures taken into account in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected). In brackets, the number of questionnaires for each category.

Table 49: Pesticides application methods adopted in the farms taken into account in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected).

Languedoc-Roussillon Region (France) - Pesticides Application Method	Number	Percentage (%)
spraying	**14**	**100,0**
fogging/fumigation		
through irrigation system	**2**	**14,3**
soil injection		
soil treatment	**8**	**57,1**
none		

Table 50: Irrigation and water amount calculation methods used by the growers in Languedoc-Roussillon area (percentages are calculated out of the 14 questionnaires totally collected).

Languedoc-Roussillon Region (France) - Irrigation Method	Number	Percentage (%)
drip irrigation	**8**	**57,1**
overhead sprinkler	**7**	**50,0**
furrows or gullies in the soil		
nutrient solution in soilless culture		
sub-irrigation		
other or none		
Irrigation Amount Calculation		
on basis of grower's experience	**8**	**57,1**
on basis of calculated crop requirements		
on basis of soil moisture measurements	**5**	**35,7**
on basis of visible water stress		
in large excess	**1**	**7,1**
other or none		

Interpretation of the collected data

The collected data have been analyzed in order to compare and contrast the different protected cultivation systems in the different Study Regions.
First of all, the growing techniques of each crop category have been examined with the aim of identifying the leading strategy of production in Southern Europe. Then, each data element has been analyzed focusing on the ones that affect the number of pesticide treatments/year. Eventually, the data concerning some of the most important crops in all the different Study Regions have been compared, so as to highlight the differences (and the similarities) between the Countries.

CORRELATIONS BETWEEN CROP TYPE AND THE FEATURES OF THE PROTECTED CULTIVATION

The collected data concerning all the different crop categories have been studied, and the growing features shared by each Study Region have been detected. The crop categories are: fruits, including berries and table grape, fruiting vegetables, leafy vegetables, including salads and herbs, cut flowers, pot ornamental and propagation materials.

Berries

The data concerning berries (strawberry, blueberry and raspberry) have been collected in the Study Region 3 (Huelva, Spain) and in the Study Region 5 (Provence, France). They are usually cultivated in walk-in tunnels, very simple structures with unregulated ventilation and no climate control. They are grown mostly in soil and are irrigated through drip. Pesticides are applied with sprayers and about 5-10 treatments/year are carried out (Tab. 51); moreover, a treatment through drip fumigation is done once every two years, for the purpose of disinfesting the soil.

Table grape

The Study Regions in which table grape is cultivated under protection are the 2 (Sicily, Italy) and the 3 (Almeria and Murcia, Spain). Protected table grape is grown both under low-tech greenhouses and high net/plastic shelters, structures that have no climate control and, respectively, manually regulated ventilation and unregulated ventilation. The growing media is represented everywhere by

soil. Between 5 and 19 pesticide treatments are executed each year through spraying or fogging. The irrigation is carried out with drip (Tab. 51).

Fruiting vegetables

Fruiting vegetables are grown in all the Study Regions. This category includes tomato, pepper, eggplant, cucumber, zucchini, melon and watermelon. They are usually cultivated in soil, mostly under low-tech greenhouses, and sometimes walk-in tunnels. These structures have no climate control and the ventilation is manually regulated or unregulated, respectively for low-tech greenhouses and walk-in tunnels. The irrigation is carried out through drip. Concerning pesticide treatments, the most used method is spraying; moreover, when crops are grown in soil, a drip fumigation, or a soil injection, aimed at the soil disinfestation, is carried out once a year (soil injection is exclusively done by eggplant growers) (Tab. 52). Rarely, tomato is grown in soilless culture and in high-tech greenhouses, but this is a very uncommon situation.

Table 51: Features of the protected cultivation of fruits.

Crop	Structure	Ventilation	Climate Control	Growing Media	Pesticide application method	Treatments/year	Irrigation method
FRUITS							
table grape	**low-tech greenhouse; high net/plastic shelter**	**manually regulated ventilation; unregulated ventilation**	**no climate control**	**soil**	**spraying; fogging**	**5-19 treatments/year**	**drip irrigation**
strawberry	**walk-in tunnel**	**unregulated ventilation**	**no climate control**	**soil**	**spraying; soil drip fumigation**	**5-10 treatments/year**	**drip irrigation**
raspberry/ blueberry	**walk-in tunnel**	**unregulated ventilation**	**no climate control**	**soil**	**spraying; soil drip fumigation**	**7 treatments/year**	**drip irrigation**

Table 52: Features regarding the cultivation of protected fruiting vegetables.

Crop	Structure	Ventilation	Climate Control	Growing Media	Pesticide application method	Treatments/year	Irrigation method
FRUITING VEGETABLES							
tomato	**low-tech greenhouse**	**manually regulated ventilation**	**variable**	**soil**	**spraying; soil drip fumigation**	**3 – 80 treatments/year**	**drip irrigation**
pepper	**low-tech greenhouse**	**variable**	**no climate control**	**soil**	**variable**	**2 – 80 treatments/year**	**drip irrigation**
eggplant	**low-tech greenhouse**	**manually regulated ventilation**	**no climate control**	**soil**	**spraying; soil injection (fumigants)**	**6 – 80 treatments/year**	**drip irrigation**
cucumber	**low-tech greenhouse**	**manually regulated ventilation**	**no climate control**	**soil**	**spraying**	**3 – 30 treatments/year**	**drip irrigation**
zucchini	**low-tech greenhouse; walk-in tunnel**	**manually regulated ventilation; unregulated ventilation**	**variable**	**soil**	**spraying; soil drip fumigation**	**4 – 15 treatments/year**	**drip irrigation**
melon	**walk-in tunnel; low-tech greenhouse**	**unregulated ventilation; manually regulated ventilation**	**no climate control**	**soil**	**spraying; soil drip fumigation**	**4 – 15 treatments/year**	**drip irrigation**
watermelon	**low-tech greenhouse**	**manually regulated ventilation**	**no climate control**	**soil**	**spraying**	**15-20 treatments/year**	**drip irrigation**

Leafy Vegetables - Salads

The data about salad plants was gathered in Study Regions 1 (Lombardy, Italy) and 5 (Languedoc-Roussillon, France). Salads are usually grown in soil under low-tech greenhouses (with manually regulated ventilation) or walk-in tunnel (with unregulated ventilation). Such equipments are not heated and the irrigation is carried out with overhead sprinkler. In France, salad plants are sometimes grown in high-tech greenhouses, provided with controlled ventilation and heating system. A soil treatment, aimed at soil disinfection, is done once a year and it is followed by some spraying treatments (Tab. 53).

Leafy Vegetables - Herbs

Concerning herbs, information were collected in Study Region 1 (Liguria, Italy) and mainly about basil, but they can be stretched to the other species. Some information were gathered also in Study Region 5 (Languedoc-Roussillon, France). It is possible to describe a common growing systems concerning basil, but this is not possible for the other aromatic crops, because of the high variability. In Italy, basil is grown in high-tech greenhouses provided with forced or controlled ventilation and heating systems. Pesticides are applied with sprayers and irrigation is carried out through overhead sprinklers (Tab. 53). Basil is grown both in soil and soilless, while the other herbs are mainly produced as pot plants, using potting mix substrates. In France the herbs cultivation is different in some ways: they are grown in soil, under low-tech greenhouses, and a soil treatments, aimed at the soil disinfection, is carried out once a year.

Cut flowers

The data concerning cut flowers have been collected in Study Region 1 (Liguria, Italy), in Study Region 4 (Crete, Greece) and in Study Region 5 (Provence, France). A distinction must be done between low value and high value cut flowers.

Ranunculus and green foliages like *Asparagus plumosus* and *Ruscus* could be considered low value cut flowers. These plants are usually grown in soil, under structures with unregulated or manually regulated ventilation. Pesticide treatments are executed through spraying. Concerning the annual species (e.g. *Ranunculus*), a soil disinfection is carried out once a year through drip fumigation or soil treatments. Drip irrigation is usually coupled with overhead sprinkler (Tab. 54).

On the other hand, high value cut flowers, like *Alstroemeria*, chrysanthemum, *Euphorbia fulgens*, freesia, *Limonium spp.*, *Lisianthus* and rose are grown under high-tech greenhouses, with controlled ventilation and heating and/or cooling systems. Concerning pesticides application, a treatment aimed to soil disinfection (soil treatments or soil injection) is carried out once a year; then, pesticides are applied through spraying (Tab. 54).

Pot ornamentals

The data on pot ornamentals have been gathered in Study Region 1 (Liguria, Italy) and in Study Region 5 (Provence, France). The characterization of this crop category is more complex, due to the high variability within the species and the growing cycles. It was possible to identify a similarity concerning pesticides application, that is executed with sprayer (but it is sometimes coupled with other, variable, methods), and irrigation, that is carried through drip. Usually, the structures used for this crops are high-tech or low-tech greenhouses, provided with a heating system (Tab. 54).

Propagation material

The collected data about this category are very few: only three questionnaires have been fulfilled in Study Region 1 (Liguria, Italy) and only one in Study Region 4 (Crete, Greece). The growing techniques vary deeply according to the species (daisy cuttings, breeding of carnation and vegetables nursery). Thus, it was not possible to make a generalization about the protected growing conditions of this category (Tab. 54).

Table 53: Features regarding the cultivation of protected leafy vegetables.

Crop	Structure	Ventilation	Climate Control	Growing Media	Pesticide application method	Treatments/year	Irrigation method
LEAFY VEGETABLES							
salads	**low-tech greenhouse; walk-in tunnel**	**manually regulated ventilation; unregulated ventilation**	**no climate control**	**soil**	**Spraying + soil disinfection**	**1 – 16 treatments/year**	**overhead sprinkler**
basil	**high-tech greenhouse**	**forced ventilation; controlled ventilation**	**heating system**	**variable**	**spraying; none**	**0 – 11 treatments/year**	**overhead sprinkler**
other fresh herbs	**variable**	**variable**	**variable**	**variable**	**spraying + soil disinfection**	**7-11 treatments/year**	**variable**

Table 54: Features regarding the cultivation of protected plant not for consumption.

Crop	Structure	Ventilation	Climate Control	Growing Media	Pesticide application method	Treatm/year	Irrigation method
CUT FLOWERS							
Low value (*)	**variable**	**unregulated ventilation; manually regulated ventilation**	**variable**	**soil**	**spraying + soil treatments**	**6 - 50**	**overhead sprinkler; drip irrigation**
High value (**)	**high-tech greenhouse**	**controlled ventilation**	**heating system; cooling system**	**variable**	**spraying + soil treatments/ injection**	**3 - 70**	**variable**
POT ORNAMENTAL	**high-tech/low-tech greenhouses**	**variable**	**heating system**	**soilless with substrate**	**spraying**	**3 - 40**	**drip irrigation**
PROPAGATION MATERIAL	**variable**	**variable**	**variable**	**soilless with substrate**	**spraying**	**10 - 50**	**variable**

(*) *Ranunculus*, green foliage.
(**) *Alstroemeria*, chrysanthemum, *Euphorbia fulgens*, freesia, *Limonium spp., Lisianthus,* rose.

CORRELATION BETWEEN NUMBER OF PESTICIDE TREATMENTS/YEAR AND FEATURES OF THE PROTECTED CULTIVATION

All the data have been evaluated through non-parametric analysis (Kruskall Wallis test) and statistical analysis of variance (Tukey Test - Anova) using the SPSS software (version 11.0 for Windows), with the aim of identifying a correlation amongst the growing features.

According to Kruskall Wallis test, there is a significant correlation between the number of treatments/year (including both chemical and non-chemical treatments) and crop category, crop, ventilation system, pest blocks, application method and structure. On the contrary, there was no significant correlation (error > 5%) with the substrate and the water recirculation system.

Concerning crop and crop category, the number of treatments was significantly higher (according to Tukey test) for the propagation material in comparison to the other categories (Tab 55 and Fig. 69, Tab. 56 and Fig. 70).

The number of treatments appeared to be related to the ventilation system, with the highest numbers where the ventilation is controlled or manually regulated (Tab 57 and Fig. 71). Manually ventilation is the most spread system: it is used for vegetables in Sicily, Spain and Greece, where these crops are, generally, interested by a high number of pesticide applications. Controlled ventilation is used for high value crops, like ornamentals, which are frequently treated.

The presence and the type of pest blocks is also related to the number of treatments: the lowest number is related both to the absence of pest blocks (low pest pressure areas) and to the presence of full pest blocks with double door (high pest pressure areas), while the highest number of treatments occurs where there are full pest blocks without double door (high pest pressure areas) (Tab. 58 and Fig. 72). Partial and full pest blocks are used in areas where pests are highly present and harmful on crops; thus, although the use of pest blocks, a lot of pesticide treatments are needed. Moreover, partial pest blocks (placed only on the openings) are not very effective. On the contrary, greenhouses equipped with full pest blocks with double door are very effective. In comparison, the absence of pest blocks demonstrates a lower pests' incidence and, consequently, a lower number of treatments/year is needed.

Table 55: Effect of crop category on the N° of pesticide treatments/year.

N° treatments/year Tukey HSD			
Crop Category	N° of available data	Subset for alpha = .05	
		1	2
Leafy vegetables	43	**5,9302**	
Fruits	92	**10,4891**	
Pot ornamentals	29	**13,6207**	
Cut flowers	71	**15,2394**	
Fruiting vegetables	271	**18,8561**	
Propagation materials	4		**67,5**
Sig.		0,137	1

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 16,889.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed

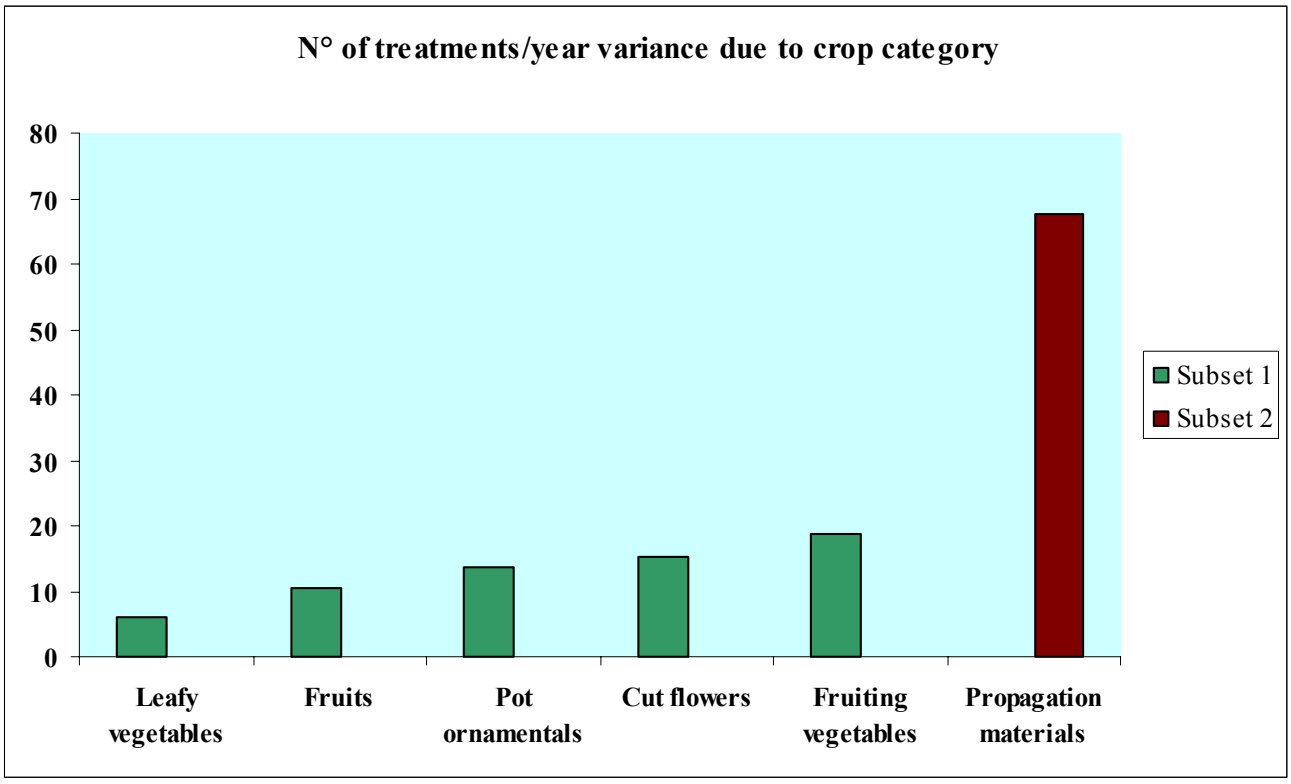

Figure 69: Histogram representing the variance of the number of treatments/year due to the crop category. Colours: categories in green are similar (subset 1) and categories in red are similar (subset 2); if two categories are represented by different colours (green and red) they are significantly different.

Table 56: Effect of crop on the N° of pesticide treatments/year.

N° treatments/year Tukey HSD			
Crop	N° of available data	Subset for alpha = .05	
		1	2
Salads	23	**4,7391**	
Raspberries	3	**4,6667**	
Strawberries	29	**6,5517**	
Other small fruits and berries	2	**7**	
Herbs	20	**7,3**	
Cucurbits inedible peel	12	**10,5**	
Table grape	58	**12,8793**	
Pot ornamentals	29	**13,6207**	
Cucurbits edible peel	31	**13,5161**	
Cut flowers	71	**15,2394**	
Solanaceae	228	**20,0219**	
Propagation material	4		**67,5**
Sig.		0,662	1

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 8,783.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

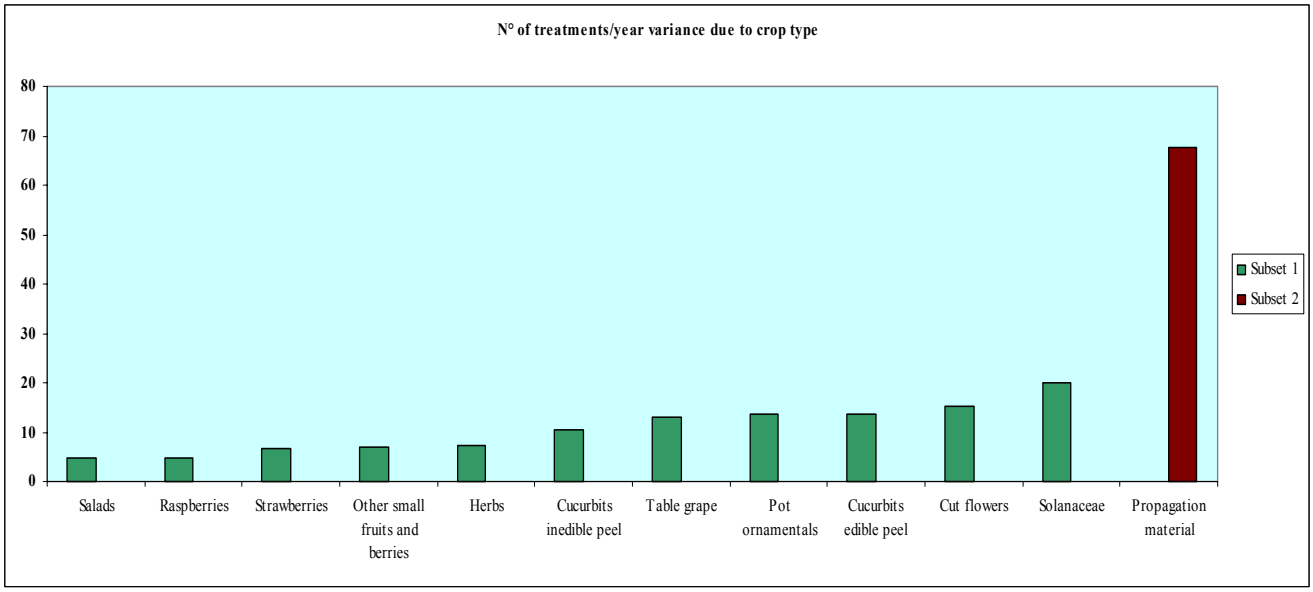

Figure 70: Histogram representing the variance of the number of treatments/year due to the crop type. Colours: categories in green are similar (subset 1) and categories in red are similar (subset 2); if two categories are represented by different colours (green and red) they are significantly different.

Table 57: Effect of the ventilation system on the N° of pesticide treatments/year.

N° treatments/year Tukey HSD			
Ventilation system	N° of available data	Subset for alpha = .05	
		1	2
Forced ventilation	28	**7,4643**	
Unregulated ventilation	109	**9,3899**	
Manually regulated ventilation	293		**17,9676**
Controlled ventilation	80		**19,75**
Sig.		0,906	0,924

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 65,250.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

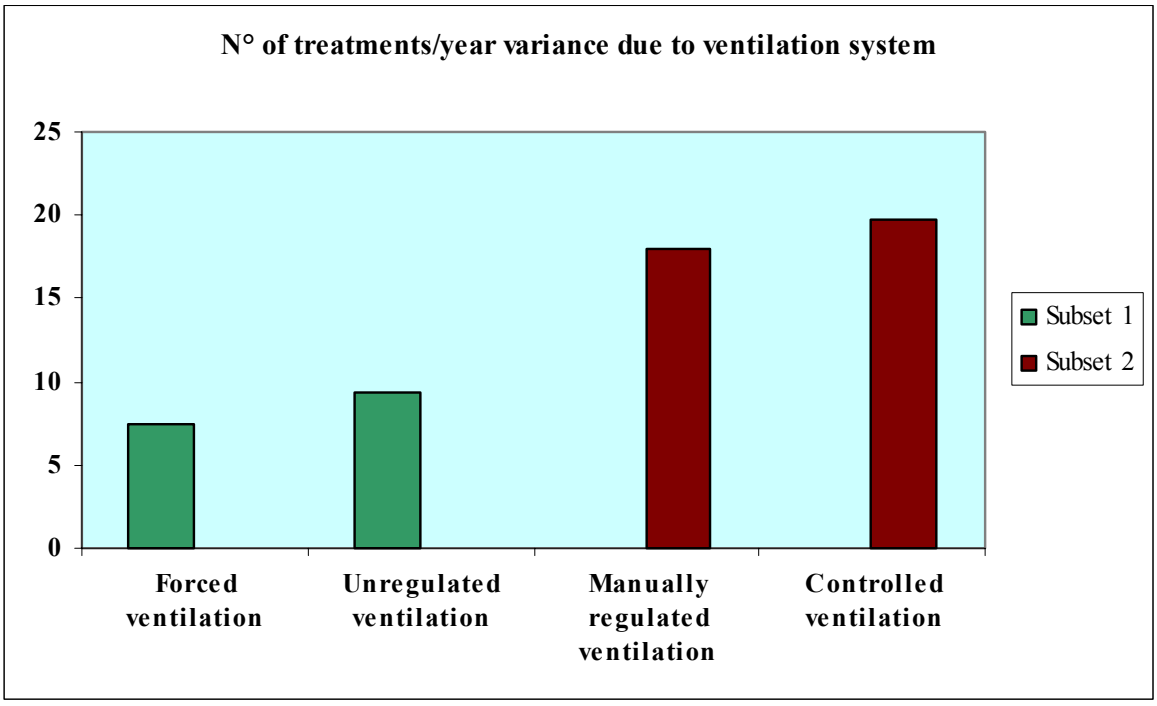

Figure 71: Histogram representing the variance of the number of treatments/year due to the ventilation system. Colours: categories in green are similar (subset 1) and categories in red are similar (subset 2); if two categories are represented by different colours (green and red) they are significantly different.

Table 58: Effect of pest blocks on the N° of pesticide treatments/year.

N° treatments/year Tukey HSD			
Pest blocks	N° of available data	Subset for alpha = .05	
		1	2
None	**242**	**12,5455**	
Fully with double door	**38**	**15,5**	
Partly	**183**	**18,0874**	**18,0874**
fully	**47**		**24,2979**
Sig.		0,192	0,116

Means for groups in homogeneous subsets are displayed.
a Uses Harmonic Mean Sample Size = 68,992.
b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

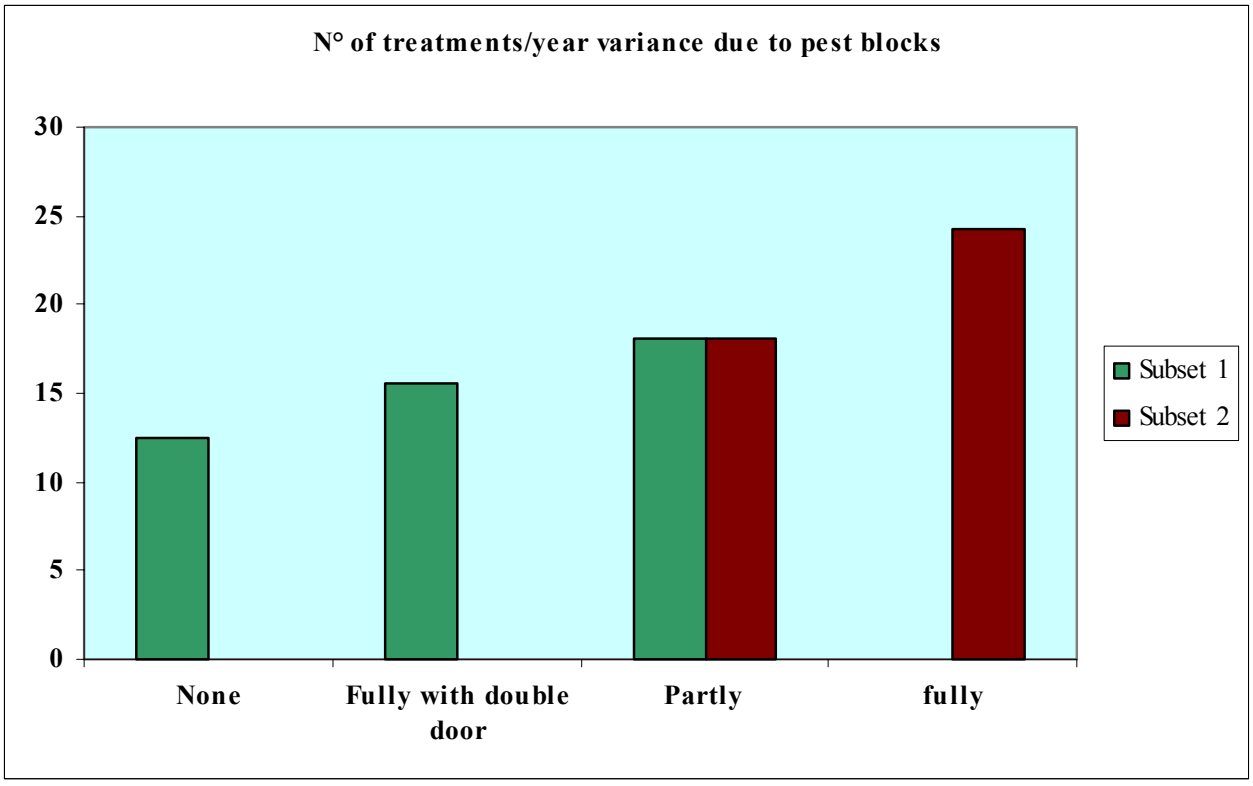

Figure 72: Histogram representing the variance of the number of treatments/year due to pest blocks. Colours: categories in green are similar (subset 1) and categories in red are similar (subset 2); if two categories are represented by different colours (green and red) they are significantly different.

The Tukey HSD test did not show a significant variability of the average number of treatments/year between the different structures, even if the non-parametric test stressed out a correlation.

The same happened with the pesticide application methods, but, according to the contractor's experience, the application methods influence the number of treatments/year very much. This is probably due to the fact that the pesticide application methods, as divided in the categories of the Coding Manual, do not allow proper analysis. It is difficult to identify categories that can standardize the data gathered all over Europe, but, in order to collect more significant data from an agronomical point of view, Ce.R.S.A.A. suggested to divide them at least into two main categories:

- Soil treatments (excluding soilless cultures), which could be further divided in fumigant and non-fumigant treatments;
- Aerial treatments.

COMPARISON BETWEEN THE CULTIVATION SYSTEMS OF THREE MOST SPREAD CROPS IN THE DIFFERENT STUDY REGIONS

The cultivation systems of three crops (strawberry, table grape and tomato) in the different Study Regions have been compared.

Strawberry

We can make a comparison between strawberry protected cultivation in Spain and in France (Tab. 59).

In Spain strawberry is grown in Huelva area, in removable plastic walk-in tunnels that have unregulated ventilation and no climate control. The crop is grown in soil and water is supplied through drip irrigation. The water amount needed is set according to grower's experience. Concerning plant protection, the tunnels usually do not have any pest blocks and the treatments are carried out with sprayers. A drip fumigation is done once every two years, aimed at soil disinfestation.

In France, only one strawberry grower has been interviewed, but, according to our experience, it is well representative of the cultivation condition of strawberry in this area. The structures used are high-tech greenhouses with controlled ventilation, or typical walk-in tunnel, specifically set in order to allow the soilless cultivation and the close-loop system. In fact, in France strawberry is usually cultivated in growing media as coconut fibre, the fertigation is carried out through drip and the

nutrient solution is recycled. The structures are not heated and are not provided with pest blocks. Pesticides are applied through spraying.

Table 59: Comparison between strawberry cultivation systems in Huelva and in Provence.

Area	**Huelva (Spain)**	**Provence (France)**
Structures	**plastic walk-in tunnel**	**metal-glass high-tech greenhouse; walk-in tunnel with double plastic film**
Growing media	**soil**	**bags with coconut fiber**
Water recirculation system	**open-loop**	**close-loop; open-loop**
Ventilation	**unregulated ventilation**	**controlled ventilation; manually regulated ventilation**
Climate control	**no climate control**	**no climate control**
Pest blocks	**no pest blocks**	**no pest blocks**
Pesticide application method	**spraying and soil drip fumigation**	**spraying**
Irrigation method	**drip irrigation**	**drip irrigation**
Irrigation amount calculation	**on basis of experience**	**on basis of experience**

In Italy strawberry is grown in Metapontum and Sele area (MT, Basilicata Region), in Battipaglia area (SA, Campania Region) and in Cesena (Emilia-Romagna Region) and Verona area (Veneto Region); in such area, the cultivation system is the same than in Spain (except for some soilless cultivation in Verona area).

Table grape

Table grape is grown under protection in Italy (in Sicily and in Apulia) and in Spain (especially in Murcia Region). Everywhere, it is grown in soil and under very simple, unheated structures (Tab 60).

In the coastal area of Sicily table grape is grown in low-tech greenhouses with manually regulated ventilation and anti-bird nets. Pesticides are applied with sprayers. Irrigation is carried out through drip, but with high flow (16 L/h) and the water amount needed is set according to the grower's experience. In the inner Sicilian areas, such as Mazzarone (Caltanissetta Province), table grape is grown under high plastic shelter; this is the unique difference with the growing system described above.

In Murcia, table grape is grown under high net shelters, which have unregulated ventilation and no pest blocks. Pesticide treatments are carried out with Ultra Low Volume of water (fogging). Irrigation is done through drip, and the water amount needed set according to grower's experience.

Table 60: Comparison between table grape cultivation systems in Sicily and in Murcia.

Area	**Sicily (Italy)**	**Murcia (Spain)**
Structures	**low-tech greenhouse/high plastic shelters**	**high net shelter**
Growing media	**soil**	**soil**
Water recirculation system	**open-loop**	**open-loop**
Ventilation	**manually regulated/unregulated ventilation**	**unregulated ventilation**
Climate control	**no climate control**	**no climate control**
Pest blocks	**partial pest-blocks (anti-birds)/no pest blocks**	**no pest blocks**
Pesticide application method	**spraying**	**fogging/fumigation**
Irrigation method	**drip irrigation (16 L/h)**	**drip irrigation**
Irrigation amount calculation	**on basis of experience**	**on basis of experience**

Tomato

Protected tomato is cultivated almost everywhere across Southern Europe (Tab. 61).

In Liguria, vegetables are not very relevant for the local rural economy, but tomato is present anyway. Protected tomato is usually grown in soil, under different type of structures (concerning the covering, the ventilation and the climate control systems). Pesticides are applied through spraying and soil treatments (especially aimed at soil disinfestation); water is supplied through drip. The irrigation amount needed is set according to grower's experience.

In Sicily, tomato is the most important cultivated crop. It is usually grown in soil, under unheated, low-tech greenhouses with manually regulated ventilation. In some cases, tomato is grown soilless, in coconut fiber substrates, under high-tech greenhouses provided with controlled ventilation and/or heating system. Because of the high pest pressure, greenhouses are provided with pest blocks. Pesticides are applied according to a common scheme: a drip fumigation done once a year, aimed at soil disinfestation, followed by about 10-30 sprayings (the number depends on tomato variety, the length of the crop cycle, the pesticides used, the location of the greenhouse, etc.). Irrigation is carried out through drip and/or overhead sprinkler; the water amount needed is set according to grower's experience.

In Almeria and in Murcia (Spain) tomato growing system is almost the same than that used for the soil culture in Sicily, except for what regards pest control: in fact, all the Spanish greenhouses are

provided with full pest blocks with double door and the soil is disinfested once every two years. Furthermore, the water amount needed is usually calculated basing on soil moisture measurements.

In Crete protected tomato is grown with almost the same techniques used in Sicily for the soil culture, including pest and diseases control. However, in Crete pest blocks, partial or full (but not with double door), are more common than in Sicily.

In the Southern France tomato growing system is different. Instead of soil, substrates as rock wool slabs or bags with coconut fibre are employed, and also the close-loop is used. Greenhouses are high-tech, having controlled ventilation and heating systems, but pest blocks are not used (probably thanks to a lower pest pressure, if compared to the other areas). Pesticides are applied through spraying and water is supplied through drip. The irrigation amount needed is calculated basing on soil/substrate moisture measurements.

Table 61: Comparison between tomato cultivation systems in the different areas of Southern Europe.

Area	**Liguria (Italy)**	**Sicily (Italy)**	**Almeria & Murcia (Spain)**	**Lang-Rouss & Aquitaine (France)**	**Crete (Greece)**
Structures	**variable**	**low-tech (rarely high-tech) greenhouse**	**low-tech greenhouse**	**high-tech greenhouse**	**low-tech greenhouse**
Growing media	**soil**	**soil (rarely soilless)**	**soil**	**bags with coconut fiber; rock wool slabs**	**soil**
Water recirculation system	**open-loop**	**open-loop**	**open-loop**	**open-loop; close-loop**	**open-loop**
Ventilation	**manually regulated ventilation**	**manually regulated (rarely controlled) ventilation**	**manually regulated ventilation**	**controlled ventilation**	**manually regulated ventilation**
Climate control	**no climate control**	**no climate control (rarely heating)**	**no climate control**	**climate control**	**no climate control**
Pest blocks	**no pest blocks**	**partial pest blocks**	**full pest blocks with double door**	**no pest blocks**	**variable**
Pesticide application method	**spraying; through irrigation system; soil treatment**	**spraying and soil drip fumigation**	**spraying and soil drip fumigation**	**spraying**	**spraying and soil drip fumigation**
Irrigation method	**drip irrigation**	**drip irrigation and overhead sprinkler**	**soil drip irrigation**	**drip irrigation**	**drip irrigation**
Irrigation amount calculation	**on basis of experience**	**on basis of experience**	**on basis of soil moisture measurements**	**on basis of soil moisture measurements**	**on basis of experience**

Fresh-cut vegetables and ornamental crops

For the sake of completeness, also the features concerning protected vegetables for fresh-cut Market (grown in Lombardy) and ornamental crops (in Liguria, in France and in Crete) are here summarized (Tab. 62 and 63).

Table 62: Fresh-cut vegetables cultivation system in Lombardy (Italy).

Area	**Lombardy (Italy)**
Structures	**plastic walk-in tunnel; low-tech greenhouse**
Growing media	**soil**
Water recirculation system	**open-loop**
Ventilation	**unregulated ventilation; manually regulated ventilation**
Climate control	**no climate control**
Pest blocks	**no pest blocks**
Pesticide application method	**high Volume spraying + soil injection/soil drench**
Irrigation method	**overhead sprinkler**
Irrigation amount calculation	**on basis of experience**

Table 63: Comparison between ornamental crops cultivation systems in the different areas of Southern Europe.

Area	**Albenga - Liguria (Italy)**	**Sanremo - Liguria (Italy)**	**France**	**Crete (Greece)**
Structures	**low-tech/high-tech greenhouse**	**variable**	**variable**	**variable**
Growing media	**loam potting substrate**	**variable**	**soilless with substrate**	**soilless with substrate**
Water recirculation system	**open-loop**	**open-loop**	**open-loop**	**close-loop/open-loop**
Ventilation	**variable**	**variable**	**variable**	**variable**
Climate control	**climate control**	**variable**	**climate control**	**climate control**
Pest blocks	**no pest blocks**	**no pest blocks**	**no pest blocks**	**no pest blocks**
Pesticide application method	**spraying**	**spraying + soil treatment**	**spraying**	**spraying**
Irrigation method	**drip irrigation**	**overhead sprinkler**	**drip irrigation**	**drip irrigation**
Irrigation amount calculation	**on basis of experience**	**on basis of experience**	**on basis of experience**	**on basis of experience**

Extrapolation of the collected data to other Southern European areas mainly dedicated to protected cultivation

The Study Regions of the survey were chosen, in agreement with EFSA, because representative of all the crop protection systems existing in Southern Europe, but there are other areas mainly dedicated to protected agriculture in Southern Europe. These areas could be compared to one or more of the 5 Study Regions.

The Tables from 64 to 69 show the Southern European areas that have a wide surface dedicated to protected crops (see also previous report: *Data collection of existing data on protected crop systems in Southern European EU Member States*, EFSA, 2009), the features of the protection systems in each of these areas and the Study Region/s to which they could be assimilated.

Table 64: Features of the crop protection systems in other Italian areas and comparison with the Study Regions.

Italy - Area	Features	Likely to (crop and Study Region)
Marsala (Sicily)	**vegetable crops and strawberry low-tech greenhouse manually regulated ventilation no climate control soil (soilless strawberry) pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2) and Crete (Study Region 4)**
	ornamental crops low-tech greenhouse manually regulated ventilation no climate control soil pest blocks pesticides applied through spraying drip irrigation	**Tomato in Sicily (Study Region 2)**
Metaponto (Basilicata)	**strawberry low-tech greenhouse manually regulated ventilation no climate control soil partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2)**
Caserta/ Agro Nocerino Sarnese (Campania)	**strawberry and vegetables low-tech greenhouse manually regulated ventilation no climate control soil no pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**

Table 65: Features of the crop protection systems in other Italian areas and comparison with the Study Regions.

Italy - Area	Features	Likely to (crop and Study Region)
Battipaglia/Sele (Campania)	**strawberry low-tech greenhouse manually regulated ventilation no climate control soil no pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**
	salads for IV Gamma Market low-tech greenhouse manually regulated ventilation no climate control soil no pest blocks pesticides applied through spraying overhead sprinkler	**Salads for IV Gamma in Lombardy (Study Region 1)**
Napoli/Ercolano, Torre del Greco, Torre Annunziata, Boscoreale, Scafati, Pagani (Campania)	**vegetables low-tech greenhouse manually regulated ventilation no climate control soil partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2) and Crete (Study Region 4)**
	ornamental high-tech greenhouse controlled ventilation climate control soilless full pest blocks pesticides applied through spraying drip irrigation	**Ornamental crops in Albenga/Sanremo (Study Region 1)**
Fondi/Agro Pontino (Lazio)	**zucchini low-tech greenhouse manually regulated ventilation no climate control soil (10% soilless) partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2)**

Table 66: Features of the crop protection systems in other Italian areas and comparison with the Study Regions.

Italy - Area	Features	Likely to (crop and Study Region)
Versilia (Tuscany)	**ornamental crops low/high-tech greenhouse controlled ventilation climate control soil and soilless no pest blocks pesticides applied through spraying drip irrigation**	**Ornamental crops in Albenga (Study Region 1), France (Study Region 5) and Crete (Study Region 4)**
Bra (Cuneo, Piedmont)	**Solanaceae and salads walk-in tunnel manually regulated ventilation climate control soil no pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Liguria (Study Region 1)**
	Solanaceae and salads high-tech greenhouse controlled ventilation climate control soilless partial pest blocks pesticides applied through spraying drip irrigation	**Tomato in France (Study Region 5)**
Verona (Veneto)	**vegetables and strawberry low-tech greenhouse manually regulated ventilation no climate control soil (soilless strawberry) no pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**
Venezia/ Cavallino (Veneto)	**tomato and vegetables for IV Gamma Market low-tech greenhouse manually regulated ventilation yes/no climate control soil pest blocks pesticides applied through spraying drip irrigation and overhead sprinkler**	**Salads for IV Gamma in Lombardy (Study Region 1) and tomato in Sicily (Study Region 2)**

Table 67: Features of the crop protection systems in other Spanish areas and comparison with the Study Regions.

Spain - Area	Features	Likely to (crop and Study Region)
Cadiz	**pot ornamental high net shelter unregulated ventilation no climate control soilless no pest blocks pesticides applied through fogging drip irrigation**	**None**
	cut flowers low-tech greenhouse manually regulated ventilation no climate control soil and soilless partial pest blocks pesticides applied through fogging drip irrigation	**Tomato in Sicily (Study Region 2)**
Granada	**vegetables low-tech greenhouse manually regulated ventilation no climate control soil and soilless full pest blocks with double door pesticides applied through fogging/ spraying drip irrigation**	**Tomato in Almeria and Murcia (Study Region 3) and Crete (Study Region 4)**
Canary Islands	**vegetables low-tech greenhouse manually regulated ventilation no climate control soil and soilless full pest blocks with double door pesticides applied through fogging/ spraying drip irrigation**	**Tomato in Almeria and Murcia (Study Region 3) and Crete (Study Region 4)**
	banana low-tech greenhouse/shade-house unregulated ventilation no climate control soil no pest blocks pesticides applied through fogging drip irrigation	**Table grape in Sicily (Study Region 2) and Murcia (Study Region 3)**
Cc.aa. Valencia	**vegetables low-tech greenhouse manually regulated ventilation no climate control soil full pest blocks with double door pesticides applied through fogging/ spraying drip irrigation**	**Tomato in Almeria and Murcia (Study Region 3) and Crete (Study Region 4)**

Table 68: Features of the crop protection systems in Portuguese areas and comparison with the Study Regions.

Portugal - Area	Features	Likely to (crop and Study Region)
Ribatejo e Oeste	**Solanaceae (mainly tomato) low-tech greenhouse manually regulated ventilation climate control soil partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Almeria (Study Region 3)**
Algarve	**strawberry walk-in tunnel unregulated ventilation no climate control soil no pest blocks pesticides applied through spraying drip irrigation**	**Strawberry in Huelva (Study Region 3)**
	Solanaceae (mainly tomato) low-tech greenhouse manually regulated ventilation no climate control soil partial pest blocks pesticides applied through spraying drip irrigation	**Tomato in Almeria (Study Region 3)**
Beira Litoral	**cabbage, lettuce low-tech greenhouse manually regulated ventilation no climate control soil partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Almeria (Study Region 3)**

Table 69: Features of the crop protection systems in other Greek areas and comparison with the Study Regions.

Greece - Area	Features	Likely to (crop and Study Region)
Central Macedonia	**Solanaceae, cucumber and salads low-tech greenhouse manually regulated ventilation climate control soil full pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**
Epirus	**tomato low-tech greenhouses manually regulated ventilation climate control soil full pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**
Peloponnese	**Solanaceae and cucumber low-tech greenhouse manually regulated ventilation no climate control soil full pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Crete (Study Region 4)**
Thessaly	**Solanaceae and cucumber low-tech greenhouse manually regulated ventilation yes/no climate control soil partial/full pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2) and Crete (Study Region 4)**
Western Greece	**Solanaceae, cucumber and strawberry low-tech greenhouse manually regulated ventilation no climate control soil partial pest blocks pesticides applied through spraying drip irrigation**	**Tomato in Sicily (Study Region 2) and Crete (Study Region 4)**

The areas were selected according to the contractor and subcontractors' experience and basing on the data reported in the First data collection concerning Southern Europe (EFSA, 2009). It was possible to describe the features of the crop protection systems in these areas thanks to the contractor and subcontractors' knowledge of the territory and thanks to the net of technicians related on them.

Crop Protection in Southern Europe in the past

Thanks to Ce.R.S.A.A. long standing experience, it was also possible to remark the evolution of protected agriculture in the 5 Study Regions. The structures existing in each region before the current ones are represented in Table 70.

Table 70: Crop protection structures in the past and nowadays in the Study Regions.

Region	Structures in the past	Structures nowadays
Study Region 1		
Liguria	**wood-glass and wood-plastic film greenhouses no pest blocks**	**metal-glass greenhouses no pest blocks**
Lombardy	**open field**	**plastic walk-in tunnels and low-tech greenhouses no pest blocks**
Study Region 2		
Sicily	**wood-plastic film greenhouses no pest blocks**	**wood-plastic film and metal/plastic film greenhouses partial pest blocks**
Study Region 3		
Almeria	**open field**	**low-tech greenhouses full pest blocks with double door**
Huelva	**low tunnels and open field**	**plastic walk-in tunnels no pest blocks**
Murcia	**wood-plastic film greenhouses no pest blocks**	**high shelters and greenhouses full pest blocks**
Study region 4		
Crete	**wood-plastic film greenhouses no pest blocks**	**wood-plastic film and metal/plastic film greenhouses partial and full pest blocks**
Study Region 5		
Southern France	**wood-glass greenhouses no pest blocks**	**metal-glass greenhouses no pest blocks**

Conclusions and Recommendations

CONCLUSIONS

In order to remark the differences between the Study Regions, all the collected data are represented in the following tables (Tab. 71-80): they show the presence of each kind of structure, growing media, water recirculation system, water source and quality, ventilation and climate control system, pest blocks, pesticide application method, irrigation method and irrigation amount calculation in each area of the survey.

Table 71: Different crop protection structures existing in each area.

Crop Protection Structures	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
low net shelter										
low plastic shelter						X				
low net tunnel										
low plastic tunnel					X			X		
high net shelter	X					X				
high plastic shelter	X		X							
shade-house	X					X				
walk-in tunnel	X	X	X	X	X		X	X		
low-tech greenhouse	X	X	X	X		X	X	X		X
high-tech greenhouse	X		X			X	X	X	X	X
closed building										

Table 72: Different growing media existing in each area.

Growing Media	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
soil	X	X	X	X	X	X	X	X		X
soilless with substrate	X		X	X		X	X	X	X	X
soilless without substrate										

Table 73: Presence of water recirculation system in each area.

Water Recirculation System	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
open-loop	X	X	X	X	X	X	X	X		X
close-loop	X					X	X	X	X	X

Table 74: Water quality in each area.

Water Quality	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
high quality water	X	X	X	X	X	X	X	X	X	X
low quality water			X							X
water from reverse osmosis										X
water from multiple sources	X		X	X		X				X
other										

Table 75: Different ventilation systems existing in each area.

Ventilation System	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
unregulated ventilation	X	X	X		X	X	X	X		X
manually regulated ventilation	X	X	X	X		X	X	X		X
forced ventilation	X					X				X
controlled ventilation	X		X			X	X	X	X	X

Table 76: Presence of climate control system in each area.

Climate Control System	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
no climate control	X	X	X	X	X	X	X	X		X
climate control (heating and/or cooling)	X		X			X	X	X	X	X

Table 77: Presence of pest blocks in each area.

Pest Blocks	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
no pest block	X	X	X		X	X	X	X	X	X
partial pest block	X		X							X
full pest block			X		X	X				X
full pest block with double door				X		X				

Table 78: Different pesticide application methods used in each area.

Pesticide Application Method	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
spraying	X	X	X	X	X	X	X	X	X	X
fogging/fumigation	X		X			X	X			X
through irrigation system	X		X	X	X	X		X		X
soil injection	X	X	X							
soil treatment	X	X						X		X
none	X						X			X

Table 79: Different irrigation methods used in each area.

Irrigation Method	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
drip irrigation	X		X	X	X	X	X	X	X	X
overhead sprinkler	X	X	X				X	X		X
furrows or gullies in the soil										
nutrient solution in soilless culture										
sub-irrigation	X						X			
other or none	X									

Table 80: Different irrigation amount calculation methods used in each area.

Irrigation Amount Calculation	Italy			Spain			France			Greece
	Liguria	Lombardy	Sicily	Almeria	Huelva	Murcia	Provence	Lang-Rouss	Aquitaine	Crete
on basis of grower's experience	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
on basis of calculated crop requirements	**X**		**X**				**X**			**X**
on basis of soil moisture measurements	**X**		**X**	**X**	**X**	**X**		**X**	**X**	**X**
on basis of visible water stress										
in large excess								**X**		
other or none										

RECOMMENDATIONS

In order to get in touch with the growers, the contractor relied on a network of technicians and advisors. Tab. 81 shows the numbers of technicians and growers directly contacted by Ce.R.S.A.A. and the numbers of the growers contacted through technicians. In the table, the *feeling* with the involved technicians and growers is also represented.

Totally, 25 technicians and 50 growers have been contacted directly and other 128 growers indirectly (this table still have to be up-dated with the data of France).

In Liguria, Ce.R.S.A.A. reached the farms thanks to its knowledge of the territory and could collect a significant number of questionnaires. Some growers in the Sanremo area were a little reluctant to arrange the meeting because during the survey period they were very busy with crops transplanting. In any case, the interviewed growers were very cooperative.

In Sicily, in Lombardy and in France Ce.R.S.A.A. has been introduced in each farm by a technician belonging to the extensions services and/or usually working in the area and so well known by the growers. No problems occurred in Sicily and in Lombardy. On the contrary, gathering information in France was very difficult. A great number of French technician were contacted (5 technicians),

the most of them belonging to the Agricultural Chambers of Nice and Perpignan (3 technicians), but they were usually not available to help the contractor in reaching the growers. The few visited farmers were mostly reluctant (except for one) to answer the questionnaire, and one grower strongly refused to be interviewed. This is the reason why the number of questionnaire collected in France is very little.

Table 81: For each Study Region the number of technicians contacted by Ce.R.S.A.A. and of growers contacted directly and through technicians are shown, along with the level of their cooperation.

Areas	Technicians directly contacted		Growers directly visited		Growers reached through technicians	
	N°	feeling	N°	feeling	N°	feeling
Liguria	**3**	**very cooperative**	**22**	**very cooperative**	**0**	**-**
Sicily	**5**	**very cooperative**	**22**	**very cooperative**	**0**	**-**
Lombardy	**1**	**very cooperative**	**1**	**very cooperative**	**2**	**very cooperative**
TOTAL ITALY	**9+5**	**very cooperative**	**45**	**very cooperative**	**2**	**very cooperative**
Almeria	**2**	**very cooperative**	**0**	**-**	**10**	**cooperative**
Huelva			**0**	**-**	**17**	**cooperative**
Murcia			**0**	**-**	**25**	**cooperative**
TOTAL SPAIN	**2**	**very cooperative**	**0**	**-**	**52**	**cooperative**
Provence-Cote d'Azur	**3**	**cooperative/not cooperative**	**5**	**little adverse**	**0**	**-**
Languedoc-Roussillon	**2**	**not cooperative**	**0**	**-**	**8**	**not cooperative**
Aquitaine	**1**	**very cooperative**	**0**	**-**	**3**	**not cooperative**
TOTAL FRANCE	**6**	**cooperative/not cooperative**	**5**	**little adverse**	**11**	**not cooperative**
Crete	**2**	**cooperative**	**0**	**-**	**63**	**cooperative/little adverse**
TOTAL GREECE	**2**	**cooperative**	**0**	**-**	**63**	**cooperative/little adverse**
PORTUGAL	**1**	**cooperative**	**0**	**-**	**0**	**-**

The subcontractors in Spain and in Greece interviewed growers who relied directly on them or on other technicians who introduced them. In Spain, A&E technician met some problems in explaining the reasons of the survey, and some farmers preferred not to directly join the interview, but to be represented by their advisor. In Greece growers were sometimes reluctant to answer questions regarding pesticides. In any case, the survey proceeded well and ended successfully.

All the technicians involved have links with Ce.R.S.A.A. since a long time: this has been fundamental for the success of the survey. In fact, growers tend to be reluctant to give information to unknown people, even if officially reliable.

The questionnaire was put also *on-line*, on Ce.R.S.A.A. *web site*, but not even one response was received through this way. This is due not only to the farmers' distrust of this kind of survey, but also to the fact that in the rural areas of Southern Europe computer, and especially internet, are still not currently used.

To perfectly achieve the aim of making a guidance document on emission of PPPs from crop protection structures, it could be useful to collect more detailed data concerning what influences pesticide routes in the environments. For example, information about pest control strategies (chemical, integrated or organic management), the active ingredients mostly used, the quantity of water distributed, the diffusion of the practice of sprayer calibration, the use of DSS (Decision Support System) and of the advise of experts in pest management, the substrate type used in soilless culture or the characteristic of the soil (e.g. the texture and the organic matters content). It could be also useful to gather information concerning the number of workers present into the greenhouse during the treatments, the height of the greenhouses, the type of openings (e.g. on the roof, lateral, etc.), the location of the greenhouses (i.e. the distance from touristic, residential or industrial areas).

Moreover, the classification of pesticide application methods should be modified and improved, including a greater number and more diversified categories. In fact, the current classification does not always and specifically fit with the situation of the different farms, as it came out during the survey, having both contractor and subcontractors found difficulties in matching the application method used by the growers with one (or more) of the categories of the Coding Manual. Ce.R.S.A.A. suggested the following classification:

- Soil treatments (excluding soilless cultures), which could be further divided into fumigant and non-fumigant treatments;
- Aerial treatments.

To be more precisely, the application methods could be divided into several categories, represented in Tab. 82.

Table 82: Pesticide application method categories as suggested by Ce.R.S.A.A.

Soil treatments	fumigant	with water	**drip fumigation**
		without water	**soil injection**
	non-fumigant (in presence or absence of the crop)	with water	**soil drench, also through drip irrigation system (fungicides)** **spraying (herbicides)**
		without water	**granules**
Aerial treatments (in presence of the crop)		with water	**Ultra Low Volume (5-50 L/ha) spraying** **Low Volume (50-100 L/ha) spraying** **Reduce Volume (100-200 L/ha) spraying** **Middle Volume (200-500 L/ha) spraying** **High Volume (>500 L/ha) spraying**
		without water	**duster** **sublimation** **canned pesticides**

It worth also mentioning the existence of informatics tools for the analysis of satellite images as support to the detection of crop protection structures and of their extent. The satellite pictures are analyzed with *pattern recognition methods*, which allow the automatic recognition of the covering structures. These methods are employed in order to produce thematic cartographies of crop protections. Between the different existing methodologies, the one that seems to carry out the more accurate classification of the crop protection areas is based on a combination of *per-pixel methods* and *texture analysis* of high resolution multi-spectral satellite images. This methodology is described in two articles recently published in the journal "Colture Protette": Immagini satellitari ad alta risoluzione per la classificazione di apprestamenti di protezione delle colture" (Arcidiacono and Porto, 2010).

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Appendices

APPENDIX A

Questionnaire

General information

First Name: ☐ Last Name: ☐

Business/Farm Name: ☐

Business/Farm Address 1: ☐

Business/Farm Address 2: ☐

Business/Farm Address 3: ☐

Business/Farm Address 4: ☐

Business/Farm Postcode: ☐ E-mail address: ☐

1) Are you a:

Grower □ Advisor □ Trade body □ Other – please specify □

2) Please, select the country where your protected area is located:

Italy □ Spain □ Greece □ France □

3) If you selected Italy, in which region is your protected area located?

Liguria □ Lombardy □ Sicily □

4) If you selected Spain, in which region is your protected area located?

Almeria □ Huelva □ Murcia Region □

5) If you selected Greece, in which region is your protected area located?

Creta □

6) If you selected France, in which region is your protected area located?

Languedoc – Roussillon □ Provence □

Protected structure choice

1) Select your structure's type among the following choices (please, select only one type):

Low crop cover
Low net shelter □
Low plastic shelter □
Low net tunnel □
Low plastic tunnel □
Open walk-in structure
High net shelter □
High plastic shelter □
Shade-house □
Closed walk-in structure
Walk-in tunnel □
Low-tech greenhouse □
High-tech greenhouse □
Closed building □

Figure: Protected structure: low plastic shelters (A); low tunnels (B); high net shelter(C); shade-house (D); walk-in tunnel (E); high-tech greenhouse (F); low-tech greenhouse (G).

Crop growing conditions

1) Which of the following crops do you grow (please, select only one choice)?

Table grape □ Strawberry □ Raspberry □ Other fruits – please specify □

Tomato □ Pepper □ Eggplant □ Cucumber □ Zucchini □ Melon □ Watermelon □

Brassica vegetables □ Lettuce and other salads □ Herbs □

Other vegetables – please specify □

Cut flowers – please specify □

Pot ornamentals – please specify □

Propagation material – please specify □

Other non-edible crops – please specify □

2) Which is the surface of the structure (protection system taken into account (in hectares)?

[ ] ha

3) How many pesticides treatments do you do in an average year?

None □ Spraying □ Fogging/fumigation □

Through the irrigation system □ Soil injection □ Soil treatment □

4) What kind of growing media do you use to grow your selected crop?

Soil □

Soilless with substrate (natural or artificial) □

Soilless without substrate (hydroponic) □

5) Which of the following do you use as the main ventilation type?

Unregulated ventilation □ Manual regulated ventilation □

Forced ventilation □ Controlled ventilation □

6) Do you use a climate control system (either a heating or cooling system)?

Yes □ No □

7) Do you use Pest blocks/Insects Screens in your protected structure?

None □ Partly □ Fully □ Fully with double door □ Not applicable □

Other – please specify □

8) Which of the following irrigation techniques do you use in your protected crop area?

Drip irrigation □ Overhead sprinkler □ Furrows or gullies in the soil □

Nutrient solution in soilless culture □ Sub-irrigation □

Other – please specify □ Not Applicable □

9) Is the drainage water re-circulated?

Yes (close-loop) □ No (open-loop) □ Both □

10) If you selected Both, how many hectares are close-loop irrigation?

[ ] ha

11) If you selected Yes or Both, what is the frequency of water discharge from the close-loop system?

[ ]

12) Regarding you irrigation system, how do you calculated the amount needed?

On basis of calculation of crop requirements (*) □

On basis of soil moisture measurements □

On basis of visible water stress □

In large excess □

Other – please specify □

(*) including the Good Field Practice (i.e. the water amount is calculated on the basis of the grower's knowledge)

13) Please, select the quality of the water source you use:

High quality water □ Low quality water (salty/brackish water) □

Water from reverse osmosis □ Water from multiple sources □

Other – please specify □

14) Please state pH and salinity (EC) of the water source you use:

pH [ ]

EC [ ] μS/cm

APPENDIX B

Motivational Letter

SURVEY ON CROP PROTECTION SYSTEMS IN SOUTH EUROPE

The following questionnaire aims to collect data on protected cropping systems in Southern Europe, including fruit vegetables and ornamental crops. The survey is being conducted by the Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) of Albenga (Savona, Italy) on the behalf of the European Food Safety Authority (EFSA). Please see link below for further information on EFSA:

http://www.efsa.europa.eu/it/

For further information on Ce.R.S.A.A. and the project:

http://www.cersaa.it/pro_crops.html

Survey's recipients are: growers and growers' associations, advisors, extension officers, trade bodies, etc. The goal of the survey is to obtain a very realistic picture of the situation of the Mediterranean greenhouses features.

Questions here stated concern the characteristics of the protection structure types, along with ventilation, irrigation and crop protection systems. The data gathered will be ownership of EFSA, which will use them to compile a comprehensive guidance document on pesticide emissions from protected crop systems.

In order to fulfil the database the Farm name is required, however EFSA assures that this information will be confidential and proprietary to Discloser.
At the end of the survey EFSA will publish a final report that will be accessible to everybody.

A questionnaire for each kind of cropping system (one species under a given protection structure) is needed. If there are more then one structure and/or crop in a farm, more questionnaires have to be compiled.

APPENDIX C

Questionario

Informazioni Generali

Nome: ☐ Cognome: ☐

Nome dell'Azienda: ☐

Indirizzo 1 dell'Azienda: ☐

Indirizzo 2 dell'Azienda: ☐

Indirizzo 3 dell'Azienda: ☐

Indirizzo 4 dell'Azienda: ☐

CAP dell'Azienda: ☐ Indirizzo e-mail: ☐

1) Lei è un:

Coltivatore □ Consulente □ Responsabile di un'organizzazione commerciale □

Altro – specificare □

2) Selezionare il Paese nel quale è situata la coltura protetta in questione:

Italia □ Spagna □ Grecia □ Francia □

3) Se ha selezionato Italia, in quale regione è situata la coltura?

Liguria □ Lombardia □ Sicilia □

4) Se ha selezionato Spagna, in quale regione è situata la coltura?

Almeria □ Huelva □ Regione di Murcia □

5) Se ha selezionato Grecia, in quale regione è situata la coltura?

Creta □

6) Se ha selezionato Francia, in quale regione è situata la coltura?

Languedoc – Roussillon □ Provenza □

Struttura della coltura protetta

1) Selezioni il tipo della sua struttura tra quelli proposti di seguito (selezionare un solo tipo):

Strutture basse
copertura (*) bassa in rete □
copertura (*) bassa in plastica □
tunnel (**) basso/minitunnel in rete □
tunnel (**) basso/minitunnel in plastica □
Strutture alte aperte
copertura (*) alta in rete □
copertura (*) alta in plastica □
ombraio (**)□
Strutture alte chiuse
tunnel (**) alto □
serra priva di sistemi di controllo automatici □
serra a elevata tecnologia □
struttura chiusa (es. fungaia) □

(*) solo porzione superiore

(**) porzioni laterali e superiore

Condizioni di Coltivazione

1) Quale delle seguenti colture lei coltiva (selezionare una sola coltura per questionario)?

Uva da tavola □ Fragole □ Lamponi □ Altri frutti – specificare □

Pomodori □ Peperoni □ Melanzane □ Cetrioli □ Zucchine □ Meloni □ Cocomeri □

Cavoli □ Lattuga e altre insalate □ Erbe □ Altre ortive - specificare □

Fiori recisi - specificare □

Ornamentali in vaso - specificare □

Materiale di propagazione - specificare □

Altre colture non commestibili - specificare □

2) Qual è la superficie di coltivazione della struttura/sistema di protezione in esame (in ettari)?

[ ] ha

3) Quanti trattamenti antiparassitari fa in media l'anno?

Nessuno □ Irrorazione sulla parte aerea □

Irrorazione a ultra basso volume/fumigazione ambientale □

Attraverso l'acqua d'irrigazione □ Iniezione nel suolo □ Trattamenti al suolo □

4) Che tipo di substrato di coltura usa?

Suolo □

Fuori suolo con substrato (naturale o artificiale) □

Fuori suolo senza substrato (idroponica) □

5) Che tipo di ventilazione utilizza nella struttura?

Ventilazione non regolabile □ Ventilazione regolata manualmente □

Ventilazione forzata □ Ventilazione controllata (sistemi di controllo climatico) □

6) Utilizza sistemi di controllo climatico (per sistemi di riscaldamento o raffreddamento)?

Si □ No □

7) Utilizza schermi/reti anti-insetto nella struttura?

Nessuno □ Parziali □ Totali □ Totali con doppia porta □ Non applicabile □

Altro – specificare □

8) Quale delle seguenti tecniche d'irrigazione utilizza?

Irrigazione a goccia □ Aspersione sopra-chioma □ Scorrimento superficiale □

Distribuzione di soluzione nutritiva in fuori suolo □ Subirrigazione □

Altro – Specificare □ Non Applicabile □

9) L'acqua di drenaggio viene rimessa in circolo?

Si (ciclo chiuso) □ No (ciclo aperto) □ Entrambi □

10) Se ha selezionato entrambi, su quanti ettari viene effettuato il ciclo chiuso?

[ ] ha

11) Se ha selezionato Si o Entrambi, con quale frequenza viene scaricata l'acqua di drenaggio dal sistema a ciclo chiuso?

[ ]

12) Riguardo al sistema d'irrigazione, come calcola la quantità necessaria di acqua?

Sulla base delle esigenze della coltura, preventivamente calcolate/note (*) □

Sulla base della misurazione del contenuto idrico del substrato □

Sulla base della visibile carenza di acqua (piante appassite) □

In eccesso □

Altro – specificare □

(*) cioè anche in base all'esperienza del coltivatore

13) Selezionare la qualità dell'acqua utilizzata:

Acqua di alta qualità □ Acqua di bassa qualità (acqua salata/salmastra) □

Acqua da osmosi inversa □ Acqua di diverse origini □

Altro – specificare □

14) Indicare pH e salinità (EC) dell'acqua utilizzata:

pH ☐

EC ☐ μS/cm

APPENDIX D

Lettera Motivazionale

INDAGINE SULLE COLTURE PROTETTE NEL SUD DELL'EUROPA

Il questionario proposto di seguito ha lo scopo di raccogliere dati sulla coltivazione in ambiente protetto di specie frutticole, orticole e ornamentali nell'Europa Meridionale. L'indagine è condotta dal Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) di Albenga (Savona, Italia) per conto della European Food Safety Authoriy (EFSA). Per maggiori informazioni sull'EFSA, potete visitare il sito web:

http://www.efsa.europa.eu/it/

Per maggiori informazioni sul Ce.R.S.A.A. e sul progetto potete visitare il sito web:

http://www.cersaa.it/pro_crops.html

Le persone intervistate per questa indagine appartengono alle seguenti categorie: coltivatori, consulenti, tecnici o responsabili di associazioni di produttori o organizzazioni simili, responsabili di organizzazioni commerciali, ecc. Con questa indagine si vuole ottenere un quadro il più realistico possibile sulle caratteristiche delle serre nel bacino del Mediterraneo.

Le domande del questionario riguardano sia il tipo di apprestamento protettivo sia la coltivazione delle piante. I dati raccolti saranno di proprietà dell'EFSA, che li utilizzerà per compilare un documento di riferimento sull'emissione dei fitofarmaci dalle strutture protette.

Il nome dell'azienda è richiesto esclusivamente per necessità di completezza del database, ma EFSA ne garantisce la riservatezza.
Al termine dell'indagine EFSA pubblicherà un documento finale accessibile a tutti.

Per assicurare un'elevata variabilità dei dati raccolti, è necessario compilare un questionario per ogni tipo di sistema-coltura, definito come "una coltura in un determinato tipo di apprestamento protettivo". Se un'azienda possiede diversi tipi di strutture e/o colture, si prega di compilare più questionari.

APPENDIX E

Questionnaire

Information général

Nom: ☐ Nom de Famille: ☐

Nom de l'Entreprise: ☐

Adresse 1 de l'Entreprise: ☐

Adresse 2 de l'Entreprise: ☐

Adresse 3 de l'Entreprise: ☐

Adresse 4 de l'Entreprise: ☐

Code Postal: ☐ E-mail adresse: ☐

1) Vous êtes un:

Producteur □ Technicien conseiller □

Responsable d'une organisation commercial □ Autre - spécifier □

2) Sélectionner l'Etat dans lequel la culture protégée est localisé:

Italie □ Espagne □ Grèce □ France □

3) Si vous avez choisi Italie, dans quelle région est la culture protégée localisé?

Ligurie □ Lombardie □ Sicile □

4) Si vous avez choisi Espagne, dans quelle région est la culture protégée localisé?

Almeria □ Huelva □ Région de Murcia □

5) Si vous avez choisi Grèce, dans quelle région est la culture protégée localisé?

Crête □

6) Si vous avez choisi France, dans quelle région est la culture protégée localisé?

Languedoc - Roussillon □ Provence □

Structure de protection

1) Sélectionner la typologie de la structure dans la liste ci dessous (sélectionner seulement une typologie):

Structures petits
couverture(*) petit en filet □
couverture(*) petit en plastique □
tunnel (**) petit/mini tunnel en filet □
tunnel (**) petit/mini tunnel en plastique □
Structures grandes ouvertes
couverture(*) grande en filet □
couverture(*) grande en plastique □
ombrage (**) □
Structures grandes abri
tunnel (**) grand □
serre sans contrôle automatique □
serre avec contrôle automatique □
structure abri (p.ex. pour les champignons) □

(*) seulement la portion supérieur

(**) portions latérales et supérieur

Conditions de Cultivassions

1) Laquelle des les cultures ci dessous cultivez-vous? (sélectionner seulement une culture par questionnaire)?

Raisin de Table □ Fraises □ Framboises □ Autres fruits– spécifier □

Tomates □ Poivrons □ Aubergines □ Concombre □ Courgettes □ Melons □ Pastèques □ Chou □ Laitue et autres salades □ Herbes □ Autre légumes - spécifier □

Fleurs coupées - spécifier □

Ornementales en pot- spécifier □

Matériaux de propagation/ pépinière- spécifier □

Autres cultures non comestibles- spécifier □

2) Indiquer la surface de la culture protégée examiné (en hectares):

[ ] ha

3) Combien de traitements antiparasitaires faites-vous en moyenne pendant l'année?

Aucun □ Irroration sur la partie aérienne□ Irroration ultra bas volume/fumigation dans l'aire□

Par l'eau d'arrosage□ Injection dans le sol□ Traitements au sol□

4) Quelle typologie de substrat utilisez-vous?

Sol □

Hors-sol avec substrat (naturel ou artificiel) □

Hors-sol sans substrat (hydroponique) □

5) Quelle typologie de ventilation utilisez-vous dans la structure?

Ventilation non réglable □ Ventilation réglée manuellement □

Ventilation forcée □ Ventilation forcée (systèmes de contrôle du climat) □

6) Est-que vous utilisez des systèmes de control du climat (pour le chauffage ou le refroidissement)?

Oui □ Non □

7) Est-que vous utilisez un filet anti-insectes dans la structure?

Aucun □ Partial □ Total □ Total avec double port □ Pas applicable □

Autre – spécifier □

8) Quelles technique d'arrosage si dessous utilisez-vous?

Goutte à goutte □ Aspersion sur feuillage □ Ecoulement gravitaire de surface □

Distribution de solution nutritive hors-sol □ Su-arrosage □

Autre – Spécifier □ Pas Applicable □

9) Est-ce que l'eau drainée est recyclée?

Oui (cycle non-ouverte) □ Non (cycle ouverte) □ Tous les deux □

10) Si vous avez choisi Tous les Deux, sur combien d'hectares le cycle non-ouverte est effectué?

[ ] ha

11) Si vous avez choisi Oui ou Tous les Deux, combien des fois l'eau du drainage est déchargée dans le cycle non-ouverte?

[ ]

12) Concernent l'arrosage, comment calculez-vous la quantité d'eau nécessaire?

Selon les exigences de la culture, préventivement calculé/connu (*) □

Selon la mesure du contenu hydrique du substrat □

Selon l'évidente pénurie d'eau (plants fané) □

En excès □

Autre - spécifier □

(*) aussi selon l'expérience du cultivateur

13) Sélectionner la qualité de l'eau utilisée:

Eau d'haute qualité □ Eau de mauvaise qualité (eau salé/saumâtre) □

Eau d'osmose inverse □ Eau de différentes origines □

Autre – spécifier □

14) Indiquer pH et salinité (EC) de l'eau utilisée:

pH ☐

EC ☐ μS/cm

APPENIDX F

Lettre de Motivation

ENQUÊTE SUR LES CULTURES PROTÉGÉES DE L'EUROPE MÉRIDIONAL

Le questionnaire proposé ci-jointe a pour objectif de collecter des données sur les cultures protégées des espèces fruitières, maraîchères et ornementales dans l'Europe Méridionale (Grèce, Italie, France et Espagne). Cette enquête est conduite par le Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) d'Albenga (Savona, Italie) et commandée par la European Food Safety Authoriy (EFSA). Pour plus d'informations sur l'EFSA, vous pouvez visiter le web site :

http://www.efsa.europa.eu/fr/

Pour plus d'informations sur le Ce.R.S.A.A. et sur le projet, vous pouvez visiter le web site :

http://www.cersaa.it/pro_crops.html

Différentes catégories professionnelles peuvent être interviewées: les producteurs et les organismes de production, les techniciens conseillers, les responsables des organisations commerciales, etc. Le but de cette enquête est d'avoir une description à jour des caractéristiques réelles des cultures protégées Méditerranéennes.

Les questions posées dans le questionnaire concernent la typologie des structures de protection et les techniques culturales. Les données collectées sont de propriété d'EFSA, qui les utilisera comme référence sur l'émission des produits agrochimiques utilisées dans les structures protégées.

Le nom et l'adresse de l'entreprise interviewée sont nécessaires seulement pour compléter la base des données et vont constituer des informations confidentielles et limitées à EFSA.
En conclusion de l'enquête l'EFSA publiera un rapport final accessible à tout le monde.

Pour assurer une haute variabilité des données collectées, il est nécessaire de réaliser un questionnaire pour chaque typologie de système-culture, définit comme « une culture dans une structure de protection ». Pour une même entreprise, plusieurs typologies de structures et/ou de cultures peuvent coexister, ce qui engendrera plusieurs questionnaires.

APPENDIX G

Cuestionario

INFORMACIÓN GENERAL

nombre	
apellidos	
nombre de la finca	
dirección 1 de la finca	
dirección 2 de la finca	
dirección 3 de la finca	
dirección 4 de la finca	
código postal:	
E-mail:	

1) Es usted:

Agricultor:		
Asesor:		
Responsable de una organización comercial:		
Otro especifique:		

2) Seleccionar el país en donde se localiza el cultivo protegido

ITALIA:	
ESPAÑA:	
GRECIA:	
FRANCIA:	

3) Si has seleccionado Italia, en cual región esta situada el cultivo.

Liguria:	
Lombardía:	
Sicilia:	

4) Si has seleccionada España, en cual región esta situada el cultivo.

Andalucía:	
Región de Murcia:	

5) Si has seleccionada Grecia, en que región esta situada el cultivo.

Creta	

6) si has seleccionado Francia, en que región esta situada el cultivo.

Languedoc - Roussillon	
Provence	

Estructura del cultivo protegido.

Estructura baja	cubierta baja	cubierta (*) con maya	
		Cubierta (*) con plástico	
		Túnel (**) bajo / mini túnel con maya	
		Túnel (**) bajo / mini túnel con plástico	
Estructura alta	estructura abierta	Cubierta (*) con maya	
		Cubierta (*) con plástico	
		umbrario (**)	
	estructura cerrada	túnel (**) alto	
		Baja tecnología	
		Alta tecnología	
		Estructura cerrada (setas, champiñones)	

(**) parcialmente lateral y superior

Condiciones del cultivo

1) Cual de las siguientes cultivos cultiva? (seleccionar solo uno).

Uva de mesa			
Fresa			
Frambuesa			
Otros frutos		*specif.*	
Tomate			
Pimiento			
Berenjena			
Pepino			
Calabacín			

Melón	☐		
Sandia	☐		
Repollo	☐		
Lechuga	☐		
Hierbas aromáticas	☐		
Otra hortícola	☐	*specif.*	☐
Flor cortada	☐	*specif.*	☐
Ornamental en maceta	☐	*specif.*	☐
Material de propagación	☐		
Otro cultivo no comestible	☐	*specif.*	☐

2) Cual es la superficie de cultivo de la estructura protegida?

☐ ha

3) Cuantos tratamientos fitosanitarios realizas de media al año?

Ninguno	☐
Pulverización	☐
Nebulización/ fumigación	☐
A través del agua de riego	
Inyección al suelo	☐
Tratamientos de suelo	☐
Trattamenti al suolo	☐

4) Que tipo de substrato usa para cultivar sus plantas?

Suelo	☐
Sustrato artificial	☐
sin sustrato	☐

5) Que tipo de ventilación utiliza en la estructura?

Ventilación no regulable	☐
Ventilación regulable manualmente	☐
Ventilación forzada	☐
Ventilación controlada (sistema de control climático)	☐

6) Utiliza sistemas de control climático (para calefacción o refrigeración?

Si	☐
No	☐

7) Utiliza maya (pantalla) anti-insecto en la estructura?

Ninguna	☐
Parcialmente	☐
Totalmente	☐
Total doble puerta	☐
No aplico	☐
Otro- especificar	☐

8) Cual de los siguientes sistemas de irrigación utilizas?

Riego localizado	☐
Aspersión	☐
Superficie	☐
Distribución de solución nutritiva	☐
fuera del suelo	☐
Riego subterráneo	☐
Otros especificar	☐
No aplica	☐

9) El agua de drenaje recircula?

Si (ciclo cerrado)	☐
No (ciclo cerrado)	☐
Ambos	☐

10) Si has seleccionado ambos, cuantas hectáreas tiene el ciclo cerrado?

☐ ha

11) si has seleccionado si o ambos, cual es la frecuencia es introducida al ciclo cerrado?
dal sistema a ciclo chiuso?

☐

12) En Relación al sistema de riego, como calcula la cantidad necesaria de agua?

En base a las exigencias del cultivo previa mente calculado (*)	☐
En base a la medición del contenido de humedad en el substrato	☐
En base al stress hídrico de la planta	☐
Riego en exceso	☐
Otros especificar	☐

(*) Incluye buenas practicas agrícolas

13) Seleccionas la calidad del agua de riego

Alta calidad	☐
Baja calidad (salobre)	☐
Agua de desaladora	☐
Agua de diverso orígenes	☐
Otro especificar	☐

14) Indicar pH y salinidad (CE) del agua utilizada

pH	☐	
EC	☐	mS/cm

APPENDIX H

Escrito Argumental

Encuesta sobre los sistemas de protección de cultivos en el sur de Europa

El siguiente cuestionario tiene como objetivo la recogida de datos sobre la protección de sistemas de cultivo en el sur de Europa, incluyendo hortícolas, frutas y plantas ornamentales. La encuesta se lleva a cabo por el Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.R.S.A.A.) de Albenga (Savona, Italia) en nombre de European Food Safety Authority (EFSA). Por favor ver el siguiente enlace para mayor información sobre la EFSA:

http://www.efsa.europa.eu

Para más información sobre Ce.R.S.A.A. , sus colaboradores y sobre el proyecto visite el siguiente link:

http://www.cersaa.it/pro_crops_eng.html

Las personas entrevistadas para estas encuestas podrán pertenecer a las siguientes categorías: agricultores, consultores, técnicos, responsables comerciales de asociaciones o cooperativas, etc. El objetivo de la encuesta es la obtención de una fotografía realista de las características de los invernaderos del Mediterráneo.

Las preguntas del cuestionario se refieren a las características de los tipos de estructura de protección de los invernaderos, junto con la ventilación, y sistemas de irrigación de los cultivos protegidos. Los datos recogidos serán de titularidad de la EFSA, que los utilizará para elaborar un documento de orientación general sobre las emisiones de plaguicidas procedentes de sistemas de cultivos protegidos.

Con el fin de cumplir con las bases de datos se requiere el nombre de la Finca, sin embargo la EFSA asegura que esta información será confidencial y propiedad de EFSA.

Al finalizar las encuestas, EFSA publicará un informe final que sea accesible a todo el mundo.

Un cuestionario para cada tipo de sistema de cultivo (un cultivo por cada estructura de protección) que se necesita. Si hay más de una estructura y / o cultivo en una finca. Habrá que rellenar más de un cuestionario.

APPENDIX I

ερωτηματολόγιο

Γενικές πληροφορίες

Όνομα	
Επίθετο	
Όνομα Επιχείρησης/Φάρμας	
Διευθυνση Επιχείρησης/ Φάρμας 1	
Διευθυνση Επιχείρησης/ Φάρμας 2	
Διευθυνση Επιχείρησης/ Φάρμας 3	
Διευθυνση Επιχείρησης/ Φάρμας 4	
Ταχυδρομικός Κώδικας	
Ηλεκτρονικό Ταχυδρομείο	

1) Εϊσαστε

Παραγωγός	
Σύμβουλος	
Εμπορικός φορέας	
Άλλο παρακαλώ προσδιορίστε	

2) Παρακαλώ επιλέξτε την χώρα στην οποία βρίσκεται η ιδιοκτησία σας

Ελλάδα	

3) Εάν επιλέξετε την Ιταλία σε ποία περιοχή βρίσκεται η καλλιέργεια σας

Liguria	
Lumbardy	
Sicily	

4) Εάν επιλέξετε την Ισπανία σε ποία περιοχή βρίσκεται η καλλιέργεια σας

Almeria	
Huelva	
Murcia Region	

5) Εάν επιλέξετε Ελλάδα σε ποία περιοχή βρίσκεται η καλλιέργεια σας

Κρήτη	

6) Εάν επιλέξετε την Γαλλία σε ποία περιοχή βρίσκεται η καλλιέργεια σας

Languedoc - Roussillon	
Provence	

Εκλογή Θερμοκηπιακής Κατασκευής

1) Επιλέξτε τον τύπο της κατασκευής σας από τις παρακάτω επιλογές (παρακαλούμε, επιλέξτε έναν μόνο τύπο):

Μικρή κατασκευή

Χαμηλή κάλυψη των καλλιεργειών

Χαμηλή κάλυψη από δίκτυ	
Χαμηλή κάλυψη από πλαστικό	
Χαμηλό Tunel από δίκτυ	
Χαμηλό Tunel από πλαστικό	

Ανοικτή κατασκευή με κάλυψη

υψηλό δικτυωτό	
υψηλό πλαστικό	
σκιαζόμενα	

Κλειστή κατασκευή

Tunnel	
θερμοκήπιο με απλή κατασκευή	
Θερμοκήπιο υψηλής τεχνολογίας	
Κλειστό κτίριο	

Καλλιεργητικές Συνθήκες

1) Ποία από τις ακόλουθες καλλιέργειες καλλιεργειτε (επιλέξτε μια καλλιέργεια)

Επιτραπέζια σταφύλια	☐		
Φράουλες	☐		
Σμέουρα	☐		
Άλλα μικρα φρούτα	☐	*προσδιόρισε*	☐
Ντομάτες	☐		
Πιπεριές	☐		
Μελιτζάνες	☐		
Αγγούρια	☐		
Κολοκύθι	☐		
Πεπόνι	☐		
Καρπούζι	☐		
Λαχανικά (μπρόκολο, κουνουπίδι,	☐		
λάχανο, λαχανάκια Βρυξελλών κ.λ.π.)	☐		
Μαρούλι και άλλες σαλάτες	☐		
Βότανα	☐		
Αλλα κηπευτικά	☐	*προσδιόρισε*	☐
Ανθοκομικά	☐	*προσδιόρισε*	☐
Καλλωπιστικά σε γλάστρες	☐	*προσδιόρισε*	☐
Πολλαπλασιαστικό Υλικό	☐		
Άλλες μη βρώσιμες καλλιεργιες	☐	*προσδιόρισε*	☐

2) Πόση έκταση καταλαμβάνει το σύστημα κάλυψης;

☐ ha

3) Πόσες εφαρμογές με φυτοφάρμακα κάνετε κάθε χρόνο

Καμμία	☐
Ψεκασμός	☐
νέφωση/υποκαπνισμός	☐
μεσα από το σύστημα άρδευσης	☐
Έγχυση στο έδαφος	☐
Εφαρμογή φυτοφάρμακου στο έδαφος με είτε χωρίς ενσωμάτωση	☐

4) Ποιό τύπο υποστρώματος χρεισιμοποιείτε για την ανάπτυξη της επιλεγμένης καλλιέργειας

Έδαφος	☐
Υπόστρωμα χωριίς έδαφος	☐
Χωρίς έδαφος και χωρίς υπόστρωμα	☐

5) Ποιο από τα παρακάτω χρησιμοποιείτε ως κύριο τύπο αερισμού

Παθητικός αερισμός	☐
Παθητικός αερισμός χειροκίνητος μέσω παραθύρων	☐
Δυναμικός αερισμός	☐
Δυναμικός αερισμός σε κλειστό κύκλωμα με έλεγχο όλων των παραμέτρων	☐

6) Χρησιμοποιείτε ενεργητικό έλεγχο κλιματισμού (είτε για θέρμανση είτε για ψύξη)

Ναι	☐
Όχι	☐

7) Χρησιμοποιείτε εντομοπαγίδες/ εντομοαπωθητικά;

Κανένα	☐
Μερικώς	☐
Πλήρως	☐
Πλήρως με διπλή πόρτα-με διπλή κάλυψη κόλλας για σύλληψη	☐
Μη εφαρμόσιμο	☐
Άλλο παρακαλώ αναφέρατε	☐

8) Ποιες από τις παρακάτω τεχνικές άρδευσης χρησιμοποιείτε;

Στάγδην άρδευση	☐
Καταιονισμός	☐
Αυλάκια ή φρεάτια στο έδαφος	☐
Θρεπτικό διάλυμα	☐
Υπόγεια άρδευση	☐
Άλλο παρακαλώ αναφέρατε	☐
Μη εφαρμόσιμο	☐

9) Τα νερά αποστράγγισης επανεισάγονται στο σύστημα άρδευσης

Ναι (κλειστό σύστημα)	☐
Όχι (ανοικτό σύστημα)	☐
Και τα δύο	☐

10) Αν επιλέξατε και τα δύο, πόσα εκτάρια είναι το κλειστό σύστημα άρδευσης

☐ ha

11) Αν επιλέξατε "Ναι" ή "και τα δύο" ποία είναι η συχνότητα απομάκρυνσης του νερού από το κλειστό συστημα άρδευσης

12) Σε σχέση με το αρδευτικό σύστημα πως υπόλογιζετε την ποσότητα του νερού που απαιτείται για άρδευση

Με βάση τις ανάγκες της καλλιέργειας (*)	
Με βάση την εδαφική υγρασία	
Με βάση την υδατική καταπόνηση	
Σε περίσσεια	
Άλλο παρακαλώ αναφέρατε	

(*) Περιλαμβανονται οι κωδικες ορθης πρακτικής στο χωράφι (π.χ. η ποσότητα του νερού άρδευσης υπολογίζεται με βάση την γνώση του παραγωγού)

13) Παρακαλώ επιλέξτε την ποιότητα της πηγής του νερού άρδευσης που χρησιμοποιείτε

Καλή ποιότητα νερού	
Κακή ποιότητα νερού (αλμυρό / υφάλμυρο νερό)	
Νερό από αντίστροφη ώσμωση	
Νερό από διάφορες πηγές	
Άλλο παρακαλώ αναφέρατε	

14) Παρακαλώ αναφέρατε το pH και την αλατότητα (EC) της πηγής του νερού που χρησιμοποιείτε για άρδευση

pH		
EC		mS/cm

APPENDIX J

ΕΝΗΜΕΡΩΤΙΚΗ ΕΠΙΣΤΟΛΗ

ΕΠΙΣΚΟΠΗΣΗ ΣΥΣΤΗΜΑΤΩΝ ΦΥΤΟΠΡΟΣΤΑΣΙΑΣ ΣΤΗ ΝΟΤΙΑ ΕΥΡΩΠΗ

Το ερωτηματολόγιο που ακολουθεί στοχεύει στη συλλογή δεδομένων για τα υπό κάλυψη καλλιεργητικά συστήματα στη Νότια Ευρώπη, συμπεριλαμβανομένων των κηπευτικών και των καλλωπιστικών φυτών. Η έρευνα διεξάγεται από το Centro Regionale di Sperimentazione e Assistenza Agricola (Ce.RSAA) της Albenga (Savona, Ιταλία) εκ μέρους της Ευρωπαϊκής Αρχής Ασφάλειας Τροφίμων (EFSA). Παρακαλώ δείτε παρακάτω τον σχετικό σύνδεσμο στο διαδίκτυο για περισσότερες πληροφορίες σχετικά με την ESFA:

http://www.efsa.europa.eu/it/

Παρακαλώ δείτε παρακάτω τον σχετικό σύνδεσμο στο διαδίκτυο για περισσότερες πληροφορίες σχετικά με την CeRSAA:

http://www.cersaa.it/pro_crops_eng.html

Παραλήπτες του ερωτηματολογίου είναι παραγωγοί, γεωργικές ενώσεις και συνεταιρισμοί, γεωργικοί σύμβουλοι, υπάλληλοι αρμόδιων γεωργικών φορέων, φορείς του εμπορίου, κλπ. Ο στόχος της έρευνας είναι να επιτευχθεί μια ρεαλιστική εικόνα των χαρακτηριστικών των θερμοκηπίων της Μεσογείου.

Οι ερωτήσεις αφορούν τα χαρακτηριστικά των τύπων των εγκαταστάσεων υπό κάλυψη, σε συνδυασμό με τον εξαερισμό, την άρδευση και τα συστήματα φυτοπροστασίας. Τα δεδομένα που θα συγκεντρωθούν θα αποτελέσουν κυριότητα της EFSA, η οποία θα τα χρησιμοποιήσει για να καταρτίσει ένα ολοκληρωμένο έγγραφο με οδηγίες σχετικά με τις εκπομπές τα φυτοφαρμάκων από τις υπό κάλυψη καλλιέργειες.

Προκειμένου να ολοκληρωθεί η βάση δεδομένων, απαιτείται το όνομα της ιδιοκτησίας-Φάρμας που συμμετέχει στην έρευνα, ωστόσο, η ESFA διαβεβαιώνει ότι οι πληροφορίες αυτές θα είναι εμπιστευτικές και είναι ιδιοκτησία της. Στο τέλος της έρευνας η EFSA θα δημοσιεύσει τελική έκθεση, η οποία θα είναι προσβάσιμη σε όλους.

Abbreviations

A&E = Agricultura y Ensayo

Ce.R.S.A.A. = Centro Regionale di Sperimentazione e Assistenza Agricola

D.O.P = Denominazione di Origine Protetta

DSS = Decision Support System

EC = European Community

EFSA = European Food Safety Authority

IPM = Integrated Pest Management

MS = Member State

N.AG.RE.F. = National Agricultural Research Foundation

NFT = Nutrient Film Technique

PPPs= Plant Protection Products

PPR = Plant Protection Products and their Residues

UV = Ultra Violet