PROJECT FINAL REPORT

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Content

1.1. Final publishable summary report

1.1.1. Executive summary

The project BIODESERT is designed to strengthen the research potential of a research team at the University of Tunis, by improving an already existing molecular microbial ecology research platform that has unique features in Tunisia. Such a platform is dedicated to study the microbial ecology of different agriculture ecosystems in the arid environments of the country. The research team leading this platform actively performs collaborative research with national and European laboratories for the development of straightforward strategies of Microbial Resource Management (MRM) in agriculture. The final objective of BIODESERT is to expand the existing platform and improve the related technical and research knowledge, to exploit microbial biotechnology and addressing agricultural problems. Such an objective is in the frame of supporting the growth and development of a bio-economy in Tunisia and North Africa. The advancement of the research platform is specifically designed for discovering novel microorganisms and developing new processes that could improve soil water retention, fertility, plant protection from pathogens and parasites, stimulate the health of pollinators and in general improve conditions for agriculture in arid ecosystems.
The activities of BIODESERT for achieving the above mentioned objectives were multiple including: i) The recruitment of experienced researchers for a total of 108 person/months to set up the novel equipments for improving the analytical potential and contributing to the improvement of the laboratory know-how in the fields of the project; ii) The acquisition, installation and operation, in the laboratory of the Tunisian partner, of a series of advanced analytical equipments including among others, a DNA Microarray system, a Real Time-thermo cycler and a Phenotypic Array System; iii) The training of the recruited experienced researchers and of the permanent research staff on modern techniques and investigation strategies with the support of the two European laboratories (Italy and Greece); iv) The dissemination of the knowledge in the scientific environment and the society in Tunisia and other North African countries, promoting MRM for improving agriculture sustainability in arid ecosystems.
All the project objectives have been fully achieved. Five experienced researchers have been recruited for a total of 108 person/months. Four of these researchers spent periods in the two partnering EU laboratories. Four of the Tunisian laboratory permanent staff spent one-week secondment periods in the two partnering EU laboratories. Nine new equipments have been purchased, installed and are currently used by the Tunisian laboratory: 1) Real Time thermo cycler, 2) Phenotypic Array system, 3) DNA microarray platform, 4) Plant Growth Chamber, 5) Gel Documentation system, 6) Automated Electrophoresis System, 7) High Performance Liquid Chromatography platform, 8) Automated Liquid Handling Station

and 9) Tangential Flow Filtration system. All dissemination activities have been completed including the preparation of a website, podcasts, website newsletters, scientific publications in peer-reviewed journals, seminars and open days in the Tunisian laboratory and three scientific workshops and a final international scientific conference. All these initiatives were very successful with a great participation form seven countries from North Africa, nine countries form the EU and from USA. This allowed to widely spreading the information about the scientific activities performed in the Tunisian laboratory and start novel collaboration to better position the Tunisian laboratory in the wide scientific community and in the European Research Area.

1.1.2. Summary description of project context and objectives

One of the most important economic sectors in North Africa is agriculture. However most of the surface area of North African countries is considered as dry lands from semi-arid to hyperarid conditions [for more detailed information please read Pointing and Belnap 2012, Nature Reviews Microbiology 10:551-562 and references therein] and includes large portions of the biggest desert on Earth, the Sahara. According to the increasing problem of the global warming and the following effects on the arable lands, desertification is a potential threat for agriculture in the region.
In the light of developing sustainable measure for improving quantitatively and qualitatively agriculture production by saving resources, the use of microbially-driven biotechnological approaches are emerging as an interesting trend for those regions that faces limited water resource. In Tunisia, a country that has a long economical cooperation with the European Union (EU), there have been investments for promoting research in the development of sustainable techniques for agriculture in arid ecosystems.
The BIODESERT project has been designed to promote such a trend and contributing to support a research platform in Tunisia on the biotechnological exploitation of microbial extremophiles from arid ecosystems for improving agriculture in arid conditions and saving waters. BIODESERT aims to support a research laboratory at the University of Tunis, the LMBA, Laboratory of Microorganisms and Active Biomolecules (identified in BIODESERT and hereafter as Beneficiary N. 2 UTUN) that is already operating along three main research axes that have been adopted as the research frames of BIODESERT: i) the plant-microbe interactions in arid ecosystems for improving the knowledge and exploiting novel microbes and microbial processes to promote plant growth under water stress of typical Tunisian crops like the olive tree; ii) the insect-microbe interactions in arid ecosystems focusing on honeybee symbionts and their exploitation to support honeybee health under hot climates; iii) discovering the extremophiles living in associations with sands, rocks and saline systems of the desert for the potential exploitation of novel biotechnological approaches.
Before the actions performed under BIODESERT, UTUN was already managing an existing molecular microbial ecology research platform, funded by local research agencies and it was active in the study of the microbial ecology of different agriculture ecosystems in the arid environments of Tunisia. In this ambit UTUN was already performing collaborative research with national and European laboratories for the development of straightforward strategies of Microbial Resource Management (MRM) in agriculture. The activity was documented by a continuous scientific production with publications in peer-reviewed journals. However the potential of the platform existing before the implementation of

BIODESERT was hampered by a series of problems like, for instance, the obsolescence or the lack of up-to-date equipments and the related know-how, preventing a full and effective interaction of UTUN with the European Research Area (ERA). One of the pillars of the EU policy is an effective interaction/collaboration with the different regions in the world and especially with the neighbouring regions like the southern side of the Mediterranean Sea.
In the light of these considerations BIODESERT has been proposed to improve the potential of the research platform of UTUN identified as an important research entity in the region, by taking advantage from the collaboration of two EU leading laboratories in the field of microbial biotechnology in agriculture.
The final objective of BIODESERT was to expand the existing platform at UTUN and improving the related technical and research knowledge, for exploiting microbial biotechnology and addressing agricultural problems. Such an objective is in the frame of supporting the growth and development of a bio-economy in Tunisia and North Africa. BIODESERT was aimed to prepare the conditions, in term of advanced research equipments and up-to-date know how, for developing research in the field of microbial applied biotechnology from the microbial extremophiles living in the arid and desert lands of Tunisia. The advancement of the research platform was specifically designed for discovering novel microorganisms and developing new processes that could improve soil water retention, fertility and plant protection in arid ecosystems, stimulate the health of pollinators and in general improve conditions for agriculture. The microbial resource management in arid environments represents an important novel approach for the development of safe and sustainable agriculture, and the improvement of the socio-economic needs addressing the strategies for the establishment of a bio-economy. High quality research potential facilitates UTUN activity and its technical and scientific competence and expertise have been greatly improved by the implementation of the specific objectives of BIODESERT:

i) Acquire new advanced research equipment to position UTUN in the front line of technology: With the implementation of the proposal BIODESERT aimed to acquire an updated instrumental platform composed at least by: (a) a DNA microarray platform, (b) a Real Time thermo cycler, (c) a Phenotypic Array, (d) a plant growth chamber and (e) a Gel documentation system. The DNA microarray platform, accompanied with a Gel Documentation system is aimed to enable UTUN to use DNA chips for the detection and identification of microorganisms in complex arid and extreme environments independently from cultivation. Real Time thermo cycler and a plant growth chamber are aimed to enable UTUN studying the localization of microorganisms and their colonization capacity of plant and insect tissues, while the phenotypic array is aimed permitting Beneficiary n. 2 to characterize phenotypically new microorganisms from the arid ecosystems. These basic objectives can be enlarged weather the contractual capacity of the BIODESERT team could get decreased price offers that would allow to enlarge the planned equipment platform.

(ii) Transfer knowledge through the recruitment by UTUN of experienced researchers in the area of molecular biology and molecular microbial ecology: This is also a central aim of the project and with its implementation the team could enable UTUN to recruit experienced researchers that would be the key persons in developing and exploiting the novel technological equipment platform. The experienced researchers to be recruited are intended for the development and support of all the scientific actions of BIODESERT, i.e. in all the three research axes of the project. The experienced researchers recruited with

BIODESERT are an essential step to improve the research capacities and potential of UTUN. The aim of BIODESERT is to recruit at least three experienced (post-doctoral) researchers for a total of 108 persons/months.

(iii) Networking with experienced research teams for enhancing UTUN know-how and experience through training of experienced researchers and permanent UTUN staff. UTUN is collaborating for several years with Beneficiary 1 (UMIL) and 3 (UOIRC) and such collaborations is planned to be developed to permit training over a one-year period of at least three experienced researchers specifically recruited with the project, on the specific analytical platforms acquired with the project. In particular two of the recruited experienced researchers are aimed to spend visits in Italy in the laboratory of UMIL to learn the use of a series of molecular and phenotype characterization methods including, among others, PCR-DGGE analysis and quantitative real time-PCR. The third experienced researcher is aimed to spend visits in Greece in the laboratory of UOIRC to learn the use of the DNA microarray platform. Besides this training activity, experienced permanent scientists of UTUN are aimed to make short visits to UMIL and UOIRC laboratories to update on the advancements available in the two EU laboratories in the respective research fields related to the BIODESERT scientific axes. The foreseen objectives is to consolidate the knowledge of advanced methodologies and approaches like those used in the laboratories of UMIL and UOIRC to be efficiently implemented in the UTUN laboratory for the different research axes on microbial resource management in arid ecosystems. This includes experience for the optimal exploitation of the novel equipment platform available at UTUN under BIODESERT.

(iv) Transferring knowledge at regional, national and international level. The fourth main aim of BIODESERT is activating UTUN in transferring knowledge both at a scientific and popular level by a series of initiatives including: (i) open days organized by the laboratory; (ii) scientific seminars; (iii) the organization of three workshops targeting scientists of Tunisia and North Africa; (iv) the organization of an international scientific conference; (v) the preparation of leaflets with explanation of the project objectives and tasks. All these activities aim at making the local, North African and international communities, as well as the Tunisian local administrations more aware of the biotechnology potential of microorganisms from arid lands.

It is expected that the correct implementation of these activities would generate a series of positive effects at different levels, including the research potential of Beneficiary n. 2 but also in general on the academic environment at the University of Tunis and in general in Tunisia and on the overall understanding that the use of the microbial resource may have a major beneficial effect on the agriculture of Tunisia and the region and in general in arid ecosystems. As specific outputs, it is expected that 1) UTUN improves the number and quality of its scientific research publications by exploiting the resources made available by BIODESERT and the interaction with the two partner European laboratories. 2) UTUN enlarges the networking with European and international laboratories finalizing other collaborative research activities with new international laboratories. 3) UTUN increases its research potential in actively participating to the European Research Area (ERA) by increasing the possibilities to participate to consortia for application on EU scientific calls. 4) UTUN becomes a reference laboratory in Tunisia and North Africa for research and development on microbial resource management for arid agriculture. 5) UTUN improves its visibility with respect to the local research authorities, by establishing a positive dialogue

with the Tunisian research agencies that should have as a consequence a higher local funds rising for research. 6) UTUN improves the perspective in the field of research on microbial resource management for agriculture in arid lands for young scientists fulfilling their study career at the University of Tunis. 7) UTUN establishes a new vision on the exploitation of the results for the development of novel products and services and prepares the initiation of a technology transfer pipeline.

1.1.3. Description of the main S&T results/foregrounds

To achieve the above mentioned objectives (paragraph 1.1.2.), BIODESERT completed multiple activities: i) The recruitment of experienced researchers for a total of 108 person/months that set up novel equipments for the improved analytical potential of UTUN; ii) The installation and running in the laboratory of UTUN of a series of advanced novel analytical equipments that are: 1) Real Time thermo cycler, 2) Phenotypic Array system, 3) DNA microarray platform, 4) Plant Growth Chamber, 5) Gel Documentation system, 6) Automated Electrophoresis System, 7) High Performance Liquid Chromatography platform, 8) Automated Liquid Handling Station and 9) Tangential Flow Filtration system; iii) The training in the laboratories of the two European partners UMIL and UOIRC of the recruited experienced researchers on modern microbial ecology and biotechnology research techniques and of the permanent staff of UTUN on modern frontiers in environmental microbial biotechnology; iv) The dissemination of the new knowledge and research approaches in the scientific environment and the society in Tunisia with the participation of scientists from Europe and other North African countries, promoting the application of Microbial Resource Management for improving agriculture sustainability in arid ecosystems.
The work done in the project regarded all the four objectives mentioned above. Despite some challenging situations, like unpredictable administrative constrains, that were all overcome causing only some delays in few deliverables, and the Tunisian revolution that contributed to the mentioned delays, the project has succeeded in realizing all the objectives and producing all the deliverables. Here the activities conducted are listed and briefly resumed giving reference to the deliverables deposited in the Participant Portal. References to the Annexes to the present Project Final Report, providing supporting documentation, are also indicated. More details and explanations of those steps that caused the above mentioned delays and the activation of alternative strategies to overcome the problems are then explained in details in the activity breakdown per each Work Package. All the mentioned documents, including reports, publications, dissemination documents, etc. have been loaded on the BIODESERT website and on the participant portal of the EU website.

i) Kick off meeting: The meeting was held on month 2 (February 2010) in Douz, southern Tunisia. The meeting was successful in addressing the procedures to achieve the foreseen deliverables and realizing the project objectives. The report on the meeting was prepared and loaded in the EU website portal. (Related completed Deliverables: D1.1. Annex 1)
ii) Recruitment of experienced researchers for a total of 108 person/months: Three experienced scientists with a PhD degree, Dr. Hanene Cherif, Dr. Mohamed Neifar and Dr. Afef Najjari, were recruited and started to work at month 10. For completing the coverage of the 108 person/months planned in the DoW two further experienced

scientists with a PhD degree were selected and recruited. Dr. Ahlem Jouini was contracted for 20.5 months, while Dr. Besma Ettoumi for 6.5 months. (Related completed Deliverables: D2.1 and D2.4. Annex 2)

iii) Website: The project website was completed and published on month 6. On month 15 a complete revision and restructuring was done with the inclusion of an area/section restricted to the partners and accessible only by the use of an ID/password. The address of the project public website is www.biodesert.unimi.it. (Related completed Deliverables: D1.2 and D4.5. Annex 3)

iv) Recruitment of the project secretary: The recruitment of the project secretary to be employed in the team of Partner 1 UMIL was completed at month 7. The selected project secretary was Dr. Bessem Chouaia who speaks besides English, French and Arabic. He worked for BIODESERT for a total of 18 months. (No specific formal deliverables foreseen in the DoW for this activity. Annex 4)

v) Acquisition of novel equipments: Despite several unpredictable administrative problems the acquisition, installation and use of the novel equipments have been completed and now the new instruments are fully operative in a dedicated laboratory at UTUN. The delay in the equipment acquisition (see below the WP2 description for details), was accompanied by a decrease of the offered prices. This allowed to purchase some other equipment that allowed to further reinforce the new technological platform at UTUN. So besides the originally planned 1) Real Time thermo cycler, 2) Phenotypic Array, 3) DNA microarray platform, 4) Plant Growth Chamber, 5) Gel Documentation system, the following equipments were purchased and installed, by keeping the same original budget dedicated to the equipments, i.e. 338,000 Euro: 6) Automated Electrophoresis System, 7) High Performance Liquid Chromatography platform, 8) Automated Liquid Handling Station and 9) Tangential Flow Filtration system. (Related completed Deliverables: D2.2 and D2.3. Annex 5)

vi) Training period of the experienced researchers recruited by UTUN: this activity was successfully completed by Month 28. Drs. Hanene Cherif and Mohamed Neifar spent their training at UMIL over the period of one year. Similarly, Drs. Afef Najjari and Dr. Ahlem Jouini spent their training at UOIRC. After their training the experienced researchers prepared a report on the advancement of the training that was uploaded on the participant portal website (Related completed Deliverables: D3.2. Annex 6)

vii) Secondment period for UTUN permanent staff: The first secondment period was done between months 7 and 9 of the project. The second secondment period was done between months 30 and 31. During these periods the permanent staff of UTUN, Prof. Abdellatif Boudabous, Prof. Ameur Cherif, Prof. Imene Ouzari and Dr. Atef Jaouani spent one week periods in Italy and/or Greece in the UMIL and UOIRC laboratories. (Related completed Deliverables: D3.1 and D3.3. Annex 7)

viii) 1st Steering committee meeting: The meeting was held at month 9 in Kolymbari, Greece. During the meeting many features and advancement of the project were discussed. The resulting report was prepared and loaded in the EU website portal. (Related completed Deliverables: D1.3. Annex 1)

ix) Seminars: Four seminars all held within structures of UTUN were organized with the aim of presenting the scientific work done in UTUN laboratories, benefiting of the novel technologies and techniques and the advanced know-how acquired under the umbrella of BIODESERT. Seminars were as follow: 1) Microbial extremophile and symbiosis, November 2010; 2) Genomic and Molecular Biology: Methods and Application, March 2011; 3) New Developments in Microarrays Technology: Recent

Applications for Research and Medical Genetics, May 2011, and 4) Identification of saprophytic and extremophile Fungi, June 2011. (Related completed Deliverables: D4.6. Annex 8)

x) Communication to the wide public: Many actions for the dissemination of BIODESERT concepts and results were undertaken. Besides the preparation and update of the BIODESERT website, these included participation to congresses and presentation of BIODESERT concept and results, publication in peer review journals and publication of articles in general public targeted journals, open days at the laboratory of UTUN, podcasts on the different scientific methods used for microbial resource management, newsletters on the website. (Related completed Deliverables: D4.7. Annex 9)

xi) BIODESERT Leaflet: A general leaflet presenting the BIODESERT project has been prepared and made available for the public by publication on the project website. The leaflet is prepared in three versions, in English, French and Arabic languages, thus reaching the widest possible scientific community and the large public of Tunisia, North Africa and Europe. (Related completed Deliverables: D4.1. Annex 10)

xii) Mid-term meeting: The meeting was held on 8 July 2011 in Athens, Greece. During the meeting all management aspects, activity advancements and activities to be initiated and implemented for the second half of the project were discussed. The resulting report on the meeting was prepared and loaded on the project web site and the participant portal of the EU website. (Related completed Deliverables: D1.1. Annex 1)

xiii) Other activities: three sampling expeditions in the desert and pre-desert areas of the south of Tunisia were organized immediately after the Kick off meeting, after the second BIODESERT workshop and following the BIODESERT Conference. The aim of these expeditions was to collect samples related to the three scientific topics of the project for the development of the foreseen experimental methods and procedures. The last expedition was aimed at verifying some of the results achieved with the previous expeditions and getting some more samples for completing and confirming the already obtained results. (No specific formal deliverables foreseen in the DoW for this activity. Annex 11)

xiv) Leaflet on microarray technology: A second leaflet introducing the microarray technology and implications for the research on agriculture in the arid ecosystems was prepared and was made available to the public by month 20. The leaflet was largely distributed during the workshop on the microarray technology and applications. (Related completed Deliverables: D4.2. Annex 12)

xv) Workshop 1: the workshop was organized in December 2011 (Month 24) in Tunis, Tunisia, and dealt with topic of Insect-microbe interaction. (Related completed Deliverables: D4.3. Annex 13)

xvi) Workshop 2: the workshop was organized in March 2012 (Month 27) in Hammamet, Tunisia, and dealt with topic of Plant-microbe interaction. (Related completed Deliverables: D4.3. Annex 13)

xvii) The 2nd steering committee meeting was held at month 27 in Hammamet, Tunisia: During this meeting many points on the advancement of the project were discussed and the following activities planned. (Related completed Deliverables: D1.3. Annex 1)

xviii) Workshop 3: the workshop was organized in July 2012 (Month 30) in Tunis, Tunisia, and dealt with topic of Extremophiles and the DNA microarray technique. (Related completed Deliverables: D4.3. Annex 13)

xix) Organizational meeting for the final BIODESERT conference: In November 2012 the Project Coordinator travelled to Tunis for a one day meeting to finalize the last steps of

the BIODESERT conference organization. (No specific formal deliverables foreseen in the DoW for this activity)

xx) Final BIODESERT meeting: The final meeting was held in Hammamet, Tunisia at Month 36. During the meeting the results of the project were discussed. Future plans for collaboration were also discussed. (Related completed Deliverables: D1.1. Annex 1)

xxi) Final BIODESERT conference: the final international conference of the project was held in Hammamet at Month 36. The conference dealt with the three main topics of BIODESERT. (Related completed Deliverables: D4.4. Annex 14)

xxii) BIODESERT project reporting: Besides the present final report and the mid-term report, a series of reports on the different specific activities have been prepared to illustrate the different achieved findings and deliverables. (Related completed Deliverables: D1.5)

xxiii) BIODESERT scientific activities: In the DoW there were not scheduled specific research task. However, the work of BIODESERT was framed under three specific research topics for which experimental activities with the related results were achieved. The research activities are documented by the publications and the lectures and posters presented at international and national scientific conferences. (No specific formal deliverables foreseen in the DoW for this activity)

The above-mentioned activities are explained in details in the following sections broken down by Work Packages. Here below are reported the details of activities of WP1, WP2 and WP3. The activities of WP4, dealing with Dissemination and Exploitation, are presented in detail under the following paragraph “1.1.4. The potential impact and the main dissemination activities and exploitation of results”.

WP1: Management of the consortium

Work Package 1 was dedicated to the project management and the management of the consortium to ensure that the project objectives were achieved with a correct timing and the estimated resources, and the results were optimally exploited. The specific objectives of this work package were: (i) to provide the overall administrative, financial and legal management of the project and (ii) to co-ordinate the technical works of the participants so as to reach the project objectives. The activities of WP1 were framed in the following two tasks: Task 1.1 Project monitoring and reporting, and Task 1.2 Project meetings and management tools. The activities and achievements in the ambit of these two tasks are reported as follows:

Task 1.1 Project monitoring and reporting

The activities within task 1.1 include: i) the recruitment of a project secretary; ii) monitoring of the project activities and work; iii) Establishment and monitoring of an online archive of project documents and information relevant to BIODESERT.

i) Recruitment of project secretary: Following the UMIL procedures, an open call for the position of project secretary was publicized two month prior to an interview. The applicant was required to have knowledge of English, French, and possibly Arabic and Italian since s/he had to interact with all the partners that are respectively from Tunisia, Italy and Greece and operates in a team established in Italy. A basic knowledge of website design, construction and management was also a preferable requisite. In addition to the help in the

management of the project, scientific knowledge related to at least to one of the topics in which BIODESERT is framed was a plus since it would ease the interaction between the secretary and the scientific staff of the project. After an interview realized in the month of May 2010, Dr. Bessem Chouaia was selected to work as secretary of the BIODESERT project. Dr. Chouaia responded to almost all the above mentioned requisites speaking English, French, Arabic and Italian. Dr. Chouaia is familiar with the web design and management of websites and has a PhD in animal biology with a specialization symbiosis with arthropods. Mr. Chouaia started the work at July 2010 for a period of 18 months.

ii) Monitoring of the project activities and work: The project coordinator, with the help of the project secretary Dr. Chouaia constantly monitored the project work and activities by keeping a strict and continuous contact with the project partners using e-mails, telephone calls, skype calls and even visits to the laboratories of the partners, in particular the Tunisian partner. The coordinator also maintained a regular information flow with the project officers Mr. Stephan Weiers and Ms. Clara Hombrados-Larriba and later with a new scientific officier Mr. Grzegorz Ambroziewicz.

iii) Establishment and monitoring of an online archive of project documents and information: Two sections of the project web site were developed to respond to this requirement. A restricted area has been established where all the relevant documents of the project (meeting agendas, meeting minutes, deliverable documents, activity reports, etc.) were archived and made available for the project partners. A newsletter, regularly updated by the project secretary, has been established on the project website, reporting major scientific events related to BIODESERT topics and research.

Task 1.2 Project meetings and management tools

The activities within task 1.2 included: i) the development, maintenance and update of the project web site; ii) the organization of the different project meetings; iii) the preparation of the different minutes and reports.

i) Realization maintenance and update of the project web site: A first version project website (www.biodesert.unimi.it) was created on month 6 as planned on Annex I. The website was updated regularly and on month 15 the design was changed and a restricted area for members with special access rights was included (as described above in Task 1.1). The website had as main aim the presentation of the BIODESERT project and the different partners involved. It had also the goal of helping dissemination since all the media planned for dissemination were loaded on the website and made free for download maximizing by this way the public targeted by the different dissemination initiatives. The website was referenced in google and appears at the first page within the first 5 answers when the word “biodesert” is googled. The website was visited by visitors from more than 17 countries representing four continents.

ii) Organization of the different project meetings: All the project meetings have been organized on due date: the Kick Off Meeting (Month 2), the 1st Steering Committee Meeting (Month 9), the Mid-Term periodical meeting (Month 19), the 2nd Steering Committee Meeting (Month 27) and the project final meeting (Month 36) and two monitoring/organizational meetings in Tunis (Months 11 and 35) were organized. The meetings are briefly described here:

Kick off meeting: the meeting was held in Douz, in the South of Tunisia on the 5th February 2010. This meeting was organized to set up the practical working guideline for the project. During this meeting project mainlines were highlighted and main research topics related to the project were defined. Strategies for the different actions in the ambit of the project were

decided. These actions were mainly the support of the Tunisian researchers, the training of both permanent staff and recruited experienced researchers, and the dissemination of knowledge among public and scientists. The meeting day was followed by a 5 days sampling expedition in the south of Tunisia. This expedition had two goals the first was the collection of material and samples that were relevant to the research topic related to BIODESERT, and second was to strengthen the bonds between the 3 partners. The stations sampled during these days were mostly in the regions of Douz, Grand-Erg-Oriental, Nefta – Tozeur, and Gafsa and were divided into 5 sampling areas from which samples of soil, sands, rocks, plants, rhizospheres and Arthropods were taken each time.

1st steering committee meeting: the meeting was held in Kolymbari – Crete, Greece on the 18th September 2010. The aim of the meeting was to assess the main advancements achieved in the ambit of the project to check the milestones and plan the corrective action where necessary. During the meeting each of the partners presented the advancements done both at the administrative and scientific levels. The situation of the recruitment of the experienced researchers was evoked, and the profiles of the experienced researchers were presented to the other partners. The profile of the administrative secretary was also presented to the other partners. It was presented the situation of the recruitment of the experienced researchers and of the equipment purchase. In consideration of the forced delay due to the position of the Tunisian Central Bank in the financial procedure for supporting the experienced researchers during their training periods in Europe, it was discussed to implement the alternative individuated procedure explained below under the activities of WP2. Similarly the Tunisian partner updated the other team leaders about the steps initiated for the alternative procedure for the equipment purchase. During this meeting the different dissemination actions undertaken were exposed and an updated plan for the future action was decided. The results of the 1st secondment period for UTUN permanent staff were also discussed and the experience from this was analyzed in order to implement the 2nd secondment period. A work plan was also discussed for the training period of the experienced researchers of UTUN in both UMIL and UOIRC laboratories.

Meeting in Tunis with the project Coordinator and the Tunisian partner: This meeting was not scheduled in the original Annex I. However, due to the forced delays in the procedures for the recruitment of the experienced researchers and the acquisition of the equipments, it was agreed between the Coordinator and the Tunisian partner to meet in Tunis to re-analyze the situation and undertake any further action if necessary. The meeting was held in Tunis on the 8th November 2010. Besides the members of the Tunisian team, the meeting saw the participation of the project Coordinator. The meeting was organized especially to assess the situation and advancement of the procedures for the equipments purchase and the recruitment of the experienced scientists by the Tunisian partner. This meeting was mostly dedicated to the choice of the most suitable equipments that may enhance UTUN analytical capacities and on the analysis of the administrative steps to be done. During this meeting, the project members discussed the fact that the equipments cost resulted lower than the one foreseen in the original project. The proposed solution was to purchase additional equipments for further potentiate the capacities of the already planned equipment within the same total equipment budget originally considered,. The meeting was held during the first open days and besides members of UTUN the project Coordinator of UMIL in addition to scientists of collaborating laboratories participated to this dissemination action.

Mid-Term periodic meeting: the meeting was held in Athens, Greece on the 8th July 2011. The aim of this meeting was to i) have a clear view on the actual situation of the project at the scientific, administrative and financial levels, ii) discuss the steps necessary to complete

the mid term report and iii) discuss about the actions to be done for addressing the different activities foreseen in the second half of the project. During the meeting the different points were discussed and it was decided how to clearly present in the report all the unpredictable '*force majeure*' reasons (see the detailed explanations in the following WP2 and WP3) that determined the encountered delays in the deliverables of the recruitment of the experienced researchers and in the equipment acquisition. It was also considered that the alternative actions put in place by the consortium effectively counteracted the observed delay and constituted the best strategy to complete the action and obtain all the planned deliverables and fully realize all the project objectives. With the alternative procedures adopted the encountered '*force majeure*' inconveniences determined just a delay of some months in obtaining the expected deliverable and milestones that do not compromise at all the full realization of all the project objectives. The scientific advancements of the different topics related to BIODESERT were also presented during the meeting. The dissemination actions undertaken for the first 18 months of the project were also exposed and the future actions were planned.

2nd steering committee meeting: the meeting was held in Hammamet, Tunisia on March 2012. The aim of the meeting was to assess the main advancements done in the ambit the project to check the milestones and plan the corrective action where necessary. During the meeting each of the partners presented the advancement done both at the administrative and scientific level. The situation of the training of the experienced researchers was explained. The organization of the 3rd workshop and the 2nd secondment period of the permanent staff of UTUN in the laboratories of UMIL and UOIRC were discussed. The situation and installation of the different already purchased equipments was discussed with a focus on the strategies to follow for an ideal exploitation of these equipments.

2nd meeting in Tunis with the project coordinator and the Tunisian partner: The meeting was held in Tunis – Tunisia on 17 November 2012 in order to assess the development of the organization of the final BIODESERT international conference to be held in Hammamet, Tunisia in December 2012. Besides, assessing that all the procedures for the conference organization were in the right direction, the situation of the equipment acquisition and scientific exploitation was analyzed and discussed.

Project final meeting: the meeting was held in Hammamet, Tunisia on the 16th December 2012. The aim of the meeting was to assess the main advancements achieved, to confirm the achievement of the different milestones and to check the state of the different deliverables that were in progress at that moment. During the meeting each of the partners presented the advancements done both at the administrative and scientific level. It was confirmed that all the deliverables were ready to be achieved before the end of the project.

iii) Preparation of the different reports: All the reports foresaw for the BIODESERT project have been prepared and loaded on the project website and the participant portal of the EU website. The reports include the Kick off meeting report, the 1st secondment period report, the 1st steering committee report, the Post-doctoral fellows' recruitment report. It was not possible to provide at the foreseen deadline the complete equipments purchase procedure report since, due to the encountered '*force majeure*' inconveniences that are explained in detail in the following section of the present report. However, following the adoption of the planned alternative strategy explained in the following description of WP2 and briefly resumed below, the equipment acquisition procedure was completed before the submission of the present report. Such a delay did not produce any negative effect on the full realization of all the project objectives

As mentioned above and below in the different sections of this report the only challenges

that the BIODESERT project faced were related to the recruitment of the experienced researchers and the acquisition of the equipments. In particular, the challenges were in relation to i) the procedure of equipment purchase since UMIL did not have the legal means to buy the equipments on behalf of UTUN as originally planned in the DoW; ii) the procedure for the contract signature and the payment of the Post-doctoral experienced fellows during their training within UMIL and UOIRC facilities. As extensively explained below the encountered problems were of a '*force majeure*' nature and it was not possible to overcome it without changing the procedures. As explained in detail in the next sections of the report, the BIODESERT team undertook all the actions necessary to address the inconveniences including, for the recruitment of the experienced Post Doctoral researchers, the modification of the Annex I made through an official Amendment procedure. Briefly the modifications adopted were the following: i) The effective recruitment of the three experienced researchers was only possible beginning from October 2010. This was due to the Tunisian local lows making possible the contracts signature only upon the total funds transfer (corresponding to 78 months) from the coordinator to the UTUN bank account. Moreover, for allowing the payment of the expenses of the experienced researchers during their training periods in the laboratories of the European partners of the project, the corresponding funding were transferred to the budget of the European partners that paid these expenses to the researchers during their period in the respective European laboratories; ii) For the acquisition of the equipment the entire purchase procedure was transferred in the hands of the Tunisian partner who started all the procedures in accordance with the Tunisian national laws to complete the acquisition of the instruments. For all the instruments the purchase and installation procedure was completed before December 2012. Only for the Phenotypic Array system the procedure of purchase and installation was completed before the submission of the present report, thus not creating any inconvenience to the achievement of the full BIODESERT objectives. The delay in the acquisition of the Phenotypic Array system was due to the unsuccessful open call initially release by UTUN. This constrained the UTUN financial office to proceed with a second open call in March 2012 and to sign a contract with SOCODI provider, the unique legal representative of Biolog Inc, in August 2012. This representative provider was constrained to follow new purchase procedure from the American company after the events that happened in Tunisia and that targeted the American embassy as described in details in D2.2. After a long and complicate procedure, the Phenotypic Array system was delivered to UTUN in February 2012 before the submission of the present report. This overall procedure allowed the UTUN team to save an amount of 14000 Euros that was used to purchase a tangential flow filtration system (TFF) as an additional instrument to reinforce the technological platform developed in the frame of the BIODESERT project. This instrument was received and installed in December 2012 (D2.2 and D2.3, Table 1: details of the acquired equipments).

Regarding the financial reporting and beside the Form C filed electronically, Partner 2 UTUN engaged the auditing procedure in the first reporting period (RP1: 1st January 2010 – 30th June 2011) since the claimed cost were EUR 414.806,68. This amount included the EUR 338.000 planned for the equipment purchase and blocked at that time for the released open call for the acquisition. With the described challenges and delays in the acquisition procedure, the EUR 338.000 amount was effectively spent in the second reporting period (RP2: 1st July 2011 – 31st December 2012). In this RP2 and as described in Form C, the claimed costs are EUR 572.405,38 which exceeds the threshold of EUR 375.000. For this, Partner 2 UTUN engaged a novel auditing procedure for RP2 as requested by the

European Commission. The Certificate of Financial Statement (CFS) will be issued by an external auditor and transmitted to the Financial Officer of the BIODESERT project.

WP2: Recruitment of incoming experienced researchers and equipment upgrade

General objective of this WP was the recruitment of experienced research fellows and the acquisition of new equipments. The specific objectives of this work package were: i) to recruit post-doctoral fellows with experience in molecular microbial ecology of extremophiles and agriculturally-relevant microorganisms. The recruitment of the experienced researchers is for a total of 108 person/months. ii) To acquire novel equipments: besides the planned Real Time thermo cycler, a Phenotypic array system, a DNA microarray system, a Gel Documentation system and a Plant growth chamber, some further equipments were purchased to use all the budget (338,000 Euro) allocated for the purchase of novel equipment and the upgrade of the instrumental platform at UTUN.

Recruitment of post-doctoral fellows: The recruitment of the experienced researchers was done, following the official Tunisian procedure, by issuing a public call. Then a selection among all the candidates was done by a Commission composed by Prof. Daniele Daffonchio (UMIL), Prof. Abdellatif Boudabous (UTUN) and Prof. Kostas Bourtzis (UOIRC), based on the *curriculum vitae* of the candidates. The first three selected scientists were Dr. Hanene Cherif, Dr. Mohamed Neifar and Dr. Afef Najjari. However, the full recruitment of the three scientists, including the contract signatures, was completed only at month 10 (October 2010) due to one of the '*force majeure*' reasons mentioned above. In detail, the delay was determined by (**i**) the prerequisite to have the overall allocated funds for the experienced researchers salaries, already transferred to the financial office of UTUN and (**ii**) to the unfeasibility of having the authorization from the Central Bank of Tunisia to open bank accounts in Euro for the experienced researchers for money transfer from UTUN to support their subsistence expenses during their one year periods of training in the two partnering EU laboratories. For the first arisen problem, the money transfer of 155.793,00 Euros including the experienced researcher's salaries (86.400 Euros) was performed by UMIL to UTUN on September 9th 2010, which allowed the contract signature in October 2010. On the contrary, the lack of the authorization from the Tunisian central bank that was confirmed only after a long negotiation which was initiated on the first month of the project, made the payment of the researchers' expenses in Europe by Partner 2 unfeasible. To solve this situation a modification of the Annex I of the project was proposed and negotiated with the project Officer Dr. Stefan Weiers. The suitable modification of the Annex I was prepared by the activation of an amendment procedure that was approved by the Commission on the 19 October 2010. With the change of the procedure the training periods of the experienced researchers in Europe were made possible starting from month 17 until month 28. The delay in the contract signatures determined the impossibility to use all the 108 person/months of experienced researchers foreseen in the project by recruiting only three scientists. So, as a correction to this deviation for completing the coverage of the 108 person/months two further post-doctoral fellows were recruited and contracted for a total of 27 person/months to be completed before the end (month 36) of the project. The recruitment of two other experienced scientists followed the same procedures as for the first three experienced researches. The 1st person selected was Dr. Ahlem Jouini for 20.5 months. The 2nd person was Besma Ettoumi for 6.5 months.

This forced delay in the recruitment has determined a delay on the onset of the training activities of the experienced researchers in the laboratories of the European partners foreseen in WP3. However, despite the delay, these activities in WP3 have been initiated in

a regular way and were concluded in April 2012 far before the end of the project (December 2012).

Acquisition of the equipments: The procedure for the acquisition of the equipments was activated immediately following the Kick-Off meeting of the project but was suddenly delayed by two unpredictable '*force majeure*' reasons, an administrative and legal constrain in the planned procedure evidenced by Partner 1 UMIL Administration, and the Tunisian Revolution. The original foreseen procedure planned the order and acquisition of the equipments by Partner 1 UMIL on behalf of Partner 2 UTUN following a written mandate, and the delivery at the laboratory of Partner 2. The Administrative offices of Partner 1, despite a previous approval of this procedure during the project negotiation, after the project start verified that such a procedure does not fully comply with the Italian legislation and notified the decision to the project coordinator on November 19th 2010. To overcome this problem the whole equipment acquisition procedure was transferred to Partner 2 that with a delay of 11 months activated the procedure at month 12 of the project (December 2010) in accordance with the Tunisian rules and after the approval of the Project Officer on November 22nd 2010. This was followed by the transfer to partner 2 UTUN of the allocated funds of 338.000 Euros for the equipment purchase on November 30th 2010. This alternative procedure foresaw the following steps with their indicative time frames: **i**) preparation of the administrative and technical specifications of the international open call with specification of the technical characteristics and indicative prices of each instrument to be acquired. These specifications have to be addressed to the to the Departmental Market Commission of the Ministry of high education and scientific research of Tunisia; **ii**) Authorization of the departmental commission to publish the call (1 month); **iii**) Publication of the international open call for 45 days (published on March 9th 2011); **iv**) Examination and selection of the best technical and financial offers for each instrument and preparation of an examination report addressed on May 10th to the Tunisian Departmental Market Commission; **v**) Decision on the examination report (August 3rd 2011); **vi**) Emission of the equipment purchase towards the selected offers and providers by the departmental commission and the financial office of the University of Tunis UTUN (minimal required timeframe of 2 months), order forms were issued on September 21st 2011 and **vii**) Delivery and installation of the equipments by the selected providers at the laboratory of Partner 2 UTUN (minimal required duration 2 months) as detailed in Table 1 and in D2.2 and D2.3. This overall procedure leading to the order forms release in September 2011 and the delivery and installation of the equipments, was further complicated by a second event of force majeure, the revolution in Tunisia that occurred officially from December 2010 to January 2011 but with extended effects during all the year of 2011 and even in 2012. The two above-mentioned unpredictable '*force majeure*' events determined a delay of about 14 months in the acquisition procedure but nevertheless all equipment has been purchased and installed in the Tunisian lab. The last equipment, the Phenotypic Array system, was delivered and installed at UTUN on February 23rd 2013 before the submission of the present report, hence pledging the achieving of the objective and deliverables D2.2 and D2.3 (Annex 5). The last delay of the acquisition of the Phenotypic Array system was due to the reinforcement of the documentations requested by the unique provider of the instrument, the Biolog Inc. Company following the commercial restrictions and controls raising after the recent political events occurred in Tunisia that targeted the American embassy in September 2012 (Annex 15, and as described in D2.2).

Due to the above mentioned delay the prices of the equipments originally foreseen in the DoW, 1) Real Time thermo cycler, 2) Phenotypic Array system, 3) DNA microarray platform,

4) Plant Growth Chamber, 5) Gel Documentation system, decreased, so it was possible, by keeping the same budget for the equipment acquisition, i.e. 338.000 Euros to reinforce the analytical platform by including some further equipments, including, 6) An Automated Electrophoresis System, 7) A High Performance Liquid Chromatography platform (HPLC), 8) An Automated Liquid Handling Station and 9) a Tangential Flow Filtration system. These four supplementary equipments allowed complementing and improving the utilization efficiency of the other equipments acquired with BIODESERT. The delay in the procedure did not affect the realization of any of the objectives of BIODESERT, nor the obtainment of the project deliverables. The project was designed to limit and adsorb such kind of problems that were unexpected due to the different legislations of Europe and Tunisia and the recent political events in Tunisia.
In summary the delivery and installation of the different purchased equipments was as reported in the following Table 1.

Table 1. Summary of the delivery and installation dates of the different equipments purchased by UTUN under the BIODESERT project and the date of submission of the final project report. N.a., not applicable; No./ID: Number of the equipment/identification of the item (R = Final report). *Dates are given as Day/Month/Year

No./ID	Equipment/Report	Equipment name	Brand/Provider	Purchase order emission date	Delivery date*	Installation date*	Training date*
R	BIODESERT final report				1/3/13	N.a.	
1	RT-QPCR	Real Time thermo cycler	Précision Electronique	21/09/2011	20/02/2012	23/02/2012	1-2/10/2012
2	Phenotypic Array	Phenotypic Array system	SOCODI	17/08/2012	23/02/2013	23/02/2013	23/02/2013
3	DNA microarray	DNA microarray platform	Prochidia	21/09/2011	30/12/2011	27/06/2012	27-28/06/2012
4	Plant Growth Chamber	Plant Growth Chamber	M2S	22/05/2012	28/12/2012	28/12/2012	28/12/2012
5	GDS	Gel Documentation system	F-Lambda	21/09/2011	07/07/2012	12/07/2012	12/07/2012
6	AES	Automated Electrophoresis System	Précision Electronique	21/09/2011	20/02/2012	23/02/2012	1-2/10/2012
7	HPLC	High Performance Liquid Chromatography platform	Biogene	21/09/2011	18/11/2012	18/11/2012	13/12/2012
8	ALHS	Automated Liquid Handling Station	Précision Electronique	21/09/2011	20/02/2012	23/02/2012	12-13/06/2012
9	TFF	Tangential Flow Filtration system	FTS	25/09/2012	25/12/2012	25/12/2012	25/12/2012

WP3: In-project training of the new recruited researchers and networking

The general objective of this WP was the training of members of UTUN by secondments and personnel exchanges with UMIL and UOIRC. With this WP the scientific networking among the three partners of the project and the general exchange of scientific knowledge and experience was further reinforced and exploited. The trainings periods were foreseen as personnel visits of different durations according to the research and training necessities over a time range of one year starting at month 9 for four of the fellows recruited by UTUN (two at UMIL facilities and two at UOIRC facilities) and secondment periods for four UTUN permanent staff (at months 7-9 and at month 32)

Training of the recruited fellows of UTUN: Because of the delay in the recruitment of the experienced scientists, due to the above mentioned '*force majeure*' reasons, the training periods of the fellows recruited by UTUN started at month 17 instead of month 9. Still, this delay did not impact the development of the other work packages and the realization of the project objectives. Four of the experienced researchers worked in the structures of UOIRC

and UMIL pursuing their training:

(i) Dr. Hanene Cherif was in the Partner 1 laboratory at UMIL learning procedures and protocols to work with Quantitative Real Time PCR. Dr. Hanene Cherif worked on the research line framed in the project related to the exploitation of plant growth promoting bacteria in arid ecosystems. Dr. Hanene Cherif worked with bacterial isolates that were obtained from date palm and olive tree root samples withdrawn from different arid environmental settings in the South of Tunisia (including oases) during the sampling expeditions organized under BIODESERT.

(ii) Dr. Mohamed Neifar was also in the Partner 1 laboratory at UMIL working on genomics and physiology of microbial isolates obtained from lithoid substrates (calcarenites and desert sands) recovered from desert environments during the sampling expedition organized under BIODESERT. Among other techniques Dr. Mohamed Neifar approached the use of the phenotypic array in order to test different hypothesis on the metabolism of the two extremophile microorganisms colonizing desert stones and calcarenites, the actinobacteria *Modestobacter multiseptatus* and *Blastococcus saxobsidens*.

(iii) Dr. Ahlem Jouini and Dr. Afef Najjari spent in alternation periods in the laboratory of Partner 3 at UOIRC. They were trained in advanced molecular biology methods like the construction, screening and sequence analysis of 16S rRNA gene-based libraries. They were also trained on how to use and manage DNA microarray systems in particular how to optimize DNA probe design and read and analyze DNA chips. An initial training on an Affymetrix microchip platform designed to run specific chips to be used in microbial ecology and environmental microbiology, the PhyloChip platform, was also achieved. The work target of both Dr. Ahlem Jouini and Dr. Afef Najjari was the study of microbial communities associated with arthropods living in the arid ecosystems of Tunisia.

Secondment periods of UTUN permanent staff: The two secondment periods of the permanent staff were successfully completed. For the 1st secondment period, the period at the UMIL facilities was held on month 7, while the period planned at UOIRC was held in month 9 in correspondence with the 1st steering committee meeting. On month 7 the permanent staff of Partner 2, Prof. Ameur Cherif and Prof. Imene Ouzari attended for a period of one week the laboratory of Partner 1 UMIL discussing and learning novel approaches of molecular microbial ecology. Prof. Abdellatif Boudabous and Dr. Atef Jaouani spent a period of one week in Greece under scientific secondment initiatives initiated and organized by Partner 3 UOIRC. Prof. Boudabous and Dr. Jaouani were able to learn the new advancements on insect-microbe symbiosis by attending a scientific workshop of the COST action FA0701. The deliverable for the 1st secondment period was submitted in month 9.

The 2nd secondment period of UTUN permanent staff was completed on Month 31 of the project. On month 31 the permanent staff of Partner 2 UTUN, Prof. Imene Ouzari attended for a period of one week the laboratory of Partner 3 UOIRC and she was updated in the current developments of DNA microarray systems and how these can be facilitated in the microbial research. Dr. Atef Jaouani spent a period of one week in Italy under scientific secondment initiatives initiated and organized by Partner 1 UMIL on month 30. The report on the first secondment periods was completed on month 32.

Despite '*force majeure*' factors affected the recruitment of experienced scientists and hence delayed the activation of the training periods foreseen in WP3, no major deviations in the planned person/months of this work package per beneficiary are expected.

1.1.4. The potential impact and the main dissemination activities and exploitation of results

In this paragraph of the BIODESERT final report are reported the impact of the project on beneficiary n. 2 UTUN, the major target of the support activities foreseen in BIODESERT, and the project dissemination that was the subject of WP4

Impact of BIODESERT

The target of the support actions of BIODESERT was Beneficiary n. 2 UTUN. The implementation of the different support actions was realized with the support and contribute of the other two partners of BIODESERT, UMIL and UOIRC. Here, it is described the impact of BIODESERT on UTUN and on the scientific environment and the implications on the wide society. According to all the collaborations activated the project positively impacted and is impacting the scientific society of North Africa and EU and in general the ERA, as well as the public at large in Tunisia. It is foreseen that such an impact will last for years, having BIODESERT contributed to start and spread a novel research area in the frame of the microbial resource management for agriculture in arid lands.

The impact actual and future impact can be broken down under three major axes: i) the establishment of new research and collaboration networks and participation to research projects; ii) The development of the CV of the UTUN personnel; and iii) The contribution to the development of new research entities in Tunisia.

i) Establishment of new research and collaboration networks and participation to research projects: The continuous and effective collaboration with the other BIODESERT partners UMIL and UOIRC resulting in the publication of several scientific papers in peer-reviewed research journals in the area of microbiology, consolidated the relationships and collaborations among the three partners. For instance, such consolidated relationship resulted in a further collaboration between UMIL and UTUN that are successfully working together in another FP7 project, the Cooperation project ULIXES.

   BIODESERT strengthened the molecular microbial ecology platform at UTUN laboratory which gave a clear notoriety not only at the national and regional levels but also at the international level. LMBA at UTUN is actually solicited by a number of Tunisian, Algerian, Moroccan and Egyptian scientists to perform training and stages on advanced approaches and techniques on Microbial Resources Management for agriculture and in other aspects of molecular microbial ecology including bioremediation and pest biocontrol.

   Moreover, the dissemination activities achieved through BIODESERT, i.e. seminars, workshops and international conference, allowed UTUN to enter new scientific networks and to have contacts with new laboratories mainly in Europe and USA. In these new networks, LMBA is a full partner in the ongoing EU-FP7 Coordination project ULIXES since 2011. UTUN has also participated in several bilateral projects and in the EU-IEVP call for proposals in 2012 with south-European laboratories; the submitted succinct note of this project was ranked first in the first evaluation phase.

   Other collaborations of UTUN with EU research entities are stemming from the effective results of BIODESERT. Among others, UTUN, in the person of Prof. Ameur Cherif has started a discussion with Prof. Robert Jackson of the University of Reading, UK, for receiving an UK young researcher to learn the technique for rearing in vitro honeybee

larvae. Similarly Prof. Maher Gtari is consolidating his collaboration with Prof. Philippe Normand of the University of Lyon on collaborative studies of the nitrogen fixing actinomycetes Frankia sp.

The BIODESERT team has been recently contacted (January 2013) by a group of students studying for a master degree in Urban Design, at the Bartlett School of Architecture, University College London, seeking for information and collaboration on a study regarding the Chott El Djerid salt lake area and the oasis of Tozeur. The student team and the design studio they belong to are researching that area of Tunisia within the context of ecology and sustainable design for assessing the feasibility and impact of possible future large projects on energy crops and energy generating plants in the desert. The team is asking the BIODESERT team to support with information on the agriculture, biology and microbiology of the oases and for logistic and scientific support on site for their research.

More recently in December 2012 and following contacts developed under BIODESERT, UTUN was implicated in a new Gates Foundation project leaded by Ravi Durvasula from New Mexico University in the US and dealing with the biocontrol of desert locust, one of the major agricultural pests in the Sahel regions. Prof. Durvasula was one of the invited speakers that gave a lecture at the first BIODESERT workshop on Insect-Microbes Symbiosis in December 2011. During this workshop the first discussion about collaboration for a research project on the biocontrol of locusts has been initiated. Prof. Durvasula and other scientists of his staff visited UTUN in the period 5-10 February 2013 for implementing a research activity on new strategy for controlling locusts based on the insect microbial symbionts.

In a similar fashion, the BIODESERT team in the person of the Coordinator has been invited to present the outcome of the BIODESERT project and the concept of the microbial resource management for agriculture in arid lands at KAUST (King Abdullah University of Science and Technology) in Saudi Arabia. Prof. Thomas Miller of University of California at Riverside, who was an invited speaker at the first workshop of BIODESERT on insect-microbe interactions highly appreciated the scientific concept behind BIODESERT. He is now co-organizing in collaboration with the conference chair Prof. Nina Fedoroff of KAUST the “High Level Red Palm Weevil Conference” devoted to the understanding of the biology and the new frontiers for the biocontrol of this palm devastating insect pest. The Conference will be held at KAUST on the 15-18 March 2013and the BIODESERT coordinator will present a lecture entitled “The EU project BIODESERT and the management of microbial resources in arid lands”.

ii) CV development of the UTUN personnel: The project permitted also know-how transfer to the UTUN by means of the training offered by the BIODESERT partners to the recruited experienced researchers and the permanent UTUN staff. The obtained results in the project period and the number of manuscripts actually submitted or in preparation, resulted in the curricula development of the young postdoc researchers. For this, UTUN has already asked the Tunisian Ministry of Higher Education and Scientific Research for opening permanent positions to sustain the recruited persons in the ambit of BIODESERT.

Also, permanent staff of UTUN has developed their curricula. Following the results and dissemination achieved with BIODESERT, Prof. Abdellatif Boudabous, the team leader of UTUN, has been nominated in June 2012 President of the National Committee for Evaluation of Research Activities (CNEAR) by the Ministry of Higher Education and Scientific Research. The scientific results achieved with BIODESERT allowed the

associate professors Ameur Cherif and Maher Gtari to be selected as full professors in December 2012 by the selection committee of the Tunisian Ministry of Higher Education and Scientific Research. Similarly, Dr. Imen Ouzari that belongs to the LMBA research team but was affiliated to another university (University of Gafsa) was officially appointed in the UTUN staff and she is actually fully permanent associate professor at UTUN.

iii) Contribution to the development of new research entities in Tunisia: with the gained notoriety of LMBA and UTUN, Prof. Ameur Cherif was able to gather other colleagues and to create a new research laboratory at the University of Manouba. The new laboratory "Biotechnology and Bio-Geo Resources Valorization" (BBGRV) has been officially recognised by the Ministry of Higher Education and Scientific Research as an autonomous research laboratory. BBGRV is now developing research in the field of microbial ecology and biotechnology (www.lab-biotech.com).
Following the impulse of BIODESERT the UTUN team had been a central role in the foundation of a new scientific society in Tunisia, the "Tunisian Association for Microbial Ecology" that have actually contacts with other scientific societies in Europe, like the "Association Francophone de l'Ecologie Microbienne, AFEM", the Italian Society of Agriculture, Environmental and Food Microbiology (SIMTREA) and the European Federation of Biotechnology (EFB) in its section on Environmental Biotechnology.

All these facts indicate that BIODESERT positively impacted not only UTUN but also many other research institutions and laboratories in North Africa countries, EU US and other regions worldwide, like the Arabic Peninsula. These benefits are also going well beyond the scientific dimension but are presumed to have a long range impact also on the society at large.

All these impacts are resulting from the dissemination of the BIODESERT results undertaken in the ambit of WP4, whose activities are reported as follows:

WP4: Dissemination/Exploitation

Within the activities of this work package, BIODESERT has been able to transfer, disperse, and facilitate the knowledge and technical advantages that UTUN research team achieved under WP2 and WP3, to researchers, SMEs, and the public at regional, national and international level. Activities in this WP4 included the following.

i) preparation of two leaflets, one on the overall project and one on the use of microarrays. (Annexes 10 and 12)
ii) establishment of the project website. (Annex 3)
iii) organization of 3 workshops. (Annex 13)
iv) organization of 4 seminars. (Annex 8)
v) organization of 3 open days. (Annex 9)
vi) organization of a final international scientific conference. (Annex 14)

Project website: A first version project website (www.biodesert.unimi.it) was realized on month 6 as planned on the DoW (Annex 3). The website was updated regularly and on month 15 the design was changed and the overall graphics restyled. A restricted area, for the access of project partners only, was established. The website is designed to target both scientific and general public. It comprises different sections in which:

i) The overall project BIODESERT is presented (Home, Overview).
ii) The different work packages are illustrated (Work Packages).
iii) The main scientific topics related to the project are explained (Scientific Area).

iv) A dissemination section divided between the scientific part (Publications) and a more general one targeting a general public (Dissemination).
v) A newsletter, regularly updated, announcing major scientific events related to BIODESERT topics and research (Home, Newsletter).
vi) A general presentation of the three partners participating to the project (Team).
vii) The different laboratories collaborating in research topics related to BIODESERT (Collaborators).
viii) The contact details of the permanent staff working on the project BIODESERT (Contacts)
ix) A photogallery illustrating main activities of the project (Photogallery).
x) A link to a forum to discuss argument related to BIODESERT (Forum).

Along with these pages, two other pages allowing the exchange of information and data to be restricted among the partners were included. These pages are also helpful for monitoring the different aspects of the project from a management perspective. The two pages included in the restricted area deal with:

xi) A page resuming the different activities related to the project but not listed as specific deliverables, but being part of deliverables or in all cases significant project outputs (Activities).
xii) A page containing the different files and data directly related to the deliverables planned in the project (Deliverables).
xiii) A page where the different planned dissemination activities were publicized
xiv) A part of the website was later dedicated to the final conference announcement and registrations

Besides these pages in the Biodesert website, a webpage or section was implemented for the BIODESERT International Conference where all the details of the conference were provided including the following: general conference information, conference topics, scientific programme, scientific and organizing committees, registration procedures, accommodation opportunities, and abstract submission.

Leaflets: A 1st leaflet (Annnex 10) in which the project BIODESERT is presented, was prepared at month 15 and made available to the public on the project web site. This leaflet was written in English, French and Arabic to be easily accessible to the Tunisian, North African and European public. This leaflet in all the three language versions was uploaded in the free access section of the website and is free to download.
The second leaflet (Annnex 12), introducing the principle of microarrays, was also prepared at month 19. This leaflet was also made free and distributed during the relative workshop.

Seminars: A series of 4 seminars (Annex 8) illustrating the concepts behind BIODESERT have been organized at the University of Tunis and at the University of Milan. The following seminars targeting scientific public in Tunisia and in Italy were held at the University of Tunis and at the University of Milan.

i) The first BIODESERT seminar was held in Tunis in November 9th 2010 on “Microbial extremophile and symbiosis”. In this seminar, Philippe Normand and Maria Fernandez (University of Lyon 1, France), Daniele Daffonchio (University of Milan, Italy), Ameur Cherif and Abdellatif Boudabous (University of Tunis El Manar), gave lectures focusing on research studies related to extremophiles and Plant/ Insect symbionts.
ii) The second Seminar of the project BIODESERT (March 3rd 2011) on ”Genomic and molecular biology: Methods and applications” was held at the University of Tunis with

the participation of Dr. Monique Zagorec from INRA Jouy-en-Josas, Paris, France and Dr. Dhafer Laouini from Pasteur Institute of Tunis. A second part of the Seminar was dedicated to practical demonstrations. Darine El Hidri, a PhD student in LMBA and Sfaxi Saoussan, technical, were in charge of the organisation of this second seminar and it's practical part.

iii) The third BIODESERT Seminar was held in Tunis on May 2nd 2011 on **"**New Developments in Microarrays Technology: Recent Applications for Research and Medical Genetics" was animated by Mr. Yann Filaudeau (Product Specialist, Agilent Life Science) that gave an overview of the Latest applications and advances in Agilent Genomics Platform: Bioanalyzer, custom microarrays, array CGH (aCGH), qPCR and target enrichment for next generation sequencing. The organization was followed by Kharbi Nedra, PhD student in LMBA.

iv) The Fourth BIODESERT Seminar was held in 1-2nd June 2011 on "*Identification des champignons saprophytes et extrêmophiles*" at the University of Tunis with the participation of Prof. Sevastianos Roussos from the University Paul Césanne, Marseille, France and Prof. Mohamed Hajlaoui from the INRA of Tunis. A second part of the Seminar was dedicated to practical demonstrations. The conferences and practical session were organized and followed by Gharbi Yosra (PhD) and Chafik Ouiania (Techncian) from LMBA.

Open Days: Three Open days (Annex 9) were held in the laboratory of Partner 2 at the University of Tunis:

i) The first Open day in the ambit of the Biodesert project was entitled "Molecular Immunology and Practical Molecular Methods" and was organised in March 16th 2011 by UTUN in cooperation with the Department of Immunology, Radium Hospital, University of Oslo, Norway. The open day focused on the dissemination of Molecular Immunology and Practical Molecular Methods, to young students of the first year of Master of Microbiology (45 Students) of the Faculty. The visit to the LMBA was organised in the afternoon (14:00 – 18:45) and was animated by the 4 postdocs (Mohamed Neifar, Hanene Cherif, Afef Najjari, and Ahlem Jouini) and the PhD student Darine El Hidri. It was explained the molecular methods used in Bacterial identification beside practical session in which five molecular and enzymatic methods used in LMBA, were demonstrated.

ii) The Second Open day, entitled "Real Time PCR and Genes expression" was organised in June 18th 2011 by UTUN with the collaboration of the Laboratory of Functional Neurophysiology and Pathology, Laboratory of Genetics, Immunology and Molecular Biology, and the Laboratory of Endocrines and metabolic aggressions (UTUN) with the company HTDS-Applied BioSystems. Presentation of three conferences, discussion and visit of laboratories were performed in the presence of 48 professors, young researchers and Master students. The focus of the open day was the real time PCR method applied on the quantification of phytovirus expression in infected plants and the different steps of enzymatic purification and gene sequencing.

iii) The third open day was organized in January, 24th 2012, in the Faculty of Sciences of Tunis (UTUN), and included 4 conferences developed by Monique ZAGOREC, Group of Micalis, INRA, Jouy-en-Josas, France and Sami BEL HADJ, Pasteur Institute of Tunis. The open day focused on "Genomics, Metagenomics, Evolution and Applications". A visit to the laboratory was organized in order to show to the present students the standard work flow in Genomics studies. The open day and the laboratory visit were

prepared by Ahlem Jouini (PostDoc) and Kharbi Nedra (PhD).

Workshops: all of the three workshops were held on the scheduled time with a modification to their order mostly due to the delay in the delivery of the DNA microarray (See also Annex 13).

i) Workshop 1: The first BIODESERT workshop organized by UTUN was held at the 'Hotel du Parc', Tunis, Tunisia from 13 to 15 December 2011. The workshop was entitled "Insect-Microbe Symbiosis". In total 15 invited speakers gave conferences within four topics: (1) Overview of the symbiont diversity in agriculture insect pests and economically useful insects, (2) Type of microbial symbionts and nature of symbiotic relationship, (3) Molecular markers for identifying and exploring biodiversity amongst insect symbionts and (4) Emerging symbiont-based strategies for the control of insects and insect-transmitted diseases. A total of 58 participants' have taken part in the workshop. They were from different countries: Italy (5), France (1), Greece (2), Belgium (1), USA (3), Algeria (10), Morocco (1), Tchad (1) and Tunisia (34). Practical sessions were ensured by postdoctoral researcher (Hanene Cherif) engaged in BIODESERT project with the help of a technician (Saoussan Sfaxi) and other PhD researchers from the LMBA (Amel Guesmi, Chadlia Hamdi, Jihene Essanaa, Imene Fhoula, Khaoula Abdi and Khaled Elmnasri). The activities aiming to study the insect microbial diversity were focused on the use of (i) the culture dependant approaches and (ii) the culture independent approaches mainly: the Denaturing Gradient Gel Electrophoresis (DGGE), the quantitative Real-Time PCR (Q-PCR) and the Fluorescence *in situ* Hybridization (FISH) techniques. Another session was devoted to the phylogenetic analysis using different softwares (MEGA4, Chromas, MacBiophotonics ImageJ and XLStat). The program and details of the 1st workshop are reported in D4.3 (Annex 13).

ii) Workshop 2: The second BIODESERT workshop "Plant-Microbe Symbiosis" was organized by UTUN and held from 17 to 19 March 2012 at the 'Hotel Laico', Hammamet, Tunis, Tunisia and focused on; (1) Plant growth promoting bacteria, (2) Nitrogen fixation and (3) Plant pathogens. This second workshop has been attended by 69 participants including 13 invited speakers from different countries: Austria (2), France (3), Italy (4), UK (2), Algeria (3), Tchad (1) and Tunisia (54). Practical session was ensured by postdoctoral researchers (Hanene Cherif, Besma Ettoumi and Mohamed Neifar) engaged in BIODESERT project with the help of a technician (Chafik Ouiania) and other PhD researcher from the LMBA (Amel Guesmi, Imed Sbissi, Imen Nouioui and Raoudha Ferjani). Several experiments were performed including (i) the use of DGGE and Terminal Fragment Length Polymorphism (T-RFLP) techniques to study plant bacterial community diversity, (ii) the screening of the bacterial plant growth promoting activities and tolerance to abiotic stresses, (iii) Volatile Organic Compounds (VOCs) production by bacteria, and (iv) study of *Arabidopsis thaliana* root colonization by *gfp*-tagged bacteria.

iii) Workshop 3: The third BIODESERT workshop was held at the 'Belvedere Hotel', Tunis, Tunisia from 9 to 11 July 2012 and entitled "Microbial diversity in desert extreme environment - Microarrays from theory to application". A total of 11 conferences were held within three topics: (1) Sand and stone dwelling microorganisms, (2) Microbial diversity in saline and halo-alkaline ecosystems and (3) New "omics" techniques for studying diversity in arid ecosystems. Another talk about the EU funding policy for Research and Innovation titled "Regional dimension of innovation, Outlook for Horizon 2020" was given by the project officer Mr. Grzegorz Ambroziewicz from the European

Commission. The workshop has been attended by 52 seniors, young scientists and PhD researchers from different countries: Netherlands (2), France (3), Italy (3), Spain (1), Greece (1) Algeria (4) and Tunisia (38). Practical sessions were ensured by postdoctoral researcher (Afef Najjarif) engaged in BIODESERT project with the help of a technician (Mounira Salhi) and other PhD students (Amel Guesmi, Khaled El Mnasri and Imen Fhoula). They explained the Gene expression Analysis using NimbleGen Gene expression 385K arrays. Prof. George Tsiamis presented two lectures on "Affymetrix and the PhyloChip microarray" and "Symchip: a custom made microarray"

International Conference: The BIODESERT International Conference organized by UTUN was held in 'Houda Hotel' Hammamet, Tunis, Tunisia, from 16 to 19 December 2012 and was entitled "Microbial resource management for agriculture in arid lands". The conference included 34 invited speakers and oral presentations and 56 posters presentations. Three main sessions were achieved: (1) Insect-Microorganisms Symbiosis, (2) Plant-Microbe interaction and (3) Extreme Ecosystems. There was a large interest on the conference topics with a total 108 participants from 10 different countries. Participants were from Italy (8), France (3), Austria (2), Greece (1), Germany (1), UK (1), Spain (1), Algeria (14), Sudan (1) and Tunisia (76). A secretary Fatma Najai was recruited for the conference preparation in it's financial part. This included contacts with the different suppliers and provider, printing of the conference documents, coordination with air companies for the invited speakers flight tickets and with the hotel administration. Mrs Fatma Najai was also implicated in the administrative preparation of the three workshops. More details of the BIODESERT conference are reported in D4.4 (Annex 14)

Other dissemination activities: These include the participation to scientific workshops and conference as well as the publication of the results related to BIODESERT topics in scientific peer-review journals

Scientific Congresses

1. WIRE: Week of Innovative Regions in Europe. 15th – 17th March 2010, Granada. Spain.
2. Rolli E.. 2010. Biodiversità microbica associata a colture agrarie in suoli aridi. Workshop Siii 2010 "Diversità: opportunità della società e dell'ambiente – Agrodiversità". 19 March 2010, Milano. Italy.
3. Borin S., E. Rolli, R. Marasco, F. Mapelli, V. Ganda, C. Sorlini, D. Daffonchio and D. Rouwet. 2010. Dalla biodiversità microbica risorse utili per l'agricoltura. BIOD. 10-11 June, Milano. Italy.
4. Hamdi C., J. Essanaa , A. Balloi, E. Crotti, N. Barbouch, A. Alma, D. Daffonchio, A. Boudabous, A. Cherif and the BIODESERT consortium. Bacteria associated to honeybee gut for symbiotic control of *Apis mellifera* pathogens. Bio-processing and application of microbial biotechnology in agriculture. 1st-3rd Novenber 2010, Cairo, Egypt.
5. Guesmi A., D. El Hirdi, I. Jaouani, M. Mahjoubi, A. Najjari , N. Raddadi , D. Daffonchio , A. Boudabous A. Cherif and the BIODESERT consortium. Biotechnological potential of spore formers isolated from arid saline systems of Southern Tunisia. Bio-processing and application of microbial biotechnology in agriculture. 1st-3rd Novenber 2010, Cairo, Egypt.
6. Marasco R., Rolli E., Mapelli F., Cherif H., Ouzari I., Tambone F., Adani F., Tamagnini I.,

Borin S., Cherif A., Daffonchio D. 2011. Diversity of the Plant Growth Promoting Microbiome associated to Olea europea growing in arid soils of south Tunisia. CAREX Conference on Life in Extreme Environments. 18-20 October, Dublin. Ireland.

7. Mapelli F., Marasco R., Rolli E., Daffonchio D., Rouwet D., Tassi F., Chiodini G., Borin S. 2011. Unraveling extremophiles diversity of volcanic habitats. CAREX Conference on Life in Extreme Environments. 18-20 October, Dublin. Ireland.
8. Guesmi A., Elhidri D., Essanaa J., Jouini A., Hassen W., Najjari A., Ettoumi B., Rolli E., Marasco R., Mapelli F., Raddadi N., Boudabous A., Daffonchio D., Cherif A., The BIODESERT Consortium. 2011. Halobacillus trueperi as major active microbial component with high biotechnological potential in extreme saline system of Southern Tunisia.1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
9. Rolli E., Marasco R., Vigani G., Dell'orto M., El-Behairy U., Cherif A., Borin S., Zocchi G., Daffonchio D. 2011. Endophytes from desert plants alleviate water stress in pepper. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
10. Marasco R., Rolli E., Mapelli F., Cherif H., Ouzari I., Tambone F., Salati S., Adani F., Borin S., Cherif A., Daffonchio D. 2011. Diversity of the Plant Growth Promoting Microbiome associated to Olea europea growing in arid soils of South Tunisia. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
11. Boujmil R., Accattino E., Chouaia B., Crotti E., Borin S., Pessione E., Normand P., Gtari M., Daffonchio D. 2011. Microbial diversity associated to calcarenetic stones. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
12. Hamdi C., Balloi A., Crotti E., Sansonno L., Essanaa J., Gonella E., Raddadi N., Boudabous A., Borin S., Manino A., Bandi C., Alma A., Daffonchio D., Cherif A. 2011. In vitro and in vivo control of the causal agent of American foulbrood disease Paenibacillus larvae by honeybee symbionts. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
13. Cherif H., Cherif C., Ferjani R., Raddadi N., Daffonchio D., Boudabous A., Ouzari H.-I. 2011. Diversity of root-endophitic bacteria associated to the date palm tree from the south of Tunisia. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
14. Crotti E., Chouaia B., Rizzi A., Mandrioli M., Sacchi L., Sassera D., Ricci I., Gonella E., Favia G., Alma A., Bandi C., Daffonchio D. 2011. Ecological interactions between acetic acid bacterial symbionts and their insect hosts. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
15. Raddadi N., Mapelli F., Ouzari I., Boudabous A., Cherif A., Daffonchio D., Fava F. 2011. Isolation of microorganisms from non-conventional environments and screening of their biotechnological traits. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.
16. Rolli E., Mapelli F., Ciccazzo S., Brusetti L., Shubotz F., Marasco R., Scaglia B., Tambone F., Adani F., Borin S., Daffonchio D. 2011. Primary colonization and soil neo-genesis in deglaciating environments at high and low latitudes. 1st International conference on microbial diversity 2011: Environmental stress and adaptation, MD 2011, 26-28 October 2011, Milan. ITALY.

17. Afef Najjari, Eva Dionysopoulou, Zeineb Ayari, Thouraya Sallami, Abdellatif Boudabbous, Kostas Bourtzis, Ameur Cherif, George Tsiamis Archaeal Community Profile from arid saline systems of Southern Tunisia using cultivation-dependent and a high density DNA microarray. 5th MBK conference, 13-16th December 2012, Athens, Greece.
18. SAIDI Mona, Vangelis Doudoumis, Hadda Ouzari, Kostas Bourtzis, George Tsiamis Characterization of the endosymbiotic community profile in *Cataglyphis* desert ants. 5th MBK conference, 13-16th December 2012, Athens, Greece.

Scientific publications:

1. Marasco R., Rolli E., Ettoumi B., Vigani G., Mapelli F., Borin S., Abou-Hadid A.F., El-Behairy U.A., Sorlini C., Cherif A., Zocchi G. and Daffonchio D. 2012. A drought resistance-promoting microbiome is selected by root system under desert farming. PLoS One. 7:e48479. doi: 10.1371/journal.pone.0048479.
2. Jaouani A., Neifar M., Hamza A., Chaabouni S., Martinez M.J., and Gtari M. 2012.Purification and characterization of a highly thermostable esterase from the actinobacterium Geodermatophilus obscurus strain G20. J Basic Microbiol. doi: 10.1002/jobm.201100428.
3. Normand P., Gury J., Pujic P., Chouaia B., Crotti E., Brusetti L., Daffonchio D., Vacherie B., Barbe V., Médigue C., Calteau A., Ghodhbane-Gtari F., Essoussi I., Nouioui I., Abbassi-Ghozzi I. and Gtari M. 2012. Genome sequence of radiation-resistant Modestobacter marinus strain BC501, a representative actinobacterium that thrives on calcareous stone surfaces. J. Bacteriol. 194:4773-4774.
4. Chouaia B., Crotti E., Brusetti L., Daffonchio D., Essoussi I., Nouioui I., Sbissi I., Ghodhbane-Gtari F., Gtari M., Vacherie B., Barbe V., Médigue C., Gury J., Pujic P. and Normand P. 2012. Genome sequence of Blastococcus saxobsidens DD2, a stone-inhabiting bacterium. J. Bacteriol. 194:2752-2753.
5. Gtari M., Essoussi I., Maaoui R., Sghaier H., Boujmil R., Gury J., Pujic P., Brusetti L., Chouaia B., Crotti E., Daffonchio D., Boudabous A. and Normand P. 2012. Contrasted resistance of stone-dwelling Geodermatophilaceae species to stresses known to give rise to reactive oxygen species. FEMS Microbiol Ecol. doi: 10.1111/j.1574-6941.2012.01320.x.
6. Essoussi I., Boujmil R., Nouioui I., Abbassi-Ghozzi I., Hamza A., Boudabous A. and Gtari M. 2011. Genetic diversity and Esterase-Profiling of Actinobacteria isolated from Sahara desert stones and monuments. Geomicrobiology Journal, 29:23–28.
7. Crotti E., Balloi A., Hamdi C., Sansonno L., Marzorati M., Gonella E., Favia G., Cherif A., Bandi C., Alma A. and Daffonchio D. 2011. Microbial symbionts: a resource for the management of insect-related problems. Microb. Biotechnol. doi: 10.1111/j.1751-7915.2011.00312.x.
8. Gonella E., Crotti E., Rizzi A., Mandrioli M., Favia G., Daffonchio D. and Alma A. 2012. Horizontal transmission of the symbiotic bacterium *Asaia* sp. in the leafhopper *Scaphoideus titanus* Ball (Hemiptera: Cicadellidae). BMC Microbiol. 12 Suppl 1:S4.
9. Chouaia B., Rossi P., Epis S., Mosca M., Ricci I., Damiani C., Ulissi U., Crotti E., Daffonchio D., Bandi C. and Favia G. 2012. Delayed larval development in *Anopheles* mosquitoes deprived of *Asaia* bacterial symbionts. BMC Microbiol. 12 Suppl 1:S2.
10. Hamdi C., Balloi A., Essanaa J., Crotti E., Gonella E., Raddadi N., Ricci I., Boudabous A., Borin S., Manino A., Bandi C., Alma A., Daffonchio D. and Cherif A. 2011. Gut microbiome dysbiosis and honeybee health. J. Appl. Entomol. 135:524-533

11. Ricci I., Damiani C., Scuppa P., Mosca M., Crotti E., Rossi P., Rizzi A., Capone A., Gonella E., Ballarini P., Chouaia B., Sagnon N'F., Esposito F., Alma A., Mandrioli M., Sacchi L., Bandi C., Daffonchio D. and Favia G. 2011. The yeast *Wickerhamomyces anomalus* (*Pichia anomala*) inhabits the midgut and reproductive system of the Asian malaria vector *Anopheles stephensi*. Environ. Microbiol. 13:911-921
12. Gonella E., Negri I., Marzorati M., Mandrioli M., Sacchi L., Pajoro M., Crotti E., Rizzi A., Clementi E., Tedeschi R., Bandi C., Alma A. and Daffonchio D. 2011. Bacterial endosymbiont localization in *Hyalesthes obsoletus*, the insect vector of Bois Noir in *Vitis vinifera*. Appl. Environ. Microbiol. 77:1423–1435.
13. Mapelli F., Marasco R., Balloi A., Rolli E., Cappitelli F., Daffonchio D. and Borin S. 2012. Mineral–microbe interactions: biotechnological potential of bioweathering. J. of Biotec. 157:473-481
14. Sbissi I., Ghodhbane-Gtari F., Neffati M., Hadda Ouzari I., Boudabous A. and Gtari M. 2011. Diversity of the desert truffle *Terfezia boudieri* Chatin. in southern Tunisia. Can. J. Microbiol. 57:599-605.
15. Sbissi I., Neffati M., Boudabous A., Murat C. and Gtari M. 2010. Phylogenetic affiliation of the desert truffles *Picoa juniperi* and *Picoa lefebvrei*. Antonie van Leeuwenhoek. 98:429-436.
16. Ghodhbane-Gtari F., Nouioui I., Chair M., Boudabous A. and Gtari M. 2010. 16S–23S rRNA Intergenic Spacer Region Variability in the Genus *Frankia*. Microb. Ecol. 60:487-495.
17. Crotti E., Rizzi A., Chouaia B., Ricci I., Favia G., Alma A., Sacchi L., Bourtzis K., Mandrioli M., Cherif A., Bandi C. and Daffonchio D. 2010. Acetic Acid Bacteria, newly emerging symbionts of insects. Appl. Environ. Microbiol. 76:6963–6970.

General press targeting a wide public:

1. WIRE: Week of Innovative Regions in Europe. Granada, Spain. 15th – 17th March 2010.
2. Unlocking the desert's potential. 2010. International Innovation. October 2010. p:56-58.

1.1.5. Address of the project public website, project logo and list of beneficiaries

The address of the BIODESERT website is http://www.biodesert.unimi.it