



# Final report

Group Training Course

Cactus Pear Evaluation & Best-Agronomic Practices

13-19 July 2019

*Prepared by:* Mounir Louhaichi and Sawsan Hassan (ICARDA – Jordan)



Training Report



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## About ICARDA

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is a non-profit, CGIAR Research Center that focusses on delivering innovative solutions for sustainable agricultural development in the non-tropical dry areas of the developing world.

We provide innovative, science-based solutions to improve the livelihoods and resilience of resource-poor smallholder farmers. We do this through strategic partnerships, linking research to development, and capacity development, and by taking into account gender equality and the role of youth in transforming the non-tropical dry areas.

### *Address*

Dalia Building, Second Floor, Bashir El Kasser St, Verdun,

Beirut, Lebanon 1108-2010.

[www.icarda.org](http://www.icarda.org)

## Acknowledgments

The authors would like to acknowledge the financial support received from the CGIAR Research Program on Livestock (CRP Livestock, feed and forage flagship), the Arab Fund for Economic and Social Development (AFSED), the Spineless Cactus in Hilly/Degraded Lands, and Grasspea in Winter Crop Fallows for Fodder, Food & Nutrition Security in Tribal Areas of Odisha project (India), Promoting cactus (*Opuntia ficus-indica*) as drought resilient feed resource under different agro-ecological production systems across India project (India), the University of Palermo (Italy), the FAO-ICARDA International Technical Cooperation Network on Cactus and the National Agricultural Research Center (NARC) in Jordan. Finally, many thanks go to the ICARDA Capacity Development Unit (CDU) for their financial and logistic support which were highly appreciated.



المركز الوطني للبحوث الزراعية  
National Agricultural Research Center

## Introduction

Climate change is one of the biggest challenges facing the world today and into the future. Prolonged droughts and desertification are among the issues threatening many countries, especially in Africa and Asia, where the rural poor and smallholders are most negatively affected. If small farmers are to survive in these ever-harsher conditions, their crops need to withstand drought, high temperatures, and poor soils.

Cactus crops are the focus of increasing interest across the globe, in particular the cactus pear (*Opuntia ficus-indica*), because of their unique characteristics, which provide resilience to such harsh conditions. Cactus pear is able to grow on land where no other crops will grow and it can be used to restore degraded land in many countries. Cactus pear is a member of the Cactaceae family, which has more than 1,500 known species worldwide. Its use of crassulacean acid metabolism (CAM) enables it to achieve incomparable water utilization efficiencies and to convert water to biomass four times more efficiently than either C<sub>3</sub> or C<sub>4</sub> plants.

In addition to being a highly drought tolerant, very productive fruit crop, it has multiple other uses. For example, it can be used to make soap, dyes, adhesives, and glue; it can be used in cosmetics such as shampoo, cream, hair and skin care products, and body lotions; and it also has medicinal properties.

Cactus pear plants have developed phenological, physiological, and structural adaptations to arid areas characterized by drought, erratic rainfall, and poor soils. This species is easy to establish, is adaptable to a wide range of soil and climatic conditions, and can contribute to sustainable food production, especially in countries with large arid and semi-arid lands. The cultivation of cactus pear requires little input and will increase the efficiency and economic viability of small and medium-sized farms of low-income farmers. Therefore, cactus pear is a plant of increasing importance in agricultural systems as a fruit, forage, and fodder provider, particularly in subsistence agriculture where it has a comparative advantage for its capacity to grow with minimal agronomic inputs and for its resistance to drought.

Within the collaboration program between the National Agricultural Research Center (NARC) and the International Center for Agricultural Research in the Dry Areas (ICARDA), a cactus germplasm bank has been established at the Mushaqqar research station in

Jordan. More than 100 cactus pear accessions have been introduced from different countries including Italy, Brazil, USA, Argentina, Tunisia, Morocco, and Mexico. These accessions have different genetic and morphologic characteristics in terms of productivity, tolerance to cold/frost, and shape and color of fruits, etc.

The main reasons for establishing this field genebank are to evaluate the suitability of various cactus accessions for the conditions of West Asia; to use the site as a training venue; and to increase awareness among partners of the importance of cactus pear and how it should be cultivated.

## **Objectives**

This course aimed to develop and improve the capabilities of participants in cactus pear evaluation and agronomic best practice through:

- providing participants with information about cactus pear requirements;
- demonstrating best agronomic practices for cactus;
- teaching participants how to evaluate and describe the different cactus accessions;
- sharing experiences related to cactus cultivation and use in different countries; and
- increasing awareness of cactus diseases (cochineal).

## **Course topics**

The training course was designed to include scientific information about the importance of cactus pear and its characterization, cultivation, and use. The course included theoretical (lectures) and practical aspects on:

- cactus pear reproductive biology;
- principles of cactus evaluation and data collection;
- best agronomic practices for cactus pear fodder production;
- best agronomic practices for establishing cactus orchards (fruit production); and
- fruit production and post-harvest management.



## Course implementation

The five-day training course was held at the Ayass Hotel in Amman, Jordan, from 14–18 July 2019. The course was delivered by Dr. Mounir Louhaichi and Dr. Sawsan Hassan of the Rangeland and Forage Research Team, Resilient Agricultural Livelihood Systems Program, ICARDA, Jordan; Mr. Abderrahmane Ait Hamou, an agricultural engineer from Morocco; and Dr. Giorgia Liguori from the University of Palermo, Italy.

## Participants

Twenty-four participants attended: nine trainees from India, 11 from Jordan, one from Iraq, one from Palestine, one from Yemen, and one from Tunisia. They represented the following research institutes, universities, and NGOs:

- Indian Grassland and Fodder Research Institute, Jhansi, India;
- Central Arid Zone Research Institute, Regional Research Station, Kukma-Bhuj, Gujarat, India;
- BAIF Development Research Foundation in India, Urulikanchan, Pune, India;
- Odisha University of Agriculture & Technology (OUAT), Bhubaneswar, Odisha, India;
- Department of Soil Conservation and Watershed Development, Bhubaneswar, Odisha, India;
- Agricultural Research Office, Baghdad, Iraq;
- National Agricultural Research Center, Palestine;
- National Agricultural Research Center, Jordan;
- Jordan University of Science and Technology, Jordan; and
- King Saud University, Riyadh, Saudi Arabia.

## Activities of the training course

### *Welcoming remarks and participants' introductions*

Dr. Nizar Haddad, Director General of the National Agricultural Research Center (NARC) in Jordan, and Dr. Mounir Louhaichi, Principle Scientist, Country Liaison for Jordan, ICARDA, welcomed the participants. They emphasized the purpose of the training course—developing the capacity of the participants—as well as the importance of interaction between participants to share information and knowledge.

Dr. Haddad highlighted the significance of cactus crops as a tool to help alleviate the challenges of water scarcity and the impacts of climate change in Jordan and other countries. He told participants that the training course aimed to promote approaches to coping with environmental challenges, including the introduction of non-traditional crops such as cactus, which both withstand climate and environmental challenges, and have economic value. He explained that the training was the result of the fruitful and successful collaboration program between the NARC in Jordan and ICARDA under which more than 100 accessions of cactus pear had been collected from different countries and planted in the Mushaqqar research station in Jordan.

Dr. Louhaichi emphasized the value of cactus as a multipurpose crop, noting that it can be considered as a food source from which secondary products can be extracted. In addition to being a vitamin-rich source of antioxidants, cactus is also a very important source of animal feed. The high-water content in cactus cladodes helps to reduce water consumption by animals; more importantly it enhances milk and meat production, which, in turn, increases livestock keepers' income. Dr. Louhaichi explained that the course would take a scientific approach to evaluating the productivity and performance of the cactus crop and to demonstrating the most important agricultural practices in obtaining optimum productivity from cactus. The course topics would include lectures on the environmental requirements of cactus, agricultural treatments, and methods of evaluating and characterizing different cactus varieties according to the purpose for which they were grown.

Both Dr. Haddad and Dr. Louhaichi wished the participants success in their training and expressed the hope that it would meet the objectives they had set out.

The participants then introduced themselves, giving their names and brief information about their backgrounds. They were asked to complete registration forms and to answer questions in a pre-training test.



Figure 1: Welcoming remarks and participants' introductions

### *Day 1 presentations*

Dr. Louhaichi began the presentation sessions by highlighting ICARDA's experience in cactus pear research. He described the importance of cactus as a drought-tolerant, multiple-use crop, which fits exactly with ICARDA's mission to serve and enhance livelihood resilience, especially in dry areas. He explained that the research had started many years ago with the establishment of cactus germplasm at ICARDA's headquarters in Aleppo, Syria. After the Syrian crisis, ICARDA had to start again and new germplasm was established in Mushaqqar, Jordan. Another work program was being established in India, where ICARDA, in collaboration with ICARDA-FAO CactusNet, had held an international workshop in New Delhi to draw up a road map and initiate cactus research in India. Dr. Louhaichi emphasized the importance of NARC as a vital partner in ensuring the success of any technology. He expressed his appreciation for international partners, particularly ICARDA-FAO CactusNet (<http://www.cactusnetwork.org>), which had created a platform where experts and interested parties across the world could come together and share their experiences, achievements, and questions. He gave a brief overview of the activities and members of ICARDA-FAO CactusNet, saying that one of its key achievements was a biennial international cactus congress. He also promoted the upcoming cactus pear congress that will be held in Tunisia in 2020, and encouraged all participants to submit their abstracts before the deadline.



Figure 2: ICARDA cactus pear research and development presented by Dr. Mounir Louhaichi

In his presentation, Mr. Ait Hamou focused on the importance of cactus and its multiple uses. He helped participants understand the anatomical and physiological characteristics of cactus that allow it to develop in hostile environments while providing useful products. He described the environmental challenges and constraints in dry lands before discussing the advantages of cactus as a CAM plant with a high-water use efficiency (WUE). He went on to list the many uses of cactus in human nutrition, animal feeding, cosmetics, medicine, etc., as well as its use for the purposes of soil and water preservation, biodiversity enhancement, clean energy provision—and in art. Examples of different fresh and processed products were well illustrated with photos and diagrams. He concluded by emphasizing the need to undertake further research on aspects that could improve the production and benefits achieved from this wonderful plant.

In the third presentation, Dr. Hassan explained the importance of cactus as a feed resource, especially in the dry areas, and the benefits of expanding cactus cultivation. She presented comparisons of the yield and WUE of cactus and other crops, and also discussed how to integrate cactus planting with different farming systems. She described how to use cactus to feed different kinds of animals, and what factors affect the quality of cactus as a feed resource. She concluded her presentation with some key rules that should be considered when using cactus to feed animals.

Dr. Liguori considered best agronomic practices for establishing cactus orchards for fruit production. Her lecture was focused on cactus pear orchard management, from planting to harvesting. In particular, the trainees were given information about cultivar selection, differentiation of cultivars by the color of the peel and ripe flesh (white, yellow, and red varieties); soil pre-planting operations; management of the cladodes before planting; planting time; planting method using single or multiple cladodes; planting density and orchard design; plant training and pruning; fruit thinning; and harvesting methods.

After a lunch break, Dr. Hassan explained the importance and effectiveness of different agronomic practices in achieving quality fodder production from cactus pear. The following points were explained: cactus ecological adaptation; environmental variables for cactus pear; orchard management for forage production in terms of planting methods, spacing, timing, fertilization, irrigation, orientation, and harvesting; nutrients in cactus



cladodes; nutrients in cactus fruits; and methods for utilizing cactus as a fodder crop. She gave an example from Brazil of planting cactus in intensive production systems and concluded her presentation with some recommendations.

In the last lecture of the first day, Dr. Liguori highlighted aspects of cactus pear physiology and reproductive biology. She presented information about CAM in the cactus pear, and commented that the ecological success of opuntias, specifically *O. ficus-indica*, is due largely to their unusual pattern of carbon uptake and water loss, both of which occur mostly at night. She described factors that may affect plant physiology, such as temperature and light interception, before concluding with an explanation of the re-flowering potential of cactus pear and the plant management methods used to get out-of-season fruits.



Figure 3: Presentations on the first day

## *Day 2 presentations*

The second day of presentations began with a lecture from Dr. Liguori about ensuring fruit quality and postharvest management. She described physiological aspects related to fruit quality and productivity as well as methods used to reduce fruit loss after harvest and to improve storage shelf life, including cooling, storage in controlled and modified atmospheres, heat treatments, and packaging.

Dr. Hassan delivered the next presentation, explaining in detail the principles of cactus evaluation, and methods of data collection to determine the production and performance of cactus crops. She outlined criteria to follow when describing cactus cladodes, flowers, fruit, plant shape, performance, and growth, and told participants that they would have the opportunity to practice these skills during practical sessions over the following two days.

The second half of the day was assigned to sharing knowledge through case studies from different countries.

The first case study discussed was the Odisha state cactus project, which had been implemented by the Directorate of Soil Conservation and Watershed Development, Government of Odisha, India, and ICARDA. Dr. Hemanta Kumar Panda presented an overview of the project entitled: “Spineless Cactus in Hilly/Degraded Lands and Grasspea in Tribal Areas of Odisha”, explaining that it had the following objectives:

- Productive use of hilly, degraded wastelands, and winter crop fallows; and
- Livelihood enhancement through the production of spineless cactus and grasspea.

He told participants that the project involved 46 foundation nurseries in 10 districts where 35 elite spineless cactus accessions had been planted in approximately 30 areas of land. He described the meetings that had been held during the implementation period, noting that, overall, the perceptions of farmers and policy makers in Odisha had been very positive and all were looking forward to more cactus plantations.

One major component within the activities of the Odisha project is the evaluation of feeding cactus to ruminants as a sustainable means of production. Dr. Niranjan Panda described a trial assessing the effect of integrating cactus into feed rations for goats, which is looking at the impact on bodyweight, weight change, and milk yield and

composition (butter fat percentage). The trial had begun one month ago and the final results would be available in the coming two months and would be shared with farmers to ensure the most appropriate use of cactus in goat feed rations.



Figure 4: Odisha project overview presented by Drs. H. K. Panda and N. Panda

The second case study was presented by Mr. Ait Hamou, who shared the experience of Morocco. He started his presentation with general information about agriculture in Morocco and the distribution of cactus plantations. In Morocco, more than 15 species of *Opuntia* are cultivated; this diversity allows year-round production, bringing benefits in terms of productivity. He described the integration of cactus planting into different farming systems in Morocco and discussed the variety of products resulting from cactus production and the role of these products in enhancing the livelihoods of women. He highlighted the different stakeholders in cactus production, processing, and marketing, and the various activities related to cactus production in Morocco. He finished his presentation by giving insights into the cost-benefit and economic values of fruit production in Morocco and how to increase the profits of cactus plantations.



Figure 5: Mr. Ait Hamou presented the Morocco experience with cactus pear



Dr. Sunil Kumar presented details of the cactus research being conducted at the Indian Grassland and Fodder Research Institute (IGFRI). These include cactus survival and growth evaluation; cactus multiplication; cactus integration with different cropping systems; cactus-based feeding trials; and evaluation of the quality of cactus accessions for fodder use. He summarized the benefits arising from planting cactus and indicated the importance of raising awareness of these benefits among different stakeholders. In this regard, the IGFRI team is placing great emphasis on arranging field days and meetings for farmers and Dr. Kumar described some of these events in his presentation.

Dr. Dana Ram Palsaniya presented a case study on the growth, production, and economic benefits achieved 1.5 years after planting cactus. In this study, the cactus had been intercropped with hot peppers in 600 m<sup>2</sup> of land and was used to feed animals; a net profit of 11,949 rupees (169 USD) was realized. Dr. Kumar then described the benefits of cactus cladode sales and cactus-based feeding to cattle. He explained how a farmer, Shri Dasrath Singh Yadav (Village Garera, District Datia), had planted 220 cactus plants in a 600 m<sup>2</sup> area of boundary and waste land. After three years he started to use cactus cladodes to feed his eight buffalo and two cows and began to sell the cladodes to other farmers at 10 rupees/cladode. He had achieved a net profit of 4470 rupees from his cactus plantation.



Figure 6: Drs. Sunil and Palsaniya presented the cactus research at the Indian Grassland and Fodder Research Institute (IGFRI) and cactus use and growth in Jhansi District, India

The last case study was presented by Dr. Vitthal Keshav Kauthale, who began by giving general information about the mission and activities of the BAIF Development Research Foundation. He then discussed the cactus accessions available in BAIF and explained that the foundation's work on cactus was based in two areas: research and development, and promotion of cactus cultivation. The research components mainly focused on germplasm collection and evaluation; development of a cactus arboretum; nursery technique standardization; agronomic trials of production technology; adaptability and multiplication trials in arid and semi-arid regions; cactus feeding trials in small ruminants; and assessment of the financial viability of cactus production and nursery development. He detailed the number of villages and farmers adopting cactus plantation and utilization before indicating the challenges facing, and the proposed approach to promoting, cactus adoption.



Figure 7: The mission and activities of the BAIF Development Research Foundation presented by Dr. Vitthal Keshav Kauthale (India)

### *Practical sessions, days 3 and 4*

The practical sessions took place over two days and consisted of fieldwork practice at the Mushaqqar research station where ICARDA's cactus germplasm collection has been established. To begin with, the participants were asked to tour the cactus germplasm collection and inspect the available accessions, observe the differences between them, and record notes about the germplasm. Dr. Mounir then gave an overview of the available accessions, their dates of planting, origins, and the differences between them in terms of use and variation in fruit color and maturity stage.

Dr. Hassan demonstrated the principles of cactus description and measurement before the participants were split into four groups to practice these skills; each group included one of the trainers, who supervised the data collection. The participants were required to measure and describe different cactus plants.

In a second practical session, Dr. Liguori demonstrated techniques for cactus pruning. Each group practiced pruning, with their efforts evaluated by the trainers and the trainees themselves. Dr. Liguori then demonstrated how to thin fruit, and the groups practiced this on different plants. The final practical session was dedicated to cactus planting methods, which were explained by Dr. Louhaichi and Dr. Hassan before all the groups had an opportunity to practice them.



Figure 8: Group photos at Mushaqqar research station (Madaba, Jordan)





Figure 9: Demonstration of cactus plant measurements



Figure 10: Trainees are counting the number of cladodes per plant and areoles per cladode





Figurer 11. Cactus pear pruning (pads) and fruit thinning practices



Figure 12: Cactus planting methods



### *Day 5 presentations*

The final day started with a lecture from Mr. Ait Hamou about the impact of the scale insect pest cochineal (*Dactylopius opuntiae*) on cactus production in Morocco. He clarified the differences between *D. opuntiae* and *Dactylopius coccus*, the life cycle of the insect, abiotic factors favoring the dynamics of *D. opuntiae*, how the cochineal is transported from one place to another and how it spreads between countries, and the impact of cochineal infection on cactus plantations and farmers in Morocco. He concluded his presentation by describing methods of insect control, emphasizing the importance of raising awareness in order to recognize and control the insect as quickly as possible.

The second presentation was delivered by Dr. Louhaichi, who discussed a case study of the use of cactus to rehabilitate rangelands in semi-arid regions of Tunisia. He highlighted the importance of Tunisia's national strategy for afforestation, soil, and water conservation, and described how desertification had been combatted in private rangelands through improvement using intensive spineless cactus plantations. The soil preparation and cactus planting had been done by farmers, and cactus pads and technical guidance had been provided by the Office de l'élevage et des pâturages (OEP). To manage the process, a signed agreement between farmers and the OEP defined the role of each party. He presented the achievements, procedures, and results of this intervention, before concluding with the constraints and the lessons learned from it: the overall take home message was, he said, "If there is a [political] will, there is a way".

Following the lectures, the participants were asked to complete a post-training test and final course evaluation. Dr. Haddad and Dr. Louhaichi then jointly chaired a general discussion session. Dr. Haddad began this session by saying that the training event could be considered a result of the true partnership between the NARC and ICARDA. He emphasized the importance of such training in enhancing the capacity of research staff. In turn, Dr. Louhaichi thanked the NARC for its support and in particular the Director General and all the staff at the Mushaqqar station where the practical training had taken place. He appreciated the comments from all the participants who were eager to learn and had collaborated effectively in all activities and discussion. Dr. Louhaichi also thanked the Odisha Government for its support and for funding the cactus project there. Dr. Hemanta Kumar Panda thanked ICARDA, NARC and all those who had helped with the

training, allowing the participants to get more information to help them practice their skills on the ground while implementing the cactus project in Odisha. Dr. Kumar expressed his gratefulness for the opportunity to attend the training and highlighted the importance of the information received in enhancing cactus research in India. Mr. Basharat from Palestine thanked ICARDA and NARC for the successful training, and said he would use the information he had received to implement it in Palestine. Mr. Ait Hamou said he had enjoyed being part of the training. Dr. Kauthale appreciated the training and expressed the BIAF Foundation's interest in establishing an active collaboration with ICARDA. Mr. Panda thanked all the team for their hard work and the successful training. After this the participants were awarded their certificates.



Figure 13: Awards and closing ceremony

## Training evaluation

### General course evaluation by trainees

General course evaluation showed a high level of satisfaction among the participants. Content and delivery were rated 4.4 out of 5 on average, as were timing and schedule. Teaching and the use of learning aids were rated around 4.3 out of 5, and logistics and transportation were rated between 3.5 and 4.5 out of 5. Participants suggested extending the length of the course and including lectures on more advanced topics, such as the economics of the cactus value chain, the handling of cactus diseases, and effects on animal health and meat quality. More field trips and case studies were also suggested, although case studies were presented as part of the training. Other suggestions included increasing international participation and conducting the training in other countries where cactus is more. All the trainees said they would recommend the course to others. A more detailed evaluation can be found below.

#### 1. Content

Item/rating/percentage	Overall average
The training course is relevant to my job	4.36
The subject matter of the training was understandable	4.48
The objectives of the course were clearly communicated	4.64
The level of the lectures was appropriate	4.56
The time allocated for discussions was appropriate	4.52
The opportunities for interaction with participants enrolled in the course were appropriate	4.44
Overall, how would you rate this course?	4.64



## *2. Schedule and time allocation*

<b>Item/rating/percentage</b>	<b>Overall average</b>
The time allocated to lectures was appropriate	4.52
The lectures were useful	4.76
The time allocated to the technical field/lab visits was appropriate	4.48
The technical field/lab visits were useful	4.76

## *3. Teaching and/or learning aids*

<b>Item/rating/percentage</b>	<b>Overall average</b>
The use of teaching aids was effective	4.32
The teaching materials and presentations were clear	4.48
The handouts and additional material provided were useful	4.28

## *4. Administrative arrangements*

<b>Item/rating/percentage</b>	<b>Overall average</b>
Pre-course communication	4.52
Travel arrangements	4.00
Quality of the accommodation	3.56
Payment of allowance on time	3.16
Transportation	3.88
Comfort and suitability of the lecture rooms	3.80

### 5. Evaluation of the instructors

In general, the participants were satisfied with the level of the lectures, with all rated more than 4 out of 5, as detailed below.

<b>Title of presentation</b>	<b>The trainers had command over the subject</b>	<b>The trainers managed to keep me interested throughout the training</b>	<b>The trainers were open to ideas and suggestion of trainees</b>	<b>The trainers managed their time effectively</b>	<b>The clarity of speech was evident</b>
ICARDA experience with cactus pear.	4.6	4.5	4.7	4.7	4.7
Use of cactus for livestock feeding.	4.5	4.4	4.8	4.8	4.6
Cactus pear importance and multiple use.	4.5	4.4	4.4	4.5	4.1
Impact of cochineal ( <i>Dactylopius opuntiae</i> ) insect pest on cactus production (case of Morocco).	4.5	4.4	4.4	4.4	4.3
Use of cactus for livestock feeding.	4.5	4.5	4.7	4.8	4.7
Cactus pear agronomic practice for fodder production.	4.6	4.6	4.6	4.7	4.6
Principles of cactus evaluation, and data	4.6	4.6	4.6	4.7	4.6

collection (using descriptor).					
Data processing and presentation.	4.4	4.6	4.6	4.6	4.6
Best agronomic practices for establishing cactus orchard (fruit production).	4.9	4.8	4.8	4.8	4.8
Reproductive biology of cactus.	4.8	4.7	4.8	4.8	4.8
Fruit production and post-harvest management.	4.9	4.8	4.8	4.9	4.8
Principles of cactus evaluation, and data collection (using descriptor).	4.8	4.6	4.7	4.7	4.8

### Group assessment

There was a 19% improvement in the participants' results in the final assessment compared with the pre-training assessment, indicating that the course had a substantial impact on the participants' comprehension of new practices relating to cactus cultivation. The average correct score in the pre-training assessment was 64% compared with 83% after the training course, and more than 50% of participants showed a considerable increase in their understanding following this training course.

#	Country	Name	Pre-training	Post-training	Variance
			Score out of 17		
1	Tunisia	Mouldi Gamoun	8	12	4
2	Iraq	Ruba Al Ameen	13	14	1
3	Palestine	Mahmoud Basharat	8	15	7
4	India	Sunil Kumar	12	15	3
5	India	Dana Ram Palsaniya	13	16	3
6	India	Rahul Dev	13	15	2
7	India	Hemanta Kumar Panda	15	15	0
8	India	S. N. Singh	11	12	1
9	India	Aparti Sethi	11	16	5
10	India	Niranjan Panda	10	16	6
11	India	Vitthal Kauthale	10	15	5
12	India	Rajakishora Swain	12	17	5
13	Yemen	Abdul Malek Mahram	11	12	1
14	Jordan	Awad Al Kaabnh	7	12	5
15	Jordan	Nizar Obeidat	14	16	2
16	Jordan	Hanadi Zayadeen	9	15	6
17	Jordan	Ahmad Aledwan	5	12	7
18	Jordan	Badr Alomari	13	16	3
19	Jordan	Ahmad Bdour	12	16	4
20	Jordan	Abdallah Aldhadha	12	15	3
21	Jordan	Yousef Alghwanmeh	9	13	4
22	Jordan	Heba Ibrahim Hasan	13	15	2
23	Jordan	Majdi Abed Abu Ishmais	8	15	7
24	Jordan	Rawad Wasfi Swidan	13	14	1
Average			11	15	4

## Course agenda

## Group Training Course on *Cactus Pear Evaluation & Best-Agronomic Practices* 13-19 July 2019 – Hotel Ayass, Amman - Jordan Draft Program



**Rational:** Cactus crops are gaining increasing interest across the globe, in particular cactus pear (*Opuntia ficus indica*), because of its unique characteristics which provide resilience to climate change impact and population pressure. Cactus pear can grow on land where no other crops are able to grow; it can be used to restore degraded land. In addition to its resilience as a crop, cactus pear is also increasingly appreciated for its multiple purposes. The fruit and young cladodes can be consumed by humans, and there is growing interest in its use as fodder. In collaboration with NARC, ICARDA has established a cactus germplasm at Mushaqqar station. The purposes of the field genebank are to evaluate various cactus accessions to the conditions of West Asia, use site as a training venue and increase awareness of partners about importance of cactus pear and how it should be cultivated (best agronomic practices).

### Objectives:

- Provide participant information about the cactus pear requirements
- Demonstrate cactus best agronomic practices
- Learn how to evaluate and describe the different cactus accessions
- Share experiences related to cactus cultivation and use in different countries
- Increase awareness about insect pests of cactus pear (cochineal)

**The Course topic:** The training course is designed to include scientific information about cactus importance, characterization, cultivation, and use. The course includes theoretical (lectures) and practical aspects on:

- Cactus pear reproductive biology
- Principles of cactus evaluation, and data collection
- Cactus pear best-agronomic practices for fodder production
- Use of cactus for livestock feeding
- Best agronomic practices for establishing cactus orchard (fruit production)
- Fruit production and post-harvest management

### Trainers:






- Dr. Mounir LOUHAICHI (ICARDA – Jordan)
- Dr. Giorgia LIGUORI (Palermo University – Italy)
- Dr. Sawsan HASSAN (ICARDA – Jordan)
- Eng. Abderrahmane AITHAMOU (Consultant - Morocco)

## Group Training Course on *Cactus Pear Evaluation & Best-Agronomic Practices* 13-19 July 2019 – Hotel Ayass, Amman - Jordan

### Saturday: 13 July 2019

Arrival of Participants

### Sunday: 14 July 2019 (Lectures) – Hotel Ayass

08:30 – 09:00	Registration Opening note and course outline	NARC ICARDA Participants		
09:00 – 09:45	ICARDA experience with cactus pear	Mounir Louhaichi		
09:45 – 10:30	Cactus pear importance and multiple use	Abderrahmane Aithamou		
10:30 – 11:00	Coffee break			
11:00 – 11:30	Use of cactus for livestock feeding	Sawsan Hassan Mounir Louhaichi		
11:30 – 13:00	Best agronomic practices for establishing cactus orchard (fruit production)	Giorgia Liguori		
13:00 – 14:00	Lunch			
14:00 – 15:30	Cactus pear agronomic practice for fodder production	Sawsan Hassan		
15:30 – 15:45	Coffee break			
15:45 – 17:00	Reproductive biology of Cactus	Giorgia Liguori		
				

### Monday: 15 July 2019 (Lectures & Case Studies) – Hotel Ayass

08:30 – 09:30	Fruit production and post-harvest management	Giorgia Liguori
09:30 – 10:30	Principles of cactus evaluation, and data collection (using descriptor)	Sawsan Hassan Giorgia Liguori



10:30 – 11:00	Coffee break	
11:00 – 12:00	Knowledge sharing (country case studies): - Odisha (India) - IGFRI (India)	- Mr. H. K Panda - Sunil Tiwari
12:00 – 13:00	Knowledge sharing (country case studies): - IGFRI (India) - INAT (Tunisia)	- D. R. Palsani - F. Messaoudi
13:00 – 14:00	Lunch	
14:00 – 15:30	Knowledge sharing (country case studies): - Morocco - BAIF (India)	- A. Aithamou - Vitthal Kauthale
15:30 – 16:00	Coffee break	
16:00 – 17:00	Knowledge sharing (country case studies): - Iraq/Palestine - Algeria/Tunisia - APRP (GGC)	TBD

### Tuesday: 16 July 2019 (Field day – Travel to Mushaqqar Research Station)

08:00 – 13:00	Field trip to Mushaqqar research station - Cactus germplasm - Demonstration of best agronomic practices	Mounir Louhaichi Sawsan Hassan Giorgia Liguori
13:00 – 14:00	Lunch	
14:00 – 15:00	- Demonstration of best agronomic practices	
18:00	Official dinner at Rim Al Bawadi Restaurant	All



### Wednesday: 17 July 2019 (Field day – Mushaqqar Research Station)

08:00 – 13:00	Field day at Mushaqqar Research Station: - Cactus accessions evaluation and data collection - Alley cropping and field genebank	Mounir Louhaichi Sawsan Hassan Giorgia Liguori
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13:00 – 16:00

Free afternoon



### Thursday: 18 July 2019 (Meeting at NARC HQs - Baqa'a)

08:00 – 08:30	Travel to NARC HQs	NARC Bus
08:30 – 09:30	Data processing and presentation	Sawsan Hassan
09:30 – 10:30	Impact of cochineal ( <i>Dactylopius opuntiae</i> ) insect pest on cactus production (case of Morocco)	Abderrahmane Aithamou
10:30 – 11:00	Coffee break	
11:00 – 11:15	FAO-ICARDA Cactus network and upcoming cactus congress in 2020	Mounir Louhaichi
11:15 – 12:15	General discussion	All
12:15 – 13:00	Certificate and closing	CDU, NARC, ICARDA
13:00 – 14:00	Lunch	

### Friday: 19 July 2019

Departure of Trainees



## List of Participants

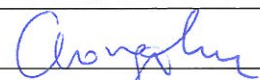

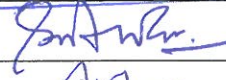





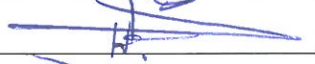

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## Group Training Course

### *Cactus Pear Evaluation & Best-Agronomic Practices*

13-19 July 2019 – Hotel Ayass, Amman - Jordan

#### List of participants

No	Name	Institution / organization	Email	Signature	*
1	Georgia Uguoka	UNIVERSITY OF PACIFIC	GEORGIA.UGUOKA@UPAC.F		<input checked="" type="checkbox"/>
2	Abdallah Aldahadha	NARC	aaldaha23@gmail.com		<input checked="" type="checkbox"/>
3	Sumil Kumar	ICAR-IGFRI, Jharkhand, India	sumitkumar98@gmail.com		<input checked="" type="checkbox"/>
4	D.R. Palsaniya	ICAR-IGFRI, India	drpalsaniya@gmail.com		<input checked="" type="checkbox"/>
5	Rahul Dev	ICAR-CARI, India	Rahul.Dev@icar.gov.in		<input checked="" type="checkbox"/>
6	Abdulmalek Muharraz	PHD-KSU	malek772000@gmail.com		<input checked="" type="checkbox"/>
7	Beedr alomari	NARC	Beedr.alomari@yahoo.com		<input checked="" type="checkbox"/>
8	Ahmad Bdour	NARC	ahmad99209@yahoo.com		<input checked="" type="checkbox"/>
9	Heba Ibraheem Hagan	NARC	hbh987@yahoo.com		<input checked="" type="checkbox"/>
10	awad Al-Kaabneh	NARC	awad Al-Kaabneh@yahoo.com		<input checked="" type="checkbox"/>

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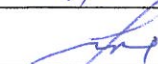

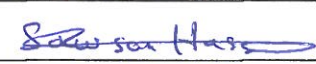


## Group Training Course

### *Cactus Pear Evaluation & Best-Agronomic Practices*

13-19 July 2019 – Hotel Ayass, Amman - Jordan

#### List of participants

No	Name	Institution / organization	Email	Signature	*
21	Rawad Wshi Swidan	NARC	rawados@gmail.com		<input checked="" type="checkbox"/>
22	Ahmad SAAD Aladwan	NARC	edwan20133@gmail.com		<input checked="" type="checkbox"/>
23	Vithal Kauthale	BAIF-India	vithal.kauthale@baif.org.in		<input checked="" type="checkbox"/>
24	Sita N. Singh	DSE, Goo, Punjab	SAS1966@gmail.com		<input checked="" type="checkbox"/>
25	H. K. Pandey	DSEWD, Goo, India	hemantaakumar@gmail.com		<input checked="" type="checkbox"/>
26	Mounir LOUHACHELI	ICARDA	m.louhachehi@cgiar.org		<input checked="" type="checkbox"/>
27	Abderrahman AITHAMOU	Cactus Premium srl	aithamon@hotmail.com		<input checked="" type="checkbox"/>
28	Sawsan Hassan	ICARDA	S.hassan@cgiar.org		<input checked="" type="checkbox"/>
29					<input type="checkbox"/>
30					<input type="checkbox"/>

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