Information Systems for Pest Control in Protected Agriculture: The Almeria Experience

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Abstract

Almeria in Southeast Spain holds the biggest concentration of greenhouses in the Mediterranean (>27000 h.). Main problems for farmers are:

- Great concentration of greenhouses. Pests expand easily by proximity.
- Strong demand on quality and food security of our traditional markets (absence of chemicals, environmental care and good labor conditions).
- Strong competition of neighboring production areas.

A key point to solve these problems is assuring the quality of the production, done via an integrated policy to control pests in the greenhouses and the implantation of quality certification systems (AENOR, EUREPGAP, NATURANE, NATURE‘CHOICE and BRC).

In order to reach this objective, an integrated effort between horticultural producers, the Ministry of Agriculture and different research groups, gave birth to a set of web applications that facilitate an adequate pest control. It is composed be:

1. “Almeria Phytosanitary Information Service – APIS/SIFA”, that compiles and offers, via Internet, all the actual information required in the pest control decision making process (biological, cultural and chemical control techniques). It takes account of environmental protection, workers health and production profitability.

2. “Phytosanitary Alerts Information Network – PAIN/RAIF”, that cumulates and uses the information about the different farms (Integrated Control) and their regular analysis, offers the whole community of farmers information about the phytosanitary situation in their areas proposing control measures, and alerts via e-mails and cellular phone calls of special risk situations.

3. “Expert Support System for Integrated Production – ESSIP/SAEPI”, that uniforms methods between advisers, and offers support to them taking account of methods used by most advanced colleagues (reassuring decisions).

In this work, we present the characteristics of these tools and how the integrated work of different producers, administration and research groups has generated them. Actually, we are working in an extension of RAIF*GIS, with detailed plot data and more detailed risk maps.

Keywords: Pest Management Systems, Phytosanitary Alert Systems, Integrated Production, Biological Control Systems, Protected Agriculture Support Systems

Introduction

Actually, Almeria holds the biggest concentration of greenhouses in the Mediterranean area, with more of 27,000 H. of plastic covered greenhouses, distributed mainly in two areas, the West and the East Counties around Almeria City. The model of protected agriculture developed in our province has specific characteristics (Fundación Cajamar 2004, IEA2001) as:
• Small farms, with a medium size of 1.7 H. and family run.
• Exploitations are concentrated in small areas, as shown in figure 1 (West County area of greenhouses, with approximately 20000 H.).
• Association of farmers in cooperatives, mainly for commercialization, buying inputs and technical advice.
• Medium level technology in greenhouses, taking account of good climatic conditions. Usually, farmers do not use complex heating or cooling systems, they use day radiation and winds to heat and cool greenhouses. Technology has been mainly developed in the area and it is adapted to our conditions.
• High level of efficiency in water management (we are located in a desert).
• Specialization of the production (mainly in the west and east areas), taking account of their specific conditions (as water characteristics and market conditions). Target markets are extremely demanding.
• Development of an industrial cluster linked with the intensive agriculture, as benefits of the production have been reinvested in the same area. The structure of the cluster, which goes from the banking system to the input production and the marketing and commercialization of products can be see in figure 2.

Fig. 1. West County area concentration of greenhouses.

This model of agriculture, which has generated a strong impact in the economy of our province, passing from the last post between the 50 provinces of Spain to a comfortable situation in the middle of the table with a good inertia scaling up posts, has offered till now good responses to the different challenges found along its history, using mainly new technology and adaptation skills.
Actually, main problems are:

- High dependence of the provincial economy on the intensive agriculture sector.
- Due to the great concentration of greenhouses, pests expand easily by proximity.
- Strong demand on quality and food security of our traditional markets. Increasing their demands on absence of chemicals, environmental care and good labor conditions.
- Strong competition of neighboring production areas (with much more cheap labor costs), wishing to expel us from the markets.

In order to solve these problems and challenges, farmers (grouped in cooperatives), are actually in a process of:

- Expanding their product catalogs, not only agricultural ones, but technological ones. They sell technology and management knowledge.
- Offering high quality and strong security, by the application of strict norms and certification of the products and processes. This certification goes from the safety of products to the environmental care of the area where they are grown up, and social responsibility with the workers. Certification includes actually AENOR - EUREPGAP - NATURANE – NATURE’CHOICE – BRC systems.
- Using technologies in order to improve this quality, as biological control of pest and the best management of them, using information systems to know real state, limitations and best solutions.

In this later work line, an agreement between farmers, the administration and the research agents of the province (like the University of Almeria), which decide to collaborate to develop a set of information tools to facilitate the correct management of the pests in the area, on the base that best information and knowledge is a key point in solving in advance and with minimum costs sanitary problems of production. The description of the products developed and actually in development from this collaboration is the object of this presentation.
**Structure of Applications**

Figure 3 shows the structure of the applications developed in order to help the agronomical technicians in the field for a better management of pests. The system is composed actually by three elements:

1. SIFA. “Servicio de Información Fitosanitaria de Almería”, Almeria Phytosanitary Information Service - APIS
2. RAIF. “Red de Alerta Fitosanitaria”, Phytosanitary Alerts Information Network - PAIN

A fourth module it is been developed actually, RAIF-GIS, a Geographic Information System for early alert information with a parcel/greenhouse resolution. It is an evolution of previous RAIF system, and it is actually been tested with a cooperative (Coprohnijar).

The different systems are related with the data required for a good pest control decision (SIFA), methods to be applied (SAEPI), and known state of the pests in real time (RAIF), this later with less o more detail (RAIF/ RAIF-GIS).

**Applications-SIFA**

Main objectives of this system are:

- Presenting the knowledge and way of application of the most adequate pest control techniques; taking account of:
  - Environmental protection
  - Workers health conditions
  - Profitability of production
Compiling and offering, via Internet, all the actual information required in the pest control decision making process:

  - Legislation
  - Certification authorities
  - Authorized phytosanitary products
    - By cultivation
    - By cultivation-pest
  - Actual studies
  - Publications

  - General list of products
  - Pest control (by pest)
  - Pest control in a cultivation
    - Effect of the phytosanitary products:
      + For all the BCOs
      + For a specific BCO
      + For a BCO with a specific application

- For control of plant residues and material
  - Legislation

- For application of phytosanitary products:
  - Legislation (European and market countries)
  - Actual information
  - Registered phytosanitary products
    - General list
    - Usable in a given cultivation
    - Usable for a given production (by product)
    - For alternative applications
  - Information of a product:
    - By active substance
    - By commercial denomination
    - By register number
  - Residues Maximum Limits
    - For an active substance
    - For a cultivation
    - For a harvested product
  - Register of phytosanitary vendors and pest control services

- Information about pests:
  - Legislation
    - Phytosanitary prospecs
    - Direct actuations
    - Eradication and control programs
  - General description of pests
  - Auto-diagnosis
  - Prospected pests

- Connection with the RAIF, the Phytosanitary Alerts Information Network.
All this information is accessed from Internet by agronomical technicians and farmers as shown in figure 4.

Applications-RAIF

The functionality of this system can be summarized in:

- Cumulating and presenting the information about the different farms using Integrated Control and the regular analysis that are accomplished about:
  - State of the production
  - Pest and damages
- Offering the whole community of farmers information about the phytosanitary situation in their areas. Proposing control measures.
- Alert via e-mails and cellular phone calls to the subscribed farmers of special risk situations.

A key point in this system is the availability of real data, obtained in the field by the agronomic technicians of the different cooperatives in a regular basis (each fifteen days or weekly depending on the area). Actually, 30 % of the whole greenhouse surface is fully controlled,
thanks to the cooperation of the cooperatives. Figure 5 presents the structure of a simple consultation.
Actually, the system offers information on a County / Station level (as example, in the West County there are 11 reference points as shown in figure 5). Now, we are translating the data to a plot/greenhouse scale, using a Geographic Information System; the new and more detailed system, RAIF-GIS, is under development and evaluation with a test cooperative (Coprohnijar).

Applications-SAEPI

The objectives of this system can be summarized in:
- Uniforming methods between advisers in the fields.
- Offering support to the advisers taking account of methods used by most advanced colleagues (reassuring decisions).
- Presenting a general methodology (Cañadas2002) to:
  - Analyze conditions on cultivations.
  - Detect pests.
  - Estimate risks generated by a given pest.
  - Propose a treatment (using the Integrated Production protocols)

SAEPI is a knowledge based system, which main phases in order to offer the diagnosis of a given problem and some possible actions are:
1. Load initial data.
2. Sample the cultivation.
3. Fix the main pest.
4. Analyze the state of the cultivation.
5. Analyze associated pests.
6. First report about possible actions (depending subsequently on profitability).
7. Profitability data (about prices and harvest date).
8. Final recommendation.
Discussion

Information systems about management of pests can be used in order to improve the quality and security of products in intensive production as those in Almería. A key point is the implication of the different sectors affected, farmers, agronomic technicians and extensionists, administration and research agents. The availability of good field data lets the system to offer more accurate data and adequate proposals; actually the RAIF system is fed with exact data from cooperatives covering the 30% of the cultivated surface. Table 1 shows the area by product. Usually, tests are made in the tomato growing area, that reason that this is the most detailed analyzed crop.

Table 1. Area of crops under analysis.

<table>
<thead>
<tr>
<th>Extension (Hs)</th>
<th>tomato</th>
<th>pepper</th>
<th>cucumber</th>
<th>egg-plant</th>
<th>Green bean</th>
<th>zucchini</th>
<th>melon</th>
<th>watermelon</th>
</tr>
</thead>
<tbody>
<tr>
<td>tomato</td>
<td>2639</td>
<td>1316</td>
<td>435</td>
<td>178</td>
<td>161</td>
<td>515</td>
<td>560</td>
<td>966</td>
</tr>
</tbody>
</table>

Internet is an adequate formula in order to give the farmers and agronomic technicians actualized information about the different aspects of the pest management process. A good set of tools, supported by the whole sector, can be helpful in order to increase quality and security of products, and in this way, improve the marketing conditions of the production. Actual competition and market opening requires of this type of systems in order to maintain our market quota. Information systems as SAIFA, RAIF and SAEPI can together support the information requirements on pest control of the productive sector.

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