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DEFICIT IRRIGATION AS A MEANS OF REDUCING AGRICULTURAL WATER USE

E. Fereres*,, M. Morales** and M.A. Soriano****

* Instituto de Agricultura Sostenible, CSIC. Alameda del Obispo s/n. 14004 Cordoba.

** Department of Agronomy, University of Cordoba. Campus Universitario de Rabanales, Edif. Celestino Mutis (C4), 14004 Cordoba. Spain.

SUMMARY- We report here an overview and the present status of DIMAS "Deficit Irrigation for Mediterranean Agricultural Systems" (DIMAS-INCO-CT-2004-509087), a research project funded by the European Commission under the Sixth Framework Programme. The project started on 1st September 2004 with an initial duration of 36 months.

Irrigation uses about 80% of all water diverted for various uses in the Mediterranean Basin. Nevertheless, increased demand for other uses coupled with water scarcity is putting unprecedented pressures on reducing the share of freshwater used in irrigation. Given the degree of scarcity in many areas of the Basin, if irrigation water use could be reduced, it could become a major source of water, thus releasing resources for alternative use. The objective of the DIMAS project is to evaluate the concept of deficit irrigation (DI) as a means of reducing irrigation water use while maintaining or increasing farmers profits.

In DIMAS, the DI concept is the subject of multidisciplinary research at different geographic locations, different scales,and with different perennial and annual crops. The aim is to develop a workable, comprehensive set of deficit irrigation (DI) strategies that can be disseminated among the various agricultural systems of the Mediterranean Region. The project addresses directly the first topic of the INCO-2002-B1.2 specific measure, 'research on sustainable irrigation, including deficit irrigation'. Nine partners from seven different countries (Greece, Italy, Jordan, Morocco, Spain, Tunisia and Turkey), including research and water association institutions will work for three years on the DIMAS project. Their main activities are: a) the development of a general summary model of crop yield as a function of water supply, b) the validation of the model for the main irrigated annual (wheat, sunflower, cotton) and perennial crops (olive, pistachio, citrus), using common research protocols, c) a survey on physical, socio-economic and cultural conditions for each crop and irrigated area, and d) scaling up by combining the yield model with economic optimization modules that will generate optimum DI strategies compatible with the specific socio-economic characteristics of each area under study.

The results of the project will lead to providing recommendations for reducing irrigation water use in specific crops while ensuring the sustainability of irrigated agricultural systems in the Mediterranean basin. Feedback with project end-users will take place via participation of farmers associations and irrigation water agencies who will contribute their expertise in managing water scarcity, thus ensuring that all relevant issues are addressed.

Key words: Deficit irrigation, water productivity, ET, agriculture.

OBJECTIVES

The ultimate objective is to reduce the consumptive use of water by crops in the irrigated lands of the Mediterranean Basin by the use of deficit irrigation and thereby to release water resources for other uses in the Basin.

Specifically, DIMAS will explore the potential of deficit irrigation (DI) as a means of maintaining or increasing farmers' profits while reducing irrigation water use. The project has the following, measurable objectives:

1. Development of a simulation model for DI design and for yield prediction in water-limited situations.
2. Validation of the simulation model using experiments with the various crops and in participant countries.
3. Generation of DI recommendations for farmers and water managers that will reduce water use for irrigation in participant countries.

4. Characterization of current DI situations in participant countries and document farmers' performance and the limitations of existing irrigation networks.
5. Assess the economic viability of DI for the various crops, environments, and water delivery methods in participant countries. For this, the DI simulation model will be coupled with an optimisation module for economic analysis.
6. Evaluate the social acceptability of DI and the institutional and cultural features that are needed for the dissemination and acceptance of DI.
7. Integrate DI strategies into the management of irrigation water at the watershed, irrigation district, and farm levels.

PARTICIPANT LIST

The project human resources consist in nine partners belonging to seven research/academic institutions and two water users associations from seven different countries. The common denominator of the countries and areas involved in the project is first, the large proportion of water devoted to irrigation and second, the water scarcity issue as the primary natural resource, environmental and social problem. Table 1 presents the description of the Consortium.

The nine partners contribute expertise in the fields of water management, modelling, agricultural economics, sociology, rural development, irrigation agronomy, crop eco-physiology, irrigation engineering, soil science, and geo-information. There are also water users associations, either as explicit partners in two countries in this proposal (P8, P9), as associated partners working with the research teams of two other countries (P4, P7), or implicit in the partnerships of the other countries. All partners will work very closely and will contribute to all major objectives described above.

Table 1. Partner Institutions and their focus

No.	Partner institution	Acronym	Country	Disciplinary focus
1.	Department of Agronomy, University of Cordoba (coord.)	UCO	Spain	Water management, Modelling
2.	Agricultural Univ. Athens.	AUA	Greece	Agro-ecology, Hydraulics
3.	Mediterranean Agronomic Institute. Bari	IAMB	Italy	Ecophysiology, Modelling
4.	University of Jordan, Faculty of Agriculture	UoJ-FoA	Jordan	Irrigation, Engineering
5.	Institute Agronomique Veterinaire Hassan II	IAV	Morocco	Economics, Sociology
6.	Institut National Agronomique de Tunisie	INAT	Tunisia	Socioeconomics, Irrigation
7.	University of Çukurova, Faculty of Agriculture	ÇUKUN	Turkey	Ecophysiology, Irrigation
8.	Union Tunisienne de l'Agriculture et de la Peche	UTAP	Tunisia	Irrigation management
9.	Consortium of Bonifica of Capitanata	CBC	Italy	Irrigation management

Table 2. Workpackage list (full duration of project)

Work-package n.	Workpackage title	Lead contractor n.
1.	Model development	3
2.	Model validation in annual crops	6
3.	Model validation in perennial crops	2
4.	Inventory of DI practices	7
5.	Economic optimisation	5
6.	Scaling up DI to the watershed	4
7.	Synthesis, integration, coordination, dissemination	1

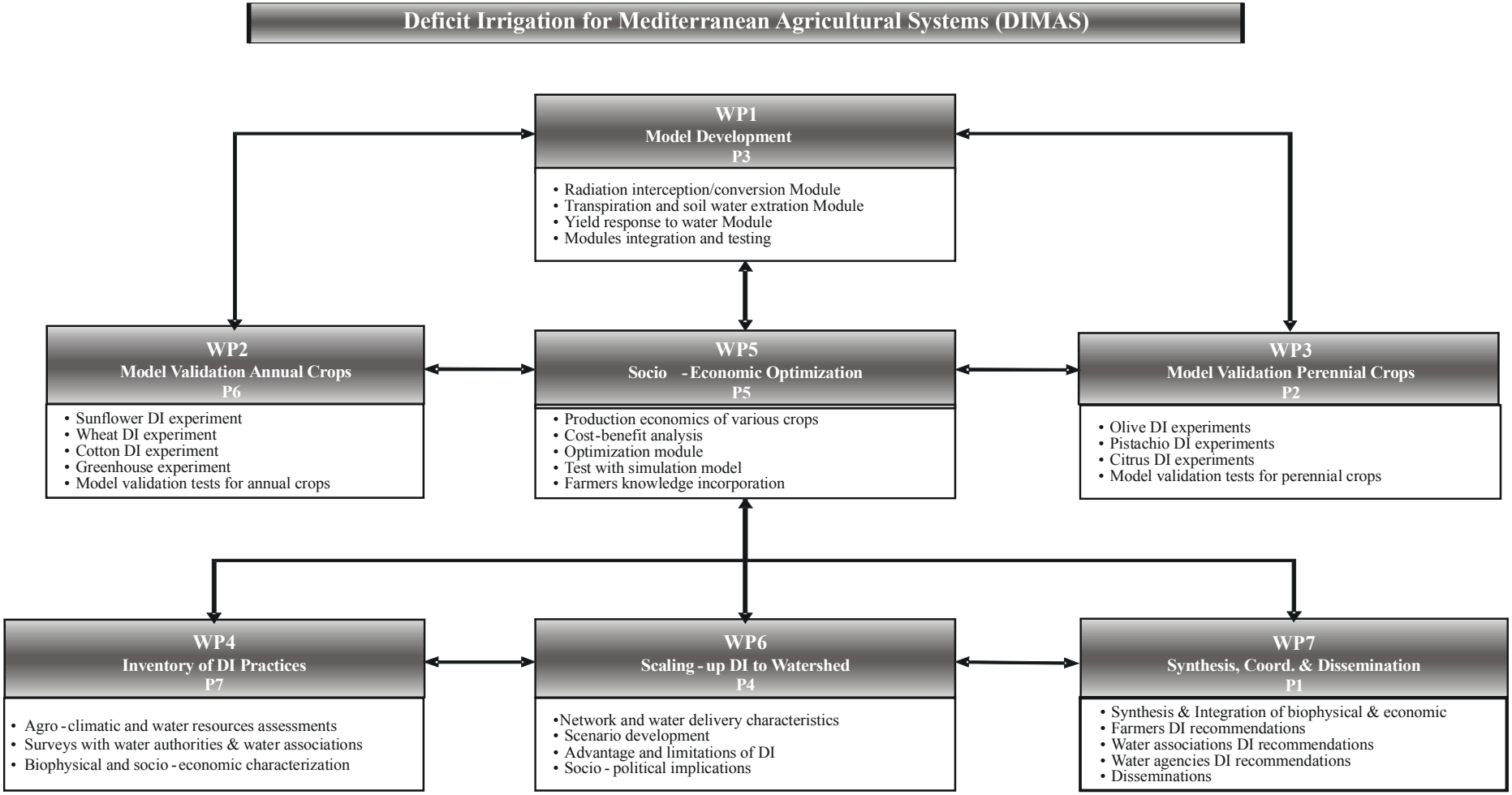

Figure 1. presents the interrelations between workpackages and activities of the project

RESULTS

Model developments

The efforts in developing a new simulation model have been directed at contributing to a larger effort along the same lines initiated by the Food and Agricultural Organization of the United Nations (FAO). Dr. Pasquale Steduto, originally a Partner of the DIMAS project and responsible for model development, moved to FAO after DIMAS started and is carrying out a programme focused on the development of a crop-water productivity model. DIMAS is cooperating in this effort and the outcome will be made available to our project.

Experimental results

The consortium has carried out field experiments aimed to obtain data to test the model for yield prediction under variable water stress. These experiments were implemented in both annual (wheat, sunflower, sugar-beet, peanut and cotton) and perennial crops (pistachio, olive and citrus). The partners involved are: UCO, Spain (sunflower and olive); AUA, Greece (cotton and pistachio); IAMB, Italy (sunflower and wheat); UoJ, Jordan (citrus); IAV, Morocco (sugar-beet and peanut); INAT, Tunisia (wheat and olive), and ÇUKUN, Turkey (cotton and pistachio). The results obtained so far, although preliminary and incomplete, are very promising. All these experiments will be repeated for two years.

Other activities are in progress. All the partners are committed to collect information on the practices followed by farmers and water authorities under the pressure of water scarcity. This activity has been carried out through enquiries with water authorities and associations and by surveys among farmers, in study zones in the various countries that participate to the project.

Training, coordination and participatory activities

The consortium paid attention from the beginning to the participatory nature of the planned activities. A kick-off meeting was held in Cordoba, Spain, in September 2004, at the beginning of the project, with the aim of develop the personal interchange of ideas and improve the personal communication between the participants. This meeting was followed in February 2005 by a methodology workshop. The goal of this workshop was to define a common base in the experimental activities, both in term of measurements and methods. Three more workshops and annual meetings have taken place in October 2005 (Amman, Jordan), in April 2006 (Adana, Turkey) and in September 2006 (Bari, Italy), where results and the current situation of the field experiments have been broadly discussed between partners.

Many details have been discussed, and the contribution of all partners led to participatory experimental protocols, specific designs for all the experiments in different countries. The treatments and the measurements performed are very homogeneous among the different experiments, although carried out at thousands of km of distance and in very different environmental and social conditions.

POTENTIAL IMPACT

DIMAS should have a direct impact on irrigation water usage in the areas and countries under study. The competitiveness of the agricultural sector and the many water-related problems in the urban, industrial and health sectors, depend, directly or indirectly on **more efficient irrigation water use**. This is particularly important in most of the Mediterranean countries where, as in other semi-arid areas, over 70% of available water is used in irrigation. Savings of even a few percentage points represents an important resource for alternative use. The use of any concept that reduces irrigation water demand such as Deficit Irrigation (DI) should **benefit the overall management of water resources**.

If DI is shown to be a viable practice and is adopted in irrigated areas, the amount of irrigation water use should decrease, leading to **reduced environmental problems**. The adoption of DI would reduce significantly the magnitude of irrigation return flows, one of the most important environmental problems that threaten irrigated agriculture and its surroundings. The advantages of DI in terms of releasing water resources for new uses and reducing environmental problems are evident but adoption has been slow because of the economic risks to farmers that are associated with this new technology. We hope to introduce a number of **innovations** to enhance the opportunities for successful demonstration of DI practices and dissemination among end-users, based on co-operative research among all project partners. It will only be possible to generate attention to this technique and promote adoption by demonstrating the outcomes of higher profits and equal or reduced risks.

Exploitation of research results will be integrated into the existing DI practices where available, as one means of melding innovation with existing experience in the area. This will be done by selecting the specific practices used and performing an evaluation using technical and economic models. Results will be disseminated in the form of recommendations for specific crops and water supply situations through training seminars and workshops at the local level. As some of the project partners are users associations and water development agencies, there will be a direct flow of results from research to implementation.

Coordinator Contact Details:

Project Coordinator:	**Contact:**
Prof. Elias FERERES CASTIEL University of Cordoba (UCO)	Mr. Manuel MORALES PRIEGO University of Cordoba (UCO)
Dept. Agronomy - ETSIAM Campus Universitario de Rabanales – (C4) 14071 CORDOBA – SPAIN	Dept. Agronomy - ETSIAM Phone: +34 957 499231 Fax: +34 957 499252
e-mail: ag1fecae@uco.es	e-mail: ag2moprm@uco.es

DIMAS Web-site: http://www.uco.es/grupos/agr119/dimas/htm/dimas.html

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