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DEVELOPMENT OF A KNOWLEDGE MODEL ABOUT PLASTICULTURE USING CONCEPT MAPS

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Abstract. We can find, actually, a great interest in the Latin-American countries on the application of the intensive agriculture techniques based in the used of plastics, because the requirements in increasing production in order to accomplish food security. Last news about food availability and prices of basic products confirm this point. Use of these technologies presents some risk, environmental, social and economical. A key point in a correct application of these techniques and material requires of a adequate knowledge that as in all natural and social environment conditioned systems, must be adapted to specific conditions of each location in order to obtain good results. In this sense in 2004, a set of 27 research groups and companies of 12 countries decided to collaborate in order to assemble a knowledge model of the plasticulture techniques, that has been assembled using mainly concept maps. Information was classified in 11 main areas and maps: agro-packing, climatic control, plant conduction, phytosanitary control, agronomic management, plant nutrition, soil preparation, crop protection, characteristics of plastics in agriculture, and a general one of plastics in agriculture. The use of the concept maps in general and of IHMC CmapTools has been a key point in ordering all the information and assembling the knowledge model.

1 Introduction

In the Latin-American countries of Portuguese and Spanish language, we can find actually a great interest in the use of plastics in agriculture, mainly as greenhouse covers and irrigation elements in intensive production. This new set of technologies is called actually as Protected Agriculture or more adequately "Plasticulture" (Pacheco 2002, Plasticulture).

Using correctly these materials, technologies and methods is a complex matter. Main characteristics are:

1. Correct application of technology depends on external conditions, as the weather, local materials, markets (local and external) requirements, soil characteristics, social situation and cultural traditions as example. It is an extremely locally specific technology, as example, a good tested greenhouse from an area of North Mexico it would be not suitable to be used in an area with same weather conditions (temperatures, humidity and winds) in Ecuador because the angle of sun rays is different and this conditions the optimum angle of roofs.
2. Actual knowledge about this technology has been developed in cold or template areas in North-America (USA), Europe (Holland and Spain) and the Mediterranean Basic (Israel), and East-Asia (Japan). Real conditions of Lain-American countries are extremely different at all levels from those of the actual technology leaders in Plasticulture. Direct translation of technology as the construction of a Israel greenhouse in a place like Venezuela Central Valley gave as result an installation absolutely inadequate, it reached inside 50 ºC.
3. Protected agriculture requires a higher investment than open-air one; bigger expenses and investments means greater risks. If there is not a good harvest (in quantity, quality and value), the farmer can go easily to ruin.
4. When correctly applied, if offers higher results, as bigger income, workload, and even environmental protection (as a reduced land area can sustain a higher population, more land areas can be reserved for ecological and environmental purposes). A correct application of these technologies offers good economic (income), social (work) and environmental (best use of lands) results, all these after assuring the availability of food to the population.

In order to improve the specific knowledge about the plasticulture technology in our area, the Latinamerican countries of Portuguese and Spanish language, a wide group of research groups and companies in our area decided to constitute a working group and propose to the CYTED Organization (the branch for Science and Technology for Development of the Ibero-American Organization of States), a project named CIACAP ("Comunidad Ibero-Americana de Conocimientos en Agro-Plasticultura", Ibero-American Community of Knowledge in Agro-Plasticulture), which main objective was cumulate and order the knowledge about these plasticulture technologies in our countries, developing a shared knowledge model and an index of active agents. The project lasted 5 years from 2004 to 2007.

2 Methodology

Main objectives of the project were:

1. Creation of a repository of the knowledge (Schreiber et al. 2000) about plasticulture in our area, supporting dynamic retrieval of information. It would use a taxonomy of the field and would include a catalogue of resources. Main difficulty reaching this objective was ordering the available knowledge.
2. Developing a virtual work system supporting the work of multiple groups in an extremely disperse area. We should require a CSCW systems adaptable to different technological conditions. This system would be capable of been used by other projects in the same organization.
3. Compiling, classifying and systematizing the accessible knowledge about plasticulture in our area, previously disperse between several groups and working areas, in order to share it easily. We would wish to find all the possible synergies between the participant groups.

One key point in our work, was classifying and ordering information, and even after several meetings we found it was required the definition of the different concepts that constituted the nucleus of the plasticulture as a new field. A second point was the fact that most of the participants were specialist in non computing areas as agronomy, plastics, environmental issues, development, and so on, with not great experience in modelling knowledge. In this sense, we analyzed several methodologies, techniques and tools for knowledge modelling, selecting finally the concept maps as representation technique and CmapTools as tool, for knowledge extraction, modelling, sharing and presentation (Novak 1998, Cañas et al. 2000). Main advantages of using CmapTools were:

- It required no previous knowledge of computing tools.
- Easy management of the tools, quite intuitive, easy learning.
- No cost for research.
- Great autonomy. After a learning session all the participants could use the tool with autonomy.

Main problem, in our case, has been the lack of a system for management of synonyms, which could be used in our case as a way of managing different languages.

Main steps related with the use of concept maps, during the project were:

1. Developing a Computer Supported Work Systems, in order to reduce real meetings.
2. Forming the different participants in the use of Concept Maps and CmapTools (2002).
3. Configuring the main areas or work, selecting finally 11 areas, that generated the 11 concept maps included in the system (2002). Each area was assigned to a manager and a developing team was in charge of their assembling. Main working language was Spanish, a special mention must be done to the Brazilian teams in charge not only of developing their parts but in charge of translating the biggest part of the information.
4. Definition of the catalogue of concepts and agents (2002).
5. Developing the different maps, starting with a personal meeting (2003), followed by on-line work, a second pre-consolidation meeting (2005) plus more on-line work, and finally a final definition meeting (2006).
6. Selecting the areas for development of the GIS related to the project (2002-2003).

3 Results

Main results of the project were:

1. A project web with several functions, presenting the results of the project, offering a Collective Work Support System, including file interchange and management, internal e-mail, chat, forums and work repository and storage of project files (as concept maps).
2. A set of concept maps where actual knowledge about the plasticulture in our countries was concentrated. These maps were structured as pointed in previous section in 11 areas: plastics in agriculture (a general one), agro-packing, agronomic management, characteristics of plastics in agriculture, climatic control, crop protection, plant conduction, plant nutrition, phytosanitary control and soil preparation. Concept maps have been developed in Spanish and Portuguese, as all the documentation of the project. Figure 1 shows the translation to English of the map about “Crop protection”. Figures 2 and 3 shows some detailed information about anti-insect nets.

3. A list of resources on plasticulture agents for the different areas and/or territorial areas of interest.

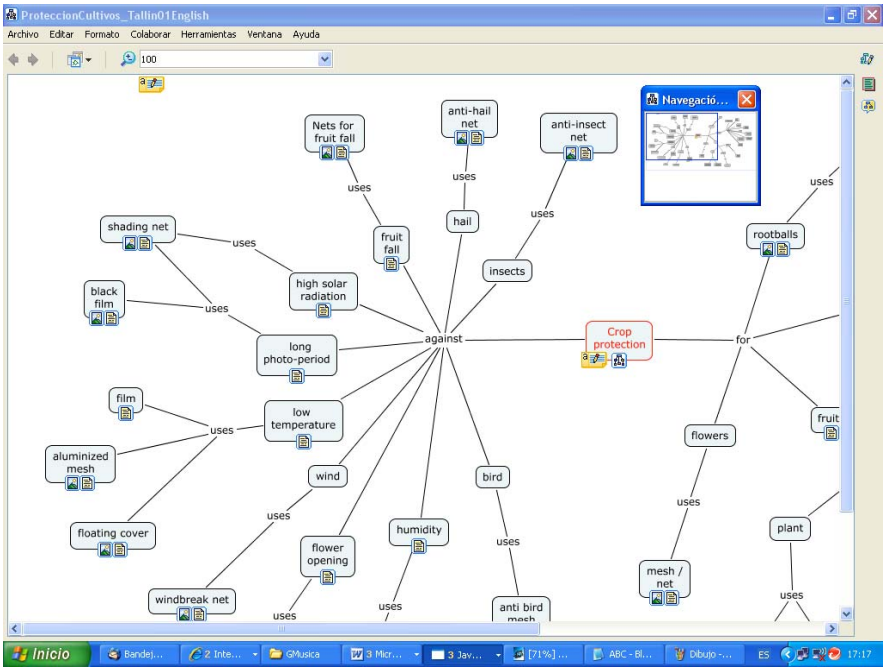

Figure 1. Concept Map about "Crop Protection", English version.

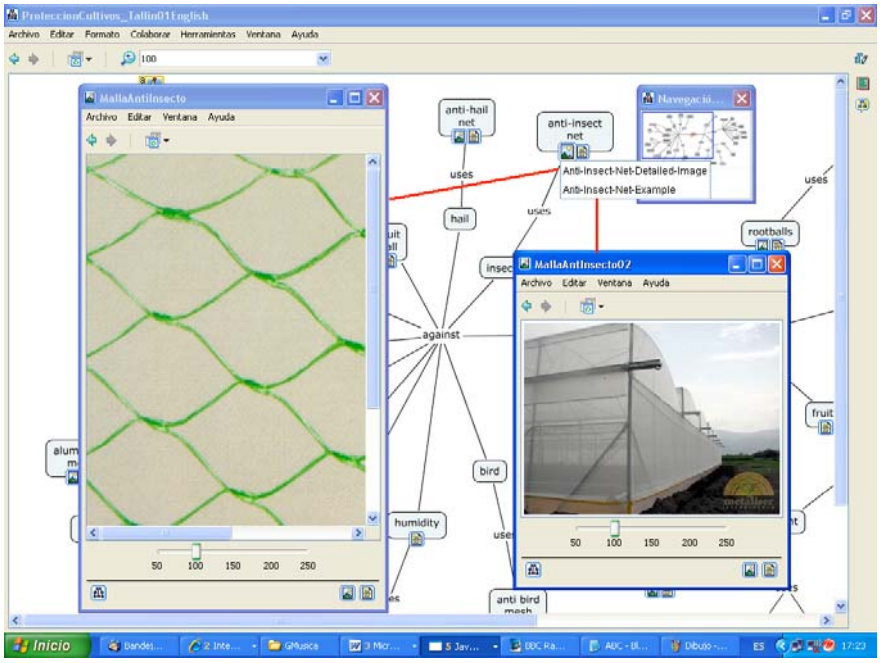

Figure 2. Images linked with the "Anti-insect nets" concept in "Crop protection" concept map.

4 Conclusions and further works

CIACAP project has been a complex project because it was highly interdisciplinary, with a great dispersion of participants, complex field of work (a new area with changing knowledge), use of different languages and argots, adaptation to specific areas requirements and novelty. One key point in the development of the project was the requirement of extracting, structuring and storing knowledge about plasticulture from different agents of diverse work fields disperse in a wide area, in this case, the use of concept maps was a good solution for this challenge.

Using of CmapTools has satisfied the requirements of our work; the only limitation has been the use of different languages, requiring the development of alternative maps instead of activating the alternative presentation of the same maps. Easily learning of the tools and their adaptability can be checked by the actual use of them in diverse fields by the participants of the project (as pest management or climatic control in greenhouses). Team members that have not used them previously have interiorized their use; they are utilizing them in other fields.

Next works include, translating the whole system to English (and probably French), transferring the system to a public ad-hoc web page, and preparing a system for public addition of references and knowledge.

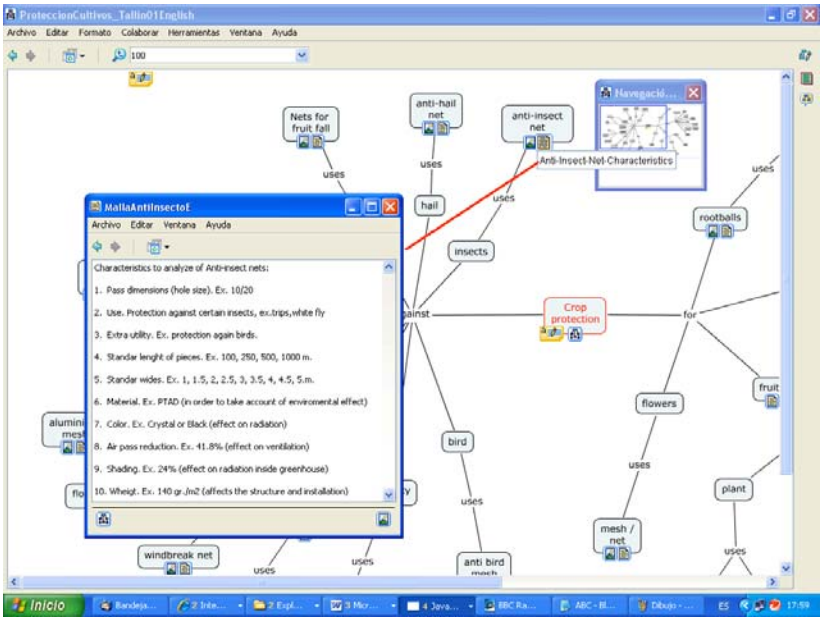

Figure 4. Characteristics to be taken in account for use of "Anti-insect nets", found in "Crop protection" concept map.

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