Christian M. Stracke

Advances in Irrigation and Hydroponics
Competence & Skills Development in Agriculture & Aquaculture

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Content

Advances in Irrigation and Hydroponics Competence & Skills Development in Agriculture & Aquaculture An Introduction

Due to the shortage of the precious resource water and the consequences of the climate change, numerous European policies have been developed and adopted for the protection and sustainable utilisation of water creating a huge demand in particular in the vocational training. Economic factors like privatisation and increasing cost pressure in water management are sharpening these educational needs leading to the demand for specific Vocational Education and Training (VET) opportunities and products as short and tailor-made as possible.

The AGRICOM project supports close links to working life in order to make VET more responsive to the labour market's needs in the agricultural sector. AGRICOM facilitates and improves the identification and anticipation of skills and competences' needs and their integration in VET provision and implies also promoting integration of learning with working. In particular AGRICOM supports the implementation of the "New Skills for New Jobs" strategy by taking into account the challenges such as environmental and demographic changes and the related growing job needs also in the agricultural sector.

The presented articles are the result of the Open Call for Papers issued by the AGRICOM Conference, which took place in Viterbo on 19th and 20th of September 2013 under the title: "Advances in Irrigation and Hydroponics: Competence & Skills Development in Agriculture & Aquaculture".

The AGRICOM Consortium has organised the AGRICOM Conference in order to raise the awareness of the stakeholders in the agricultural sector concerning competence modelling, with a special focus on hydroponics and irrigation. Thus, the AGRICOM Conference aimed to provide an opportunity for meetings and discussions between scientists and experts from all over Europe who are either subject experts or who deal with competence modelling as well as educational and training issues in the field of agriculture.

The scientific articles published in this book are the selected papers of applicants from over six countries received upon the Open Call for Papers issued by the AGRICOM Conference 2013: They were reviewed by the scientific Programme Committee of AGRICOM 2013 in double-blind peer reviews and selected according the review results. In addition all authors of the selected articles could present and discuss their papers at the AGRICOM conference in a speech.

Daniela Borgognone, Eva Švecová, Antonio Fiorillo, Elvira Rea, Mariateresa Cardarelli, Giuseppe Colla (all from Italy) present the effect of irrigation regime on growth, flowering and water use of Bougainvillea spectabilis. The effect of three irrigation regimes on morpho-physiological parameters and product quality of Bougainvillea spectabilis was investigated with an emphasis on the tolerance to water stress in post-production. The results showed that the use of an irrigation regime based on 60% of daily water use can be recommended for potted production of Bougainvillea because it allows to reduce water consumption and to increase water use efficiency without any detrimental effect on plant growth.

Andrea Dührkoop (Germany), Prof. Dr. Tarik Hartani (Algeria), Edward Muchiri (Algeria), Abdelaali Bencheikh (Algeria), Tarek A. Ouamane (Algeria), Madjed A. Djoudi ((Algeria), Prof. Dr. Oliver Hensel (Germany) present an interdisciplinary research project, aiming at the modernisation of pitcher-irrigation by applying modern materials and production technology based on semi-permeable membranes accompanied by trainings for the involved local scientific staff.

Manuela Capodilupo and Accursio Venezia (both from Italy) demonstrate current research in trough bench subirrigation system for tomato and other vegetables initiated by the OFRALSER project.

A. Parente (Italy), Y. L. Tsirogiannis (Greece), M. Nicolaos (Greece), B. Pantelis (Greece) and F. Montesano (Italy) present a project aiming at the establishment of a network of knowledge and expertise which will lead to the development of practical irrigation management tools for demand driven capitalization of scientific knowledge and good practices: "The IRMA project: Efficient Irrigation Management Tools for Agricultural Cultivations and Urban Landscapes".

Andrea Dührkoop and Prof. Dr. Oliver Hensel (both from Germany) present a joint research program to establish links between projects dealing with subsurface irrigation (SI) methods in Ivory Coast, Algeria, Kenya, Turkey and Namibia. Each country will conduct an analysis of SI methods in field

trials under local conditions in terms of water productivity, use of low quality water, salinity effects in the soil and socio economic aspects. to summarize the results into guidelines for stakeholders, farmers, water managers, water authorities and ministries.

Cornelia Helmstedt, Xenia Rodriguez and Christian M. Stracke (all from Germany) present the AGRICOM Project which main goal is to establish the first Competence Model for the Agricultural Sector (ACM) in order to strengthen the transparency and comparability of VET opportunities at a European level.

Henrike Perner (from Germany) describes the method used to transfer the water competence model (WCM) into the agricultural and horticultural sector in the framework of the AGRICOM project.

Andreas Drakos, Charalampos Thanopoulos, Yannis Psochios (all from Greece) introduce to one of the main outputs of the AGRICOM initiative: the web portal and repository for storing and hosting Vocational Education and Training (VET) elements based on the AGRICOM Competence Model (ACM) and the implemented quality management system. The system forces uploaded content through a specific workflow that requires user interaction and validation before publishing.

To summarise, this book contributes to the current developments and debate on competence modelling in the agricultural and horticultural sectors by presenting latest techniques, offering different views and solutions on competence modelling and by providing suggestions for future improvements European vocational education and training in the agricultural and horticultural sectors.

Cornelia Helmstedt, Xenia Rodriguez and Christian M. Stracke

Effect of irrigation regime on growth, flowering and water use of Bougainvillea spectabilis

Daniela Borgognone[1], Eva Švecová[1], Antonio Fiorillo[1], Elvira Rea[2], Mariateresa Cardarelli[2], Giuseppe Colla[1]

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Abstract. *Bougainvillea* Comm. ex Juss. (*Nyctaginaceae*) is an important ornamental plant widely grown in mild and warm regions. The selection of varieties and good management of the cultivation reflect on the performance of plants in post-production. During the transport, Bougainvillea plants are often subjected to a water stress leading to physiological disorders and severe damages of plant material. To avoid the damages by water stress, the increase of drought tolerance is essential. In the present study, the effect of three irrigation regimes on morpho-physiological parameters and product quality of *Bougainvillea spectabilis* was investigated with an emphasis on the tolerance to water stress in post-production. Leaf water potential and flowering were significantly affected by irrigation regime. Increasing irrigation amount increased water consumption and decreased water use efficiency. The results showed that the use of an irrigation regime based on 60% of daily water use can be recommended for potted production of Bougainvillea because it allows to reduce water consumption and to increase water use efficiency without any detrimental effect on plant growth.

Keywords: Bougainvillea, irrigation regime control, water stress, drought tolerance.

1 Introduction

Bougainvillea Comm. ex Juss. (*Nyctaginaceae*) is an important genus from the category of ornamental plants, widely grown in mild and warm regions. It includes numerous species of arborescent shrubs and climbing plants with origin in the tropical regions of South America (Huxley et al., 1999). The species of greatest interest are the *B. spectabilis*, *B. glabra* and *B. x buttiana* (Dole and Wilkins, 1999). Each species contains several subspecies characterized by different growth habit, bract colour and the foliage (Huxley et al., 1999). Thanks to the remarkable variety of forms and strong adaptability to the Mediterranean climatic conditions, bougainvillea has spread widely in Italy (Leonardi and Romano, 2003).

Due to the great demand, this ornamental plant requires the appropriate management of the large scale plant production, and subsequently the adequate logistics. In fact, during the transport Bougainvillea plants are often subjected to a water stress leading to various physiological disorders. Although in some cases the controlled water stress is required to control plant height and width, e.g. in *B. spectabilis* (Ma and Gu, 2012), uncontrolled water stress leads to severe damages of plant material. Currently, little is known about the physiological disorders occurring to the potted plants under water stress conditions.

Drought tolerance might be increased by irrigation regime control (Fernández et al., 2006). In the study of Li and Yang (2009), the water use efficiency of *Bougainvillea glabra* was highest after four days of water stress, indicating that moderate water stress improves the water use efficiency. These findings suggest that pre-adaptation of the plants to a drought stress may increase resistance to the stress during the transport.

The aim of the present study was to investigate the effect of three irrigation regimes on growth, flowering, and water use efficiency of *Bougainvillea spectabilis.*

2 Materials and Methods

The trial was carried out at the Experimental Farm of Tuscia University, central Italy (lat. 42°25'N, long. 12°08'E, alt. 310 m above sea level) under greenhouse conditions. The greenhouse was maintained at day/night temperatures between 14 and 28°C, and day/night relative humidity of 50/85%. Rooted cuttings of *Bougainvillea spectabilis* 'Fucsia colour' from Torsanlorenzo Nursery, Torsanlorenzo (RM), Italy were transplanted on 1 August 2010 in plastic pots (diameter 20 cm) filled with a mixture of peat/pumice (2:1 v/v) substrate.

Three irrigation regimes were tested in a randomized complete block design with four replicates. Irrigation regimes were obtained by varying the level of water recovery (100%, 60% and 40% of the daily water use obtained respectively with drippers 8, 6 and 2 L/h). Daily water use was equal to the water required to bring the substrate to container capacity plus 15% of runoff. Plants were fertigated prior planting with a slow release fertilizer (4 g/L of Baycote, Bayer) and during the cropping cycle with a complete nutrient solution.

On 24 September 2010 (55 days from transplanting, DAT), plant height, number of stems per plant and SPAD index of leaves were measured. Moreover, on 6 January 2011 (159 DAT), SPAD index of leaves was measured. At the end of the cropping cycle (257 DAT), leaf water potential, SPAD index of leaves, percentage of flowering, fresh weight of leaves, stems, and inflorescence were measured. Leaves, stems, and inflorescences were dried in a forced-air oven at 80 °C for 72 h for dry biomass determination. Water consumption was monitored during the cropping cycle using a gravimetric method. Water use efficiency was calculated as the ratio between above ground dry biomass and water consumption.

3 Results

At 55 DAT, no significant differences were recorded on plant height and number of stems among plants irrigated with different water amounts (avg. 102.6 cm and 2.8 stems/plant, respectively). No significant differences were

recorded on SPAD of leaves during the cropping cycle (avg. 57.4, 70.9, 74.9 at 55, 159, and 257 DAT, respectively). At the end of the cropping cycle, leaf water potential was significantly affected by irrigation regime with higher value in leaves of plants irrigated with 40% of DWU (-1.69 MPa) than in those irrigated with 100% DWU (-1.22 MPa) while leaves of plants irrigated with 60% DWU gave an intermediate value (-1.48 MPa) Total above ground dry biomass was significantly lower in 40% DWU treatment than in 100% and 60% DWU (88 vs 175 g/plant).

Water regime significantly affected the flowering ($P<0.01$) with higher value in plants irrigated with 100 and 60% of daily water use (avg 22.6%) compared to plants irrigated with 40% of DWU (16.1%). Increasing irrigation amount increased water consumption (Fig. 1) and decreased water use efficiency (1.1, 1.8, and 2.1 g/L for 100, 60 and 40% of DWU, respectively). Similar results were achieved in wheat, where an increased irrigation regime caused decrease in water use efficiency and lead to increase in days to maturity and water use (Onyibe, 2005). Similarly, water use efficiency significantly increased under water stress in *Catharanthus roseus* (L.) G. Don. (Jaleel et al., 2005). These plant responses suggest that controlled water stress might contribute to stress tolerance, that is essential especially during the transport, and to reduce the water use during the growth cycle at the same time.

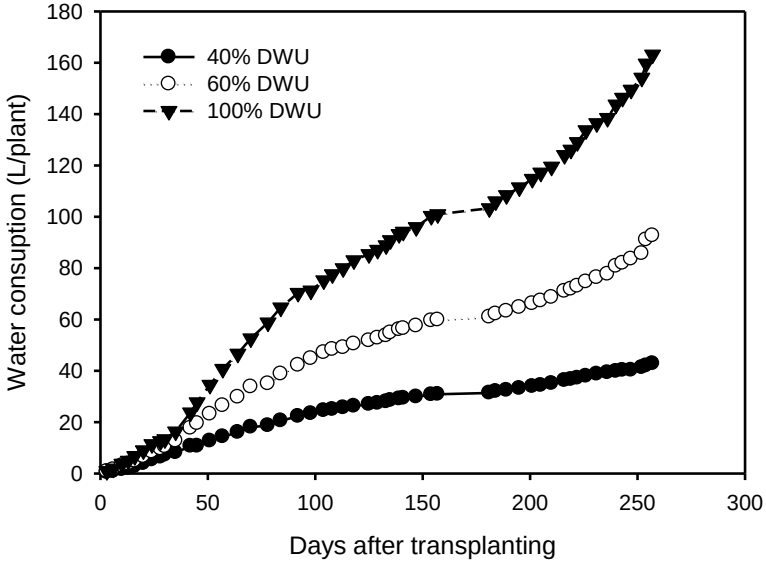

Figure 1: Effect of irrigation regimes on water consumption of Bougainvillea plants.

4 Conclusion

The results demonstrated that the use of an irrigation regime based on 60% of daily water use can be recommended for potted production of Bougainvillea because it allows to reduce water consumption and to increase water use efficiency without any detrimental effect on plant growth.

5 Acknowledgment

This work was financed by Ministry of Agricultural, Food and Forestry Policies (MiPAAF) Project “Tecnologie di filiera per il controllo della tolleranza a stress idrico in Bougainvillea“(D.M. 11053/7643/09 of 7 May 2009).

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International research activities on innovative low pressure irrigation technique with polymer membrane

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Abstract: The paper presents an interdisciplinary and effect-oriented research project, aiming at the development of a both ecological and economical irrigation technology. The research project is financed by the German Federal Ministry for Education and Research (BMBF) within the framework of the support programme “Sustainable Solutions for Sub-Saharan Africa”. The involved project partners comprise Universities, research institutes and industry companies from Algeria, Kenya and Germany.
The technological approach is focused on a modernization of pitcher-irrigation. This irrigation method - well known for its superior efficiency in arid areas since ancient times - has the disadvantage of not to be economic when used in modern agriculture. The project adopts the pitcher-irrigation principle to modern materials and production technology based on semi-permeable membranes. Field tests in Algeria and Kenya are presented, showing promising results with respect to economic and ecologic aspects.

Keywords: irrigation, subsurface irrigation, water efficiency, auto-regulative, water saving, intelligent irrigation.

1 Introduction

In Algeria, Kenya and many other states of arid and semi-arid zones, water consumption exceeds the renewable water resources, leading to widespread groundwater depletion and water scarcity. Considering climate change and poverty as well as water and food scarcity it is vital to enhance crop yields while at the same time reducing water demand. Current irrigation methods use only a minor portion of the applied water, and up to 60 % of water applied is lost due to percolation, evaporation and poor water management (Hübener, 2006).

Within this context the BMBF has initiated joint research activities among Universities, industry companies and research institutes from Germany and Subsahara Africa financed for a period of 24 months. The presented project comprises two key aspects: the first is the testing and development of an innovative auto-regulative subsurface irrigation technique with membrane material and the second is the qualification of the involved project partners and their junior researchers in order to intensify research cooperation between Germany and countries from Subsahara Africa.

2 Project structure

The project was initiated by the Institute of Agricultural Engineering of the Kassel University in Germany, having a long experience in irrigation, especially in subsurface and pitcher irrigation. Due to the institute's numerous research and education activities in Africa partners for the BMBF project were easy to find. Preliminary studies carried out at the institute could be transferred to field conditions in the partner countries Algeria and Kenya.

On the African partner side Algerian and Kenyan four research institutes are involved. From Algeria there are:

- the National Advabced School of Agronomy (ENSA), Agricultural water management laboratory – Institute for Water in Agriculture

- the Research Center for Science and Technologies in Arid regions (C.R.S.T.R.A.) and
- the Technical Institute of Vegetable and Industrial Culture – Ministry of Agriculture (ITCMI).

From the Kenyan side there is the University of Egerton with its department of Civil and Environmental Engineering.

The pool of involved project partners comprises on the German side:

- the Department of Agricultural Engineering of the Kassel University,
- the Institute for Tropical and Subtropical Agriculture (DITSL),
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH with its Algerian Integrated Water Resources Program,
- the Chair of Chemical Process Engineering of the RWTH Aachen.

Partners from industry comprise MICRODYN-NADIR (Wiesbaden, Membrane Technology) and PFAFF Industrial (Kaiserslautern, welding technology for synthetic tissues), furnishing know-how and materials necessary for prototype production.

3 Scientific objectives and results

The project bundles research and development activities of various stakeholders in order to develop a new environment friendly and water saving technology.

Within the cooperation period the following research activities were accomplished:

A. Developing and testing of the water saving subsurface irrigation technology.

The used pipe for irrigation purposes in this project is normally used for medical or filtration applications. Its functionality for an auto-regulative

subsurface irrigation application can be assumed due to its hydraulic properties. Field tests confirmed results of preliminary laboratory testing.

As with the traditional pitcher irrigation, the irrigation pipe is characterized by its ability of auto regulation of water flow, which arises from the close interaction between the plant, the dry soil and the pipe material. This feature makes the system very efficient, as water flows out of the irrigation pipe only when the soil is dry and the crop suffers water stress. If the soil humidity rises, the water flow will decrease or even stop automatically.

Experiments are actually conducted on Algerian test sites from ENSA and C.R.S.T.R.A. and on Kenyan test fields of the Egerton University to assess the auto-regulative system performance at three study sites (Algiers and Biskra in Algeria and Nakuru in Kenya). The irrigation system was installed at 30 cm depth below tomato plants grown in greenhouses. Each experimental trial was replicated and compared to a common drip irrigation system.

The following photos give an impression of the irrigation trial in a greenhouse at the experimental station El Outaya of the Research Center for Science and Technologies in Arid regions (C.R.S.T.R.A.) in Algeria.

Irrigation pipe

Installation of the irrigation pipe in a greenhouse trial

Installation depth 30 cm

Connection with the submain line (PE pipe ∅ 17 mm)

Planted crop: tomatoes

Dry soil surface

Water consumption and tomato production were calculated with respect to various parameters: climate, water quality and soil characteristics. In addition to high quality well water, saline and treated wastewaters were tested. Soils characteristics varied between clay, loamy-clay and sandy clay.

First results of the investigations confirm the assumption that water consumption with the auto-regulative system is lower than with drip irrigation (see figure 1, results of a greenhouse trial by the Algerian partner ENSA, the water consumption is for 156 tomato plants on a surface of 104 m²). In addition, the water use efficiency defined as units of produced fruit per amount of delivered water is higher with the auto-regulative system.

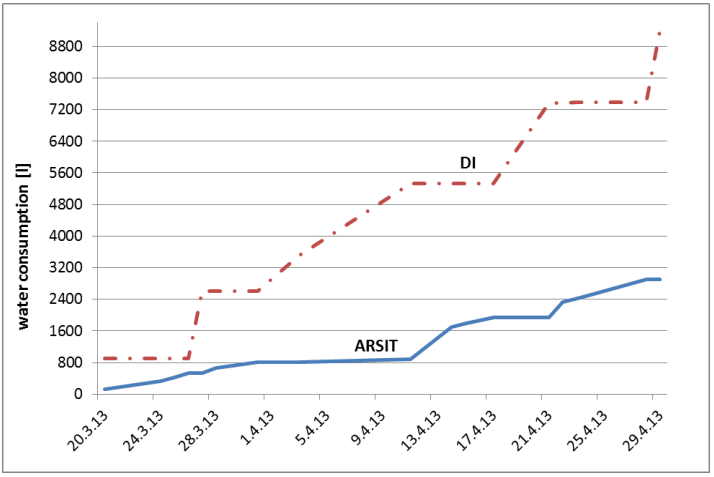

Figure 1: Cumulated water consumption, greenhouse trial of the project partner ENSA, ARSIT = auto regulative subsurface irrigation technology, DI = drip irrigation

The developed auto-regulative irrigation system does not require a monitoring, inhibits weeds because of the dry soil surface and allows the use of liquid fertilizer.

B. Investigations of the retention capacity of the polymer membrane against dissolved mineral salts and of salinization effects.

Soil degradation caused by salt is a problem common even to advanced localized irrigation methods, such as drip irrigation. Investigation of salt distribution around the sub-soil irrigation pipe is of major importance in the research project.

The irrigation method developed in this project is less affected by salinization, as evaporation has little influence on the water applied. See figure 2 where a buried membrane pipe is shown. The soil around the pipe is wet but the soil surface is dry. So the influence of evaporation on the subsurface system is negligible and no losses by evaporation can arise.

Figure 2: Dry soil surface over the irrigation pipe

Further detailed results will be published in future publications.

C. Analysis of the suitability for low quality irrigation water

In order to preserve natural water resources, the use of treated waste water or water with low quality is desirable. Regarding this aspect it was investigated if the polymer-membrane pipe wall of the irrigation pipe is capable to deal with low-quality water.

First trials with treated waste water were conducted at the campus of the Egerton University in Kenya in 2013. The results will be available soon.

A trial with harvested rain water has shown that the pipe was totally clogged by solid particles (especially silty soil fractions). The diameter of the tested membrane pipe is very small so it is easy to clog the pipe by bigger particles. For a good functioning system operation a pipe flushing modus must be consider.

D. Identify barriers for the implementation of the new irrigation technology.

This part of the program, which is focused on socio-economic aspects, has also the ambition to identify barriers to implementation of the new water-saving technology. It will propose recommendations to improve the dialogue between the different involved parties, and provide information to the involved stakeholders (farmers, water managers, agricultural advisors, etc.). These studies are mainly conducted by colleagues from CRSTRA (Algeria), results will be given in future publications.

4 Qualification measures

Project workshops and the supervision of Master thesis or doctoral thesis form part of the project. One workshop was conducted at the Algerian partner C.R.S.T.R.A. in Biskra, where the involved partners, local administrations and farmers participated. The main discussion points were the utilisation of the auto-regulative subsurface irrigation technique by the farmers and the functionality of the innovative system in comparison with common used irrigation systems.

With presentations and round tables an engaged communication was opened between the different participants.

The photos show experiences of the workshop in Biskra in 2013 at C.R.S.T.R.A.

Presentation

Round table

Another workshop will be in autumn of 2013 at the Institute of the Agricultural Engineering of the Kassel University in Germany will comprise topics of soil physics and numeric simulations of the water movement in irrigated soils, especially with the innovative subsurface irrigation system.

5 Conclusion

The paper presents a joint research project financed by the Federal Ministry for Education and Research on investigations and development of an auto-regulative subsurface irrigation technique with membrane materials, including qualification measures for the involved scientific staff. Irrigation trials in the partner countries in Africa tested the irrigation system and compared its efficiency and suitability with the common drip irrigation. First results were positive and proof the auto-regulative and water saving potential. The water consumption of the innovative technique was 70 % less (ENSA trial in Algeria) than the compared drip irrigation. The soil surface stayed totally dry so no losses by evaporation could occur. The trials in the partner countries are still running at the moment, further results will be given in future publications.

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Trough bench subirrigation system for tomato and other vegetables: the OFRALSER project

Manuela Capodilupo and Accursio Venezia

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Poster. The closed-loop system is among the most environmentally sustainable soilless culture innovations, minimizing water and fertilizer wastes. The nutrient solution is frequently readjusted to plant requirement and disinfected to reduce the risk of disease outbreaks. With trough bench and other subirrigation systems of recirculating nutrient solution, the substrate bottom is in contact with the solution and water and nutrients are carried upward through the root-zone by capillary flow, ending in the substrate top layer, so that ions exceeding plant absorption do not reflow in the recirculating solution, as in drip irrigation, while plant growth is not impaired by the high concentration of salts at the substrate surface. The advantages of the system can be summarized as: 1) stability of the nutrient solution; 2) uniformity of water and nutrient distribution; 3) low incidence of disease; 4) low compaction of the substrate 5) reduction of labour by better use of greenhouse surface and mechanization of many tasks. A decade of research on soilless cultivation of cherry tomato by trough bench irrigation system has been conducted at the Italian Agriculture Research Council - Vegetable Crops Research Centre (CRA-ORT), aimed at an alternative to drip irrigation, which is predominantly used in Italy for fast growing vegetable species. The main factors studied include: tomato cultivar and root stock, concentration of the nutrient solution, substrates, quality of irrigation water, irrigation frequency, watering duration, mulch, frequency of water reintegration. In an on-going project (High - Convenience Fruits And Vegetables: New Technologies For Quality And New Products, OFRALSER) the possibility of prolonging the tomato cycle to more than 30 trusses, of growing other vegetables and of reusing the substrate for further soilless cultivation of tomato or other vegetable species is investigated,

focusing on avoidance of possible autotoxic effects due to root residues and on non-pathogenic micro-organisms in recirculating solutions and substrates, for a possible role in the decomposition of root residues and against soil-borne pathogens.

Keywords: Hydroponics, Solanum lycopersicum, Soilless cultivation, Closed system, Subirrigation, Substrate.

The IRMA project: Efficient Irrigation Management Tools for Agricultural Cultivations and Urban Landscapes

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Poster. Greece and Italy use about about 70% and 40%, respectively, of the available water resources for irrigation purposes (FAO-AQUASTAT estimations). According to directive 2000/60/EC, action is needed to protect water in qualitative and quantitative terms. Optimization of irrigation management is a key-point for water saving. In fact, this approach has its advantage in the efficiency regarding outcome/cost relationship.

The general objective of IRMA project is to establish a network of knowledge and expertise which will lead to the development of practical irrigation management tools for demand driven capitalization of scientific knowledge and good practices. The partnership is composed by six Greece and Italian partners: Technological Educational Institution of Epirus (TEIEP/Research-Committee, Dept. Floriculture-Landscape Architecture) as lead partner, Decentralised Administration of Epirus–Western Macedonia (ROEDM), Development Enterprise of Achaia- Region of Western Greece (NEA), Region of Puglia (ROP), Istituto Nazionale di Economia Agraria / Bari Branch (INEA) and National Research Council - Institute of Sciences of Food Production (CNR-ISPA).

The project is a part of the European Territorial Cooperation Programme Greece-Italy 2007-2013, priority axis “Strengthening competitiveness and innovation”, specific objective “Strengthening interaction between research/innovation institutions, SMEs and public authorities”.

In the framework of IRMA project, in accordance with the main objectives to be achieved, the following activities will be carried out: a) development of networking -expertise transfer mechanisms; b) survey regarding the local irrigation practice (legislation, administration, delivery and distribution systems, applied techniques); c) development, applications and evaluations of tools to increase efficiency of agricultural and landscape irrigation (auditing procedures, web information system, creation of knowledge and practical guidance regarding irrigation scheduling, counselling for draught tolerant cultivations, sensors for irrigation management and alternative sources of water) and d) actions for public consciousness building and professional training-certification regarding strategies and methods for efficient irrigation management.

The project is expected to benefit productive agricultural SMEs, agricultural counselling SMEs and local communities by contributing in considerable water and energy savings from improved irrigation efficiency and development of strong cross-border links between agricultural stakeholders, public administration authorities and academic-research institutions in the field of irrigation management.

In the framework of the project 2 open international conferences under the theme: “Efficient Irrigation Management Tools for Agricultural Cultivations and Urban Landscapes” will be organized. One in Patras/Greece and one in Bari/Italy for which cooperation with relevant international organization is expected.

The project has a duration of two years from April 2013.

Evaluation of Subsurface Irrigation Practice in Sub-Sahara Africa

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Abstract. A joint research program coordinated by the Kassel University establishes links between projects dealing with subsurface irrigation (SI) methods in Ivory Coast, Algeria, Kenya, Turkey and Namibia. Within the framework each project will conduct an analysis of SI methods in field trials under local conditions in terms of water productivity, use of low quality water, salinity effects in the soil and socio economic aspects. One main objective of this project is to summarize the results from different SI projects into guidelines for stakeholders, farmers, water managers, water authorities and ministries.

Keywords: subsurface irrigation, water efficiency, porous pipe, pitcher irrigation, subsurface drip irrigation.

1 Why this project

The implementation of subsurface irrigation (SI) techniques aims on increasing water productivity – gaining more yields and value from water is an effective means of intensifying agricultural production and reducing environmental degradation. The reduction of water consumption for irrigation purposes leads to a significant improvement in the security of the inhabitants of agriculturally dominated regions with limited water resources, both in terms of water supply (primary effect) as well as the food supply (secondary effect).

2 Support program for the project

The project will be conducted in the frame of the European Research Area for Agricultural Research for Development program (ERA-ARD II) funded by the European Commission's Framework 7 Programme. ERA-ARD II will address these issues through improving coordination and collaboration between national research programmes. The ERA-ARD project is a partnership of 17 organisations involved in funding agricultural research for development in 15 European countries. In Germany the Ministry in charge is the Federal Agency Agriculture and Food (BLE) providing financial support for the presented project.

3 Project description

Africa currently lags behind all other regions in terms of farm productivity levels, with depressed crop and livestock yields. Its agricultural sector is confronted with numerous constraints, such as soil erosion and degradation, increasing salinity, excessive tapping of groundwater and persistent droughts (IFAD 2010[1]). A major part of these problems can be related to poor irrigation technology.

The commonly used, accepted and low cost irrigation technique is the traditional surface irrigation (flooding) which is water wasting and not environmentally friendly. A more efficient and environmental friendly technique is the subsurface irrigation (SI). The main advantages of this technique are the dry soil surface (evaporation is minimized), dry plant foliage (prevents plant diseases) and the effective use of water due to the direct application in the plants' root zone. These known system advantages make the SI techniques very favourable with respect to the expected impacts of climate change like water scarcity, rising temperature and thus higher evaporation rates.

The project coordinated by the Kassel University will establish links between projects dealing with SI methods in Ivory Coast, Algeria, Kenya and

1 IFAD – International Fund for Agricultural Development 2010: http://www.ruralpovertyportal.org/web/guest/country/approaches

Namibia. Within the framework each project will conduct an analysis of SI methods in field trials under local conditions in terms of water productivity, use of low quality water, salinity effects in the soil and socio economic aspects.

Nevertheless, as SI is a rather new approach, different approaches exist that are based on different technological concepts. These concepts are analysed and evaluated in several independent research activities, which will be bundled into the above mentioned research project:

- Subsurface drip irrigation (SDI) (buried dripper lines), as derived from conventional drip irrigation (currently investigated in the frame of the Association for the Development of Intensive Food Crops in Côte d'Ivoire (ADCVI) as well as in the Small scale Producers of vegetables in the Savanna region (= Petits Producteurs Maraîchers dans les régions des Savanes, PPMS) which is a development support program dealing with food crop chains in the savanna regions (northern part of Côte d'Ivoire)
- Porous hose made of used tires granular (investigated in the frame of an IWRM-project in Namibia and Côte d'Ivoire)
- ARSIT (Auto regulative Subsurface Irrigation technology, developed by the chairing institute for Agricultural Engineering in the frame project financed by the German Minstry of Education and Research (BMBF).

The project aims at aligning these projects and the involved capacity-building activities, in order to achieve results that will finally allow comparing and evaluating existing SI technologies in order to summarize the results into guidelines for stakeholders, small scale farmers, water managers, water authorities and ministries.

The main part of the necessary field trials, laboratory testing and socio-economic investigations will be performed in the frame of existing research projects.

The project is divided into 8 work packages (WP) with certain tasks:

WP1	Management and Coordination
WP2	Collection of local knowledge
WP3	Socio-economic assessment for the implementation of the SI techniques
WP4	Environmental impacts of the SI when using low quality or treated waste water
WP5	Installation technology
WP6	Summarize the achieved results in guidelines for an adoption by the small scale farmers
WP7	Numeric modelling of the water and solute transport in each subproject for evaluating water productivity and environmental risks
WP8	Capacity building

The project will induce important progress in comprehensive knowledge on SI-technology. It will allow maximizing the quality and skill diversity of the expertise base by strengthening research and training links between African institutions, between African institutions and northern partners, and between francophone and anglophone countries (north-south and south-south cooperation). The project results will allow an optimized choice and application of appropriate technology with respect to specific local conditions. It will thus contribute to an improvement of the environmental and economic situation of farmers in the affected countries and beyond.

4 Conclusion

The authors present a joint research project which aims at evaluating different subsurface irrigation techniques and increasing their implementation. The research project will establish links between existing projects which are dealing with SI methods. In each of these projects field trials with different subsurface irrigation will be conducted and evaluated with respect to different boundary conditions (climate, soil, water quality etc.). On the scientific level, the project will provide reliable data that will allow evaluating different SI-technologies. The results will finally allow

establishing guidelines for the use of subsurface irrigation as an efficient and environmental friendly irrigation technique. The guidelines will be provided to stakeholders, farmers, water managers, water authorities and ministries.

Competence Modelling for the Agricultural Sector: The AGRICOM Project

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Abstract. This article presents the AGRICOM Project. The main goal of the AGRICOM project is to establish the first Competence Model for the Agricultural Sector (ACM) in order to strengthen the transparency and comparability of VET opportunities at a European level. AGRICOM stands for Transfer of the Water Competences Model to AGRIcultural COMpetences and is supported and funded by the European Commission.

Keywords: AGRICOM, Competence Modelling, competence, agriculture

1 Introduction

Due to the shortage of the valuable resource water and the consequences of climate change, numerous European policies have been developed and adopted for the protection and sustainable utilisation of water also with impact on vocational education and training (VET). Economic factors like privatisation and increasing cost pressure in water management are increasing these VET needs and thus have led to an increased demand for modularised and tailor-made VET opportunities.

2 The AGRICOM Project

One project to address this demand and to make VET more responsive to labour market needs in the agricultural sector is the AGRICOM project.

AGRICOM aims to improve the identification and anticipation of skill and competence needs and their integration in VET provisions. In particular AGRICOM supports the implementation of the "New Skills for New Jobs" (http://www.na-bibb.de/index.php?id=1518) strategy by taking into account challenges, such as environmental and demographic changes, and related growing job needs in the agricultural sector. "An agenda for new skills and jobs" to modernise labour markets and empower people by developing their skills throughout the lifecycle is one of the seven flagship initiatives of the strategic framework for the European Digital Agenda (DAE) and the core focus of the long-term framework for European cooperation in education and training (ET 2020). The on-going development and management of knowledge, skills and competences at the individual and organisational level is therefore set as a clear priority and challenge for the EU and its Member States, for vocational education and training, for companies, employees, and learners.

To facilitate a better relationship between the professional and work life, skills, competence needs, and their implication in vocational education and training have to be identified and anticipated. Competence Modelling is becoming more and more crucial not only for business success but also for the European society and citizens. It will become an integrated part of both organizational and individual lifelong learning strategy. The current challenges are to address learning outcomes and competences and their modelling within the given frameworks of national and regional education systems and regulations.

Thanks to the Bologna Declaration (http://ec.europa.eu/education/policies/educ/bologna/bologna.pdf), learning outcomes and competences are already integrated in higher education, but are just now becoming important for VET. Therefore European projects in the VET field are most important for the promotion and sustainable establishment of Competence Modelling.

AGRICOM capitalises and transfers the results of prior European LdV-projects: on one hand, the Competence Model developed for water resources management in the WACOM Project (www.wacom-project.eu) as the core input, and on the other hand, the instruments for the integration of competences in the EU policies EQF and Europass developed in the

framework of the e-competences tools eCOTOOL project (www.ecompetence.eu).

The WACOM Competence Model transferred the European Qualification Framework (EQF) and the German Reference Model for the Competence Modelling PAS 1093 into the water sector and its Vocational Education and Training (VET) throughout all of Europe. The overall objective of eCOTOOL was to improve the development, exchange, and maintenance of VET certificates as well as their accessibility and transparency by harmonising Europass with other European instruments (such as EQF, ECVET) and e-competences to provide a harmonised and standardised structure for the definition and description of competences and skills.

The European AGRICOM project advances the development of competence modelling in Europe through its application to one of the most important European vocational areas – the agricultural sector, and in particular the fields related with the unitization of the water resources in irrigation, hydroponics and other agricultural fields.

The main product of AGRICOM is the AGRICOM Competence Model (ACM), which provides all elaborated competences for the agricultural sector, templates for competence descriptions, job profiles and competence profiles, and use examples of a single competences or job profiles and trainings opportunities.

During the first project year, the AGRICOM Consortium concentrated on needs analysis, covering national workshops, desk research, and an online survey, as well as the transfer and adaptation of the ACM, whereas in the second year the focus has been on the pilot testing and optimization of the ACM, as well as the dissemination and exploitation of all project results.

The intensive and comprehensive pilot-testing phase took place over six months in four countries and ensured a long period of evaluation, validation, and optimization of the ACM. This supported further outcomes as well as many implementations and applications throughout Europe.

3 Conclusion

The AGRICOM Project established the first Competence Model for the Agricultural Sector, in the form of the ACM, in order to strengthen the transparency and comparability of VET opportunities on the European level by transferring an existing Competence Model from the water sector to the agricultural sector.

The AGRICOM project has thus built a basis for harmonization on a European scale through the combination of leading European instruments and aforementioned frameworks. The ACM facilitates the continuous development and management of knowledge, skills, and competences at both individual and organizational levels. This is clearly set as a priority and task for the EU and its member states, as well as education and training providers, companies, workers, and learners.

Through AGRICOM, a competence and qualification model for the most important field of the agricultural sector has been established exemplarily for hydroponics and irrigation of crops that can be transferred easily into other fields in the agricultural sector (and also into other sectors). Modular VET opportunities and products in the field of hydroponics and irrigation of crops, as well as other agricultural fields, can be defined precisely corresponding to the addressed competences and qualifications, becoming transparent and easy to select as they accurately fit the needs of their users.

In conclusion, AGRICOM has provided an effective Competence Model through the consolidation and technical representation of competence definitions, thus enhancing the transparency and comparability of training opportunities and job profile descriptions at a European level.

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Methodology for Transfer of the Water Competence Model into the Agricultural and Horticultural Sector

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Abstract. This article describes a method to transfer the water competence model (WCM) into the agricultural and horticultural sector. Both models were developed in projects on lifelong learning to increase the transparency of educational programs and the mobilization between the European countries.

Italy, Germany, Greece, and the Netherlands participated to collect data in terms of competences, vocational and educational training, job profiles and competence modelling in the special field of irrigation and hydroponics. The described agricultural competence model (ACM) consists of four main components: (a) stakeholders, (b) competences, (c) template for job profiles, and (d) template for use case scenarios and learning outcomes. The templates are complemented by Entity-Relationship-Diagrams.

These templates can be used e.g. to create individual job profiles or to compare the educational levels and teaching content of training unit between countries.

Keywords: water competence model (WCM), agricultural competence model (ACM), hydroponics, irrigation, transfer, competence, job profile, training units, use case scenarios, and learning outcomes.

1 Introduction

The Water Competence Model (WCM) and the Agricultural Competence Model (ACM) were developed in the projects WACOM and AGRICOM, respectively. They support the overall goal of the European Union to increase the transparency of educational programs and the mobilization between the European countries.

In general, competence modelling is based on the development of a database relational model using templates for description of the data (Ghanei, 1999). These templates are complemented by diagrams to describe the relation of the different data (Entity-Relationship-Diagram). In case of two models describing vocational and educational training (VET), the educational quality standards of the EU are important. Therefore, the indication of the qualification levels within the WCM and the ACM are based on the COUNCIL DECISION of 16 July 1986 on the comparability of vocational training qualifications between the Member States of the European Community (85/368/EEC) and are in line with the RECOMMENDATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning and the German specification PAS 1093 on competence modeling.

For the methodological transfer of the WCM into the agricultural and horticultural sector, especially into the area of irrigation and hydroponics, the templates of the WCM were investigated, described and adjusted to the ACM. Results of collected data within the fields of agriculture and horticulture of the four European countries Italy, Germany, Greece and the Netherlands were analysed and integrated into the templates of the ACM model. Data were collected on a) competences, competence models and needs for a competence model in the different fields of agriculture and horticulture, b) stakeholders that might be interested in a competence model, c) information about quality standards and general knowledge on EQF in the partner countries, and d) different VET models already used in the partner countries.

In this text the WCM and its methodological transfer to the ACM are described in short.

2 Water Competence Model

Several steps have been taken to develop the WCM. First the water sector was analysed and a pool of competences collected. These competences were grouped and defined (competence = skills, knowledge, ability, qualification level). From this competence pool several templates were generated, including job profile descriptions, trainee profiles, training opportunities and certificate supplements. Core elements of the WCM instrument to create training curricula were the competence catalogue and the competence profiles (Fig. 1). A competence profile describes a pool of competences of a certain unit, e.g. all jobs performed on a certain farm. The competence model defined competences that each training unit contained.

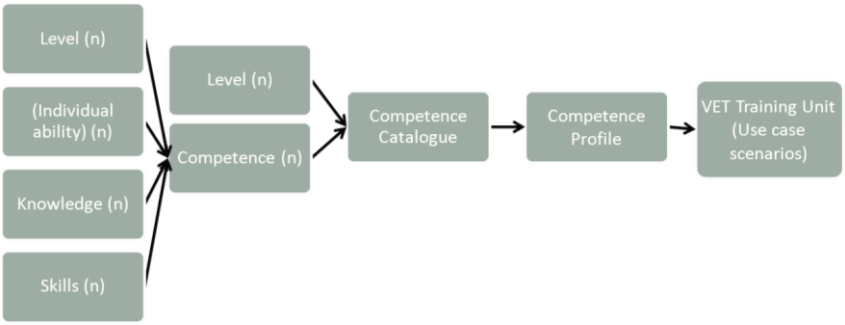

Figure 1: Example for a competence modeling pathway towards a VET training unit of the WACOM model. By clustering competences into units, individual training curricula and learning opportunities can be created. (n) Stands for numerous possibilities.

The two main components of the WCM were competences and qualification levels (WACOM, 2011). The competences were divided into *key competences, individual competences*, and *water-specific competences*. The *key competences* were based on the European Policy key competences of the European Commission. The *individual competences* and *water-specific competences* were generated from research done in the water sector. Additionally, five qualification levels described the standard for learning outcomes, following the recommendations of PAS 1093 and the European Qualification Framework (EQF). Four templates have been developed to describe different situations in the area of VET: WCM templates for

competence description, for job profiles, for competence profiles and for use case scenarios.

To transfer the WCM into the agricultural and horticultural sector it was necessary to investigate first the state of art in the agricultural sector. From the background of this analysis of the agricultural and horticultural sector the developed templates of the WCM were adapted to the needs of the ACM. Additionally, learning outcomes were described as a valuable basis for the development of the ACM.

3 Agricultural Competence Model

The first step taken was the identification of possible stakeholders that might use the ACM in future. They were chosen on the basis of data collected in workshops, personal and online surveys, interviews, and personal experience of the project partners. The following groups were identified: agronomists related to hydroponics or irrigation in the private and public sector, individual and associated growers, private and public authorities related to VET, learners, government, local and regional authorithies, VET trainer, hydroponical start-ups and investors, technology/service provider and supplier, and environmental bodies.

Competence

A competence was defined as a combination of skills, knowledge and the individual attitude and ability to perform a job. In personal interviews and during national consultation meetings competences for professionals in irrigation and hydroponics have been gathered. Three different categories of competences have been described: *key competences, managerial or individual competences* and *professional or agricultural/horticultural competences.* The professional competences have been divided into two groups, plant and water (Table 1).

A. Key competences	
Social competence	
Communication	
Professional practitioner	
IT-Competence and building of networks and online communities	
B. Managerial or individual competences	
Management, e.g.: business administrative, human resource and resource management, maintain profitability, production plan, quality management	
Safety at work	
Self development	
Product safety	
Legal basic knowledge	
C. Professional or agricultural/horticultural competences	
Plant nutrition	
Plant production	PLANT
Plant hygiene and protection also in water management	
Soil and substrate science	
Water resources, qualiy and storage	
Sustainable water management	WATER
Process control	
Selection of the appropriate system and the supporting technical equipment	
Steering of hydroponic and irrigation technique (climate control or meteorology)	
Consideration of nutrient evaluation for optimisation of irrigation	

Table 1: Selection of competences for the agricultural and horticultural sector that are useful for the maintenance of irrigation and hydroponic systems.

Job profile

The template for job profiles (Table 2) used for the ACM includes definition of the job profile, target group, the context in which this job is performed and level. On the basis of the analysis of the agricultural and horticultural sector the context and the general qualification level were added to the WCM template of the job profile.

ACM Job profile	**"Title"**	
Definition of job profile		
Target group of job profile		
Context in which job is performed		
Level		
Competences contained in and required for job profile (comp. catalogue)		
Name of competence	**Definition**	**Required level**

Table 2: ACM Template for a job profile

The templates for competence profiles, use case scenarios and the use case diagram were transfered from WCM with minor changes.

Use case scenarios, diagrams, and learning outcomes

In competence modelling the search path towards an individual training unit/module must be described in a process oriented way (Ghanei, 1999). In order to consider all stakeholder perspectives, use case scenarios were developed. The perspective was not only important, but also the communication pathway to describe the relation of the different stakeholders within one use case scenario (Ghanei, 1999). This was done by adding use case diagrams. Depending on which stakeholder wanted to make use of a training unit, different use case scenarios were developed. One use case scenario with a matching diagram was a system to determine the needs of one particular stakeholder for specific competences from one particular

perspective (Jacobsen, 2011). The sum of use cases made clear what a system was going to do and what it was not going to do.

Use cases have been utilized to develop software systems since their initial introduction at “Conference on Object-Oriented Programming Systems, Languages, and Applications in 1987” (Meyrowitz, 1987). Over the years they have become the foundation for many different methods and an integral part of the Unified Modeling Language (Jacobsen, 2011). They are used in many different contexts and environments, and by many different types of teams. For example use cases can be beneficial for both small agile development teams producing user-intensive applications and large projects producing complex systems of interconnected systems, such as enterprise systems, product lines, and systems in the cloud.

The ACM use case template includes a title, summary, stakeholder, stakeholders’ goal, and need for individual learning pathways, competence profiles, job profiles, a competence catalogue, use case procedure, and unit. It describes the path to achieve a certain goal from different stakeholder perspective. If he or she is an employee who wants to achieve certain competences, it describes the way from his or her employer to the VET provider. On the other hand it could also show how a VET provider offers particular competences to an employee out of his or her pool of training units and competences.

The diagram below shows the relationship between the different stakeholders (Figure 2). It clarifies the correspondence paths between the different stakeholders. This facilitates the creation of a database which can be saved and processed in a computer-based system.

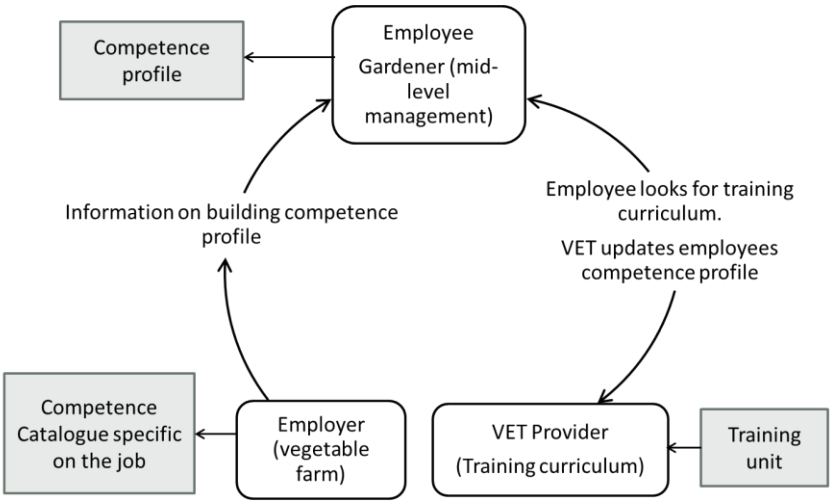

Figure 2: Use case diagram, showing the interactions paths between the different stakeholders.

Using the competences for the description of job profiles and use case scenarios revealed that the same competences were used for different levels of education. It was assumed that the same terminology could be utilized with increasing qualification levels, but at the same time a broader knowledge was hiding behind the competences. To describe these differences, competences also have been described in terms of general learning outcomes. A template has been developed additional to the templates used in the WCM to describe learning outcomes.

The implementation of learning outcomes for the description of competences is one goal of the European Union. They hope to increase permeability and improve the dialogue between the different education institutions by implementing national qualifications frameworks (NQF) (PLA, 2009). Mapping qualifications against the same set of descriptors makes it apparent where two (or more) qualifications lead to comparable learning outcomes and what the learners additionally need to achieve. A guideline for the formulation of learning outcomes (BMBF, 2012) describes learning outcomes as statements of what a learner knows, understands and is able to do on completion of a learning process. Learning outcomes are defined in terms of knowledge, skills and competence.

The ACM template for describing learning outcomes for different use case scenarios includes title, competence catalogue and learning outcomes (Table 3).

Titel (One-sentence title of the Use Case)	
Competence Catalogue	**Learning outcomes:** He/she is able to…
Competence (n)	Knowledge: …. Skills: … Competences: …

Table 3: General template for learning outcomes for a use case scenario. (n) Stands for numerous possibilities.

One of the main parts of the ACM was the interaction of different competences forming a certain training unit/module. A competence, including skills, knowledge, and the individual attitude and ability to perform a job, were combined into an activity area (Figure 3). The competence catalogue, in combination with the quality level and the context in which a certain job is performed, can be used to describe specific job profiles, competence profiles, use case scenarios, and VET training units/modules. Additionally, learning outcomes have been included in the ACM to improve the comparability of competences on different qualification levels.

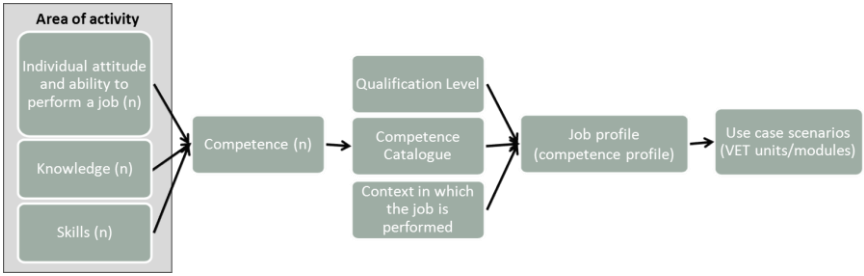

Figure 2: Example for a competence modelling pathway towards a VET training unit of the AGRICOM model. A detailed description of the competencies forms the competence catalogue. Out of this competence catalogue, job profiles, including competence profiles, can be created. Using the competence profiles a use case scenario with specific training unit can be generated. (n) Stands for numerous possibilities.

The usage of the ACM can have various forms. One possibility would be to describe all job profiles in a specific company to support the search for adequate human resources. Another possible application of the ACM would be its integration into an online tool. For example, on a web portal an employer, searching for new staff, can choose the adequate competences out of a list of competences to write a plain job application. On the other hand, an employee who wants to improve his professional skills might use this tool to reveal missing competences in his job profile, a so called gap analysis. This gap analysis of course can just as well be used by an employer.

4 Conclusion

In conclusion it can be said that the transfer and adaptation of the WCM into the agricultural and horticultural sector in form of the ACM should be possible with the described metholodology. Further work will be needed to standardise competence definitions, clearly describe working places, job profiles, and training solutions.

In the end, the user might use the ACM and its tools in several contexts, e.g. for the development of job advertisements, description of job profiles, or for writing curricula. In this way, the competence model would support the need in agriculture and horticulture for a better match between the labour market and VET.

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A Quality Management System for Hosting AGRICOM Representations

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Abstract. The AGRICOM project establishes the first competence model for the agricultural sector in order to strengthen the transparency and comparability of training opportunities at European level. One of the main outputs of the AGRICOM initiative is the creation of a web portal and of a repository for storing and hosting Vocational Education and Training (VET) elements based on the AGRICOM Competence Model (ACM). To ensure the quality of the elements hosted in the AGRICOM portal, a specific quality management system has been implemented. The system forces uploaded content through a specific workflow that requires user interaction and validation before publishing; hence by involving users it certifies that specific quality criteria are met.

Keywords: Agriculture, AGRICOM, Quality Management System, Competence Model, VET

1 Introduction

AGRICOM project (http://www.agricultural-competences.eu), Transfer of Water Competence Model to AGRIcultural COMpetences, is a European Project in the context of Lifelong Learning Program, which intends to support the professionals and learners in the agricultural sector with the identification of required competences for the successful work performance in specific agricultural fields. The identification of agricultural competences can serve two different aspects. On one hand competences are defined in a way to describe the learning outcomes of learning courses [0], [0] and on

the other hand a list of essential and desired competences sets the outline of the job profile of the employees in specific working framework [0], [0], as farmers or workers with specific duties in the production chain of a farm (e.g. harvesting techniques, taking care a vegetables garden or experienced agronomists in handling pests and diseases management in terms of prevention and control them).

The AGRICOM Competence Model (ACM), the main outcome of AGRICOM, provides a standardised and harmonised competence model for the agricultural sector [0]. Apart from the ACM model, the AGRICOM project also aims in creating an online tool – a web portal – for the representation of the ACM. The AGRCIOM web portal provides a user-friendly tool with a quality control system for the enhancement of the ACM dissemination in a greater amount of experts and interested users from the whole Europe. This will support the further evaluation of the ACM by experts from several fields of the agricultural sector and it will give the opportunity to professionals, employees and employers to test the structured Competence Model in real cases of the job professions and training opportunities in the agricultural sector.

In this paper we present the AGRICOM Web Portal as the mean to host and represent ACM elements and the quality control system that is implemented to validate the numerous uploaded elements. The rest of the paper is divided as follows: in the next chapter we present the different categories of elements that can be stored and hosted in the AGRICOM Web Portal, the following chapter presents the general architecture of the portal and the different user roles that are present all of which are necessary to explain in the next chapter the quality control system used in AGRICOM and the final chapter that concludes this paper.

2 Online Representation of the ACM

The main goal of the AGRICOM Web Portal [2] is to support the development of the establishment of the first Competence Model for the Agricultural Sector (ACM) in order to strengthen the transparency and comparability of VET opportunities at European level. The portal lists, collects, describes and categorizes vocational training content based on the competence building block and represents it in a user-friendly environment.

The portal is the online tool that implements the AGRICOM Competence Model and allows the creation and population of competence profiles for different cases in the agricultural sector. It is used to describe a number of learning elements, the description of training opportunities and the related certificates and tasks and responsibilities for defined working places. These elements have been further categorised, depending on their purpose as follows:

- Competence Elements (CEs), descriptions of competences in the agricultural sector, including skills and knowledge. Competences are a building and supporting block for all other Elements.
- Job Profile Elements (JPEs), represent professions in the agricultural sector, including workplaces descriptions and are registered according to the category - classification to which they belong e.g. Educational support activities.
- Training Opportunity Elements (TOEs), descriptions of training opportunities related to the agricultural sector, registered based on their classification and includes both required and targeted CEs while they can be connected to specific JPEs and targeted Certificates.
- Certificate Description Elements (CDEs), represent certificates that can be attained through specific TOEs to certify that a person has specific CEs

The intention of the categorization is from one point of view to help Content Providers upload and annotate their material, while at the same

[2] http://portal.agriculture-competence.eu/

time help all users (e.g. professionals, training providers) in their search for particular material. All elements that are described in the portal follow the AGRICOM Competence Model (ACM).

3 General Architecture of the Portal

Figure 1 illustrates the main architecture of the AGRICOM Web Portal. As it can be seen in the figure, in the portal different kind of users have been defined based on the services provided to each type. Each type can access different functionalities of the site and can interact with the different available databases. The different types of users and the services that are provided to them are the following:

- **Visitor**, can use the Public Services of the Web Portal such as browsing or searching for CEs, JPEs, TOEs and CDEs.
- **Content Provider,** can upload CEs, JPEs, TOEs and CDEs and their corresponding Metadata.
- **Content Annotator,** can further annotate uploaded CEs, JPEs, TOEs and CDEs.
- **Content Translator,** responsible for translating the uploaded elements in other languages.
- **Content Validator,** responsible for validating a CE, JPE, TOE and CDE, before the element is made available to the public.
- **Administrator,** perform all the administrative functions related to Users, These include Viewing / Deleting / Deactivating / Validating CEs, JPEs, TOEs and CDEs, Accepting or Declining Requests for Registration from Users, Viewing / Activating / Deactivating Users etc.
- **External Tools** (e.g. Harvesters) interfacing with the Repository and consuming content.

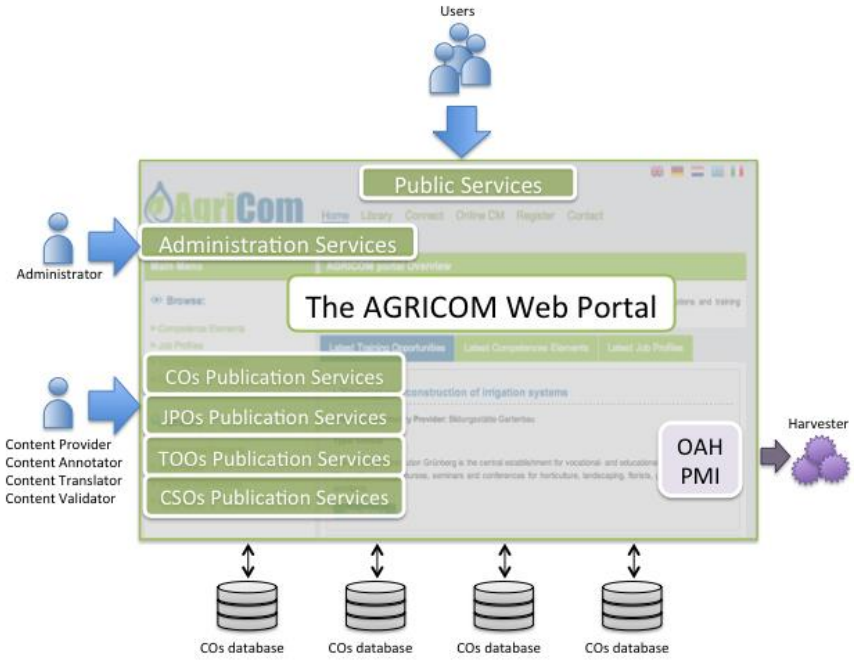

Figure 1: Overall Architecture of the AGRICOM Web Portal

Another main characteristic of the AGRICOM Web Portal is multilinguality. Providing a service in different languages is a very important factor to facilitate users in searching and browsing content throughout the portal. In the AGRICOM portal all pages are available in the following five languages: Dutch, English, German, Greek and Italian.

4 Quality Management System

In order to ensure the validity and the quality of information uploaded to the AGRICOM Web Portal a specific process regarding the information flow is implemented. Releasing everything to the public as soon as it is uploaded would diminish the quality of information provided by the web portal. Thus, although the process requires the actors to engage higher effort, it ensures as much as possible, the quality of the information.

AGRICOM uses a specific Quality Management System in order for the uploaded content to be validated before being published. The validation of the content refers to the following two criteria: the content must have full metadata descriptions and be translated in the different languages that are supported by the portal. The generic version of quality management system is consisted of the following:

- Only registered providers can upload content
- Annotators are available to inspect and annotate content when needed
- All content must be translated in all the available languages
- Before publication, the content must be validated

The above process ensures the quality of the content that is being published in the AGRICOM web portal.

The implementation of the quality management system in the AGRICOM portal leads to the following workflow for uploading new content:

- Step 1: a Content Provider uploads an Element (competence, job profile, training opportunity or certificate) to the AGRICOM Web Portal in his own language and in the English language.
- Step 2: the administrator assigns to a specific Annotator the Element for annotation in the language of the Element.
- Step 3: the Annotator annotates the Element in his own language and in the English language.
- Step 4: the administrator assigns the Element to one Translator for each language in order to provide information in all languages of the Web Portal.
- Step 5: each Translator submits the translated version of the Element.
- Step 6: the Administrator assigns the Element for validation to a Validator.
- Step 7: as soon as the Validator reviews all the information the Element, it is published and is now available for the portal visitors and for harvesting processes.

A schematic version of the steps described above is shown in the figure bellow.

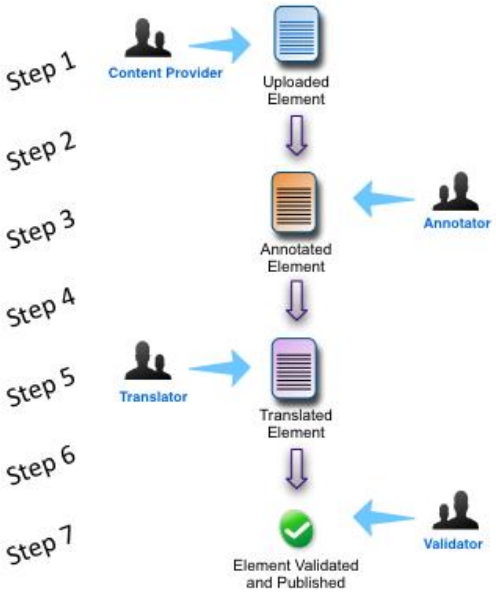

Figure 2: AGRICOM Workflow, implementing the quality management system

The AGRICOM Workflow for quality management can also be explained through the following example. John is a Human Resources (HR) manager working in a Greek company related to the agricultural sector. John has learned about the AGRICOM web portal and believes that the portal is a nice way to describe job profiles related to his company and connect them with required competences. John, following the information available at the portal, contacts the AGRICOM administrator to register as a content provider user. When his account is enabled he uses the portal to upload his first job profile with the description of “Cultivation Specialist“.

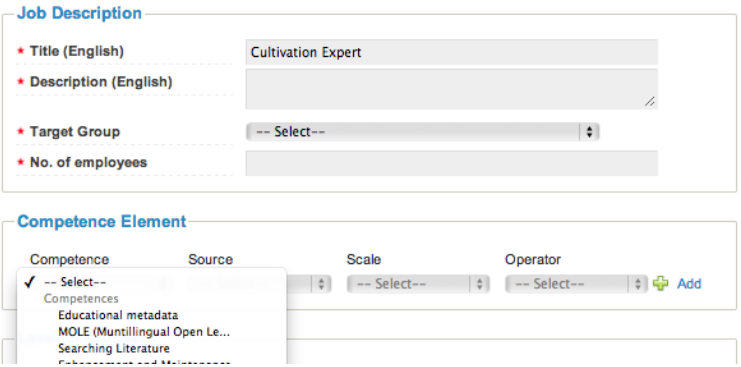

Figure 3: Part of the form to upload a job profile

To do so, John is redirected to a specific page where a form is available to describe the job profile and connect it with a number of different competences as shown in Figure 3. John needs to fill the form with all the necessary information regarding this specific Job, to add the title and the description and finally from a drop down menu he can access the AGRICOM list of competences to select and relate with this specific job.

As soon as John uploads the job profile, it enters the AGRICOM workflow. The administrator first assigns to a user from the pool of Annotators in Greece, for this job profile to be annotated, i.e. check if all the fields are correctly filled and make any corrections necessary. When the job profile is successfully annotated, the administrator is responsible to assign translators so it is translated to all the supported languages. After the translation, as a final step, the administrator assigns this job profile to a validator who will check if all the process is successfully finished and will finally publish the job profile.

5 Conclusion

The main idea of the design and development of an online representation of the ACM is to provide a user-friendly environment where the description of job profiles, training opportunities and certificates is mapped with the needed and required competences and skills. The AGRICOM web portal is open to users across the world and in order to ensure the quality of the

uploaded content it implements a specific quality control system. This system is incubated in the upload process of the AGRICOM web portal, the AGRICOM workflow, and requires user interaction in order to annotate, translate and validate each element that is being uploaded. Through this process all the uploaded content is validated and a specific quality can always be met.

6 Acknowledgements

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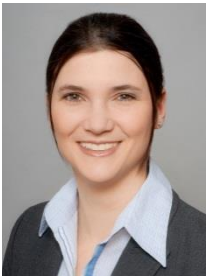

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About the European project AGRICOM:

Main goal of the project AGRICOM is the transfer and population of the WACOM Water Competence Model (WCM) from the Water Sector to the Agricultural Sector.

Main objectives of AGRICOM are:

1. Identifying and analysing targeted needs and competences that are required by the labour market for specific use cases and jobs from several fields of the agricultural sector,
2. Transferring and adapting the generic WACOM competence model towards the AGRICOM competence model (ACM) allowing more agricultural use cases,
3. Pilot testing the ACM to the jobs specialisations related to agricultural uses of water resources (irrigation, hydroponics, etc.),
4. Establishing the AGRICOM online community for communication, moderated discussions and exchange of project results, experiences and expertise on competence modelling for vocational education and training in the agricultural sector,
5. Establishing the AGRICOM web portal and populating it with more agricultural use cases,
6. Enhancing the transparency of the job profiles in the agricultural sector,
7. Supporting the conjunction of vocational education and training with the labour market and jobs specialisations.

Main long-term objective and addressed impact is the introduction of competence modelling to the agricultural sector to develop a first Agriculture Competence Model and to strengthen the transparency and comparability of VET opportunities through the transfer of WCM and the adaptation of ECVET and EQF.

More information about AGRICOM online:
http://www.agriculture-competences.eu

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