

Promoting Cactus (*Opuntia ficus-indica*) As drought resilient feed resource under different agro-ecological production systems across India: Progress Report 2021

ICARDA-ICAR PROJECT (PROJECT 3: SUB PROJECT 2)

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RESEARCH
PROGRAM ON
Livestock

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Executive Summary

Cactus pear can play a strategic role in agricultural and economic development, particularly in arid areas, in view of its opportunities for income generation, food production and ecosystem conservation. Thus, considerable work has been done on the use of spineless cactus in arid and semi-arid regions of several countries. It has great potential to improve productivity under harsh conditions due to its Crassulacean Acid Metabolism photosynthetic system results in better adaptation, it can produce a large quantity of palatable green fodder throughout the year. In addition, the use of cactus in animal feeding substantially reduces water consumption as a result of its high-water content. These factors led to the introduction of *Opuntia* spp. to the farming communities in order to reduce the dependency on external feed, reduce costs and improve income via increased farm output. Using cactus as livestock feed can improve production of meat and milk for cash earnings, while helping to reduce agriculture water use through its high-water use efficiency (65 percent less water needed to produce 1 kg of dry matter compared to the most important forage crops in the country). Additionally, growing spineless cactus as forage crop to feed animals during the feed shortage season can improve the ability to cope with droughts.

Within the ICARDA-ICAR collaboration a five-year project (2017-2022) on “Promoting Cactus (*Opuntia ficus-indica*) as drought resilient feed resource under different agro-ecological production systems across India” was established. The project has been implemented with partnership with ICAR institutions: Indian Grassland and Forage Research institute (IGFRI), Jhansi and Central Arid Zone Research institute (CAZRI), Regional Research Station, Kukma, Bhuj, Gujarat. The specific objectives of this project are: develop best agronomic practices for optimum spineless cactus growth to increase yield and quality; develop various cactus-based feed rations depending on available feed resources; establish linkages with farmers, private sectors and other enterprises to disseminate cactus pear and promote cladodes plantation, and enhance capacity building of all partners (emphasis on farmers and particularly woman). The main purpose of this report is to highlight the activities performed during the period of 1st April 2021 to 30th November 2021. The fodder quality of cactus cladodes of different accessions has been analyzed and discussed in different phenological phases. Almost 36,700 cladodes have been distributed to farmers/ stakeholders (Gaushala or cow shelter, Universities, institutes and NGOs) despite the challenges due to COVID-19. To overcome the travel restriction and social distancing a series of capacity development took place during this reporting period. In particular, five online training sessions on cactus pear were conducted by IGFRI. Trainings were conveyed to India Fodder Officers of various state line departments, forest & soil conservation department, agriculture and animal husbandry departments. Following on-line training communication, workshop for accelerating fodder production in various states of the country were conducted. In total more than 300 participants benefited from these online training events. Additionally, seven face to face capacity development events conducted targeted more than 500 farmers (21% females) included 4 field days and 3 ICAR Scientist - Farmer’s interaction procedures. The results of the project activities were documented in different forms. One ISI paper was published in the Agronomy Journal; another ISI paper is under consideration with the Archives of Agronomy & Soil Science Journal, two proceeding papers were accepted in the X INTERNATIONAL CONGRESS ON CACTUS PEAR AND COCHINEAL,

which will be held in João Pessoa, Paraíba, Brazil, from 28 to 31 March 2022. Moreover, cactus success story was published in popular local newspaper.

ICAR - ICARDA – Project information

Project Name:	Promoting cactus (<i>Opuntia ficus-indica</i>) as drought resilient feed resource under different agro-ecological production systems across India
Funding agency:	ICAR - Indian Council of Agricultural Research
Lead implementing institution:	ICARDA
Principal Investigator (name, institution, email):	Mounir Louhaichi, ICARDA, M.Louhaichi@cgiar.org
Start date (anticipated if not yet approved):	04-01-17
Duration:	5 Years
Implementing partner organizations:	ICAR through IGFR and CAZRI <ul style="list-style-type: none"> Indian Grassland and Forage Research institute (IGFR), Jhansi Central Arid Zone Research institute (CAZRI), Regional Research Station, Kukma, Bhuj, Gujarat
Summary of project objectives,	<p>This project will attempt to close the feeding gap by taking new feed (spineless cactus) and forage technologies to scale through:</p> <ol style="list-style-type: none"> 1. Trial on agronomic practices for optimum spineless cactus growth to increase yield and quality under different environments. 2. Develop and conduct new trial about new feed rations in combination with Cactus at IGFR. 3. Enhance capacity building of all partners and increase cactus importance awareness including cactus dissemination and adoption
Summary of project outputs,	<p>The project expected to contribute to the following impacts:</p> <ol style="list-style-type: none"> 1. Well adapted cactus accessions to be made available farmers and other stakeholders in different agro-ecological sites across India and incorporated into their livestock (mainly cattle) feeding regimes. 2. Development of guidelines and protocols for best agronomic practices for promising cactus accessions made available for extension and development agencies in India as well other parts of the semi-arid regions. 3. Developing and strengthening the capacity and networking of NARS.
Budget	
2020-2021 budget	USD 40,000
Reporting period	1 st April 2021 to 30 th November 2021

ICAR-ICARDA Technical Progress Report

1st April 2020 to 30th November 2021

Similar to 2020, the reporting period was overwhelmed with COVID-19 viral pandemic unprecedented global phenomenon and decimated movement of all stripes including the physical movement as well as on social gathering. Both ICAR-IGFRI, Jhansi and CAZRI Bhubaneswar institutes have continued to operate as per recommended measures set by the Indian government. Despite this pressing time, the project activities were carried out in all possible manner to achieve planned activities. All efforts were focused on finding alternative technologies to communicate with farmers and stakeholders to follow up and to promote the use of spineless cactus as alternate fodder resource and to include it as part of the feed calendar of their livestock.

1. Research activities

1.1. Cactus Pear Agronomic Management in a Semi-Arid Region of India

The results of this trial were published in Agronomy (impact factor: 3.147):

Kumar et al. 2021. Cactus Pear (*Opuntia ficus-indica*) Productivity, Proximal Composition and Soil Parameters as Affected by Planting Time and Agronomic Management in a Semi-Arid Region of India. Agronomy 11, 1647. <https://doi.org/10.3390/agronomy11081647>

Cactus pear (*Opuntia ficus-indica* (L.) Mill) can survive extreme environmental conditions and is known for fodder potential in many parts of the world. Although cactus pear is a low-input crop, it can respond well to manipulating agronomic practices and soil types. However, only limited studies are available on planting time and nutrient management response of cactus pear for semi-arid regions. To realize the full genetic potential of cactus pear, it is necessary to evaluate its planting time, nutritional and water requirements. Such studies are required for obtaining better yields in each soil and climatic situation. This study was undertaken to evaluate the response of cactus pear growth and soil properties to different planting times and farmyard manure (FYM) and irrigation application. The results are expected to provide guidance to farmers about when to plant and how to manage cactus pear with minimal input resources for semi-arid situations in India.

1.1.1. Methodology:

- The experiment was conducted at the ICAR-Indian Grassland and Fodder Research Institute (IGFRI) in Jhansi, UP during July 2016. Spineless cactus 'Yellow San Cono' accessions that identified at IGFRI Jhansi was selected for plantation.
- The experiment consisted with 2 factors under randomized complete block design with 3-replications:
 - Four planting dates (mid-July, mid-October, mid-February and mid-April) and;
 - Organic manure and supplemental irrigation application treatment (2 kg/plant organic manure was added combined with supplemental irrigation when necessary) and control: where the experimental units left without any treatment.

- Survival and nutrient status were evaluated after 2 years, whereas aboveground (plant height, biomass, primary and secondary cladode numbers, primary and secondary cladode lengths) and belowground (root length, weight, and surface area) measurements were done after 6 years since cladode planting.
- The proximate nutrient values of the crude protein (CP) and cell wall constituents NDF (neutral detergent fibre), ADF (acid detergent fibre), and lignin contents in addition to in vitro dry matter digestibility (IVDMD) were estimated in each experimental unit.



Fig. 1. View of agronomic trial conducted in IGRI- Jhansi

1.1.2. Results:

Cladodes planted in July had greater plant height, plant width, cladode number, cladode weight and biomass yield, followed by planting in October (Table 3). However, there was no significant difference in cladode width between July- and October-planted cladodes (Fig.2). The July-planted cladodes had greater plant height (130.1 cm), plant width (126.4 cm), cladode number (32.5 cladode plant⁻¹), cladode weight (914 g) and biomass yield (157 t ha⁻¹) compared to October-planted cladodes (Fig 2).

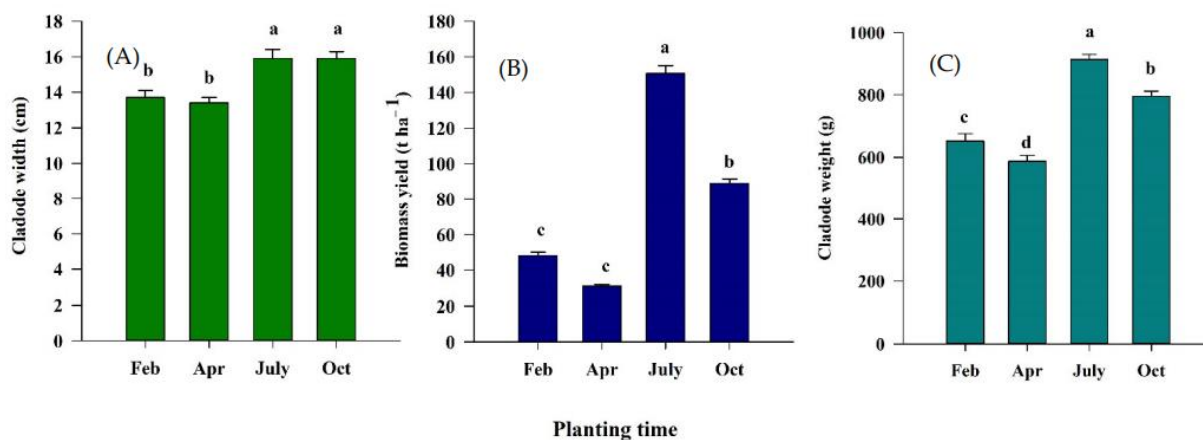


Fig 2. Influence of planting time on cactus pear (A) cladode width, (B) biomass yield and (C) cladode weight (different letters above the bars indicate the significance ($p < 0.05$)).

The main effect of both planting time and application of irrigation and fertilizer treatments and their interaction on crude protein and all nutrient contents in cactus pear were significant except for Cu, which

was affected by the main effects of irrigation and fertilizer application and planting time, but not by their interaction (Fig. 3).

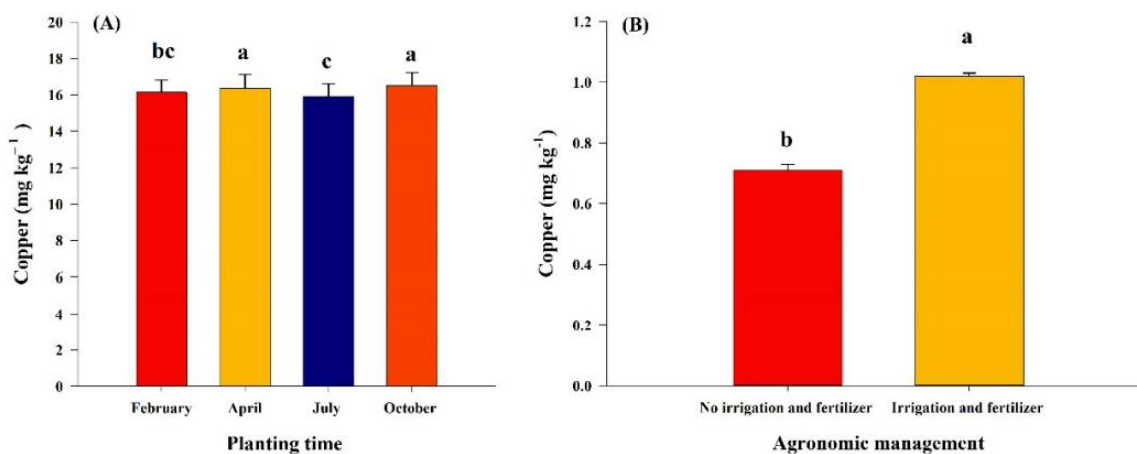


Fig 3. Plant copper accumulation response of cactus pear to (A) planting time and (B) agronomic management practices (different letters above the bars indicate the significance).

1.2. Changes in cactus pear fodder quality with the phenological phase in arid Gujarat (CAZRI Bhuj)

Recently studies concerning the growth physiology of cactus pear cladodes have increased due to their nutritional value and economic potential as a green fodder. However, there are limited studies dealing with the evaluation of cactus composition during several maturation phase. Therefore, a study was conducted in ICAR-CAZRI, RRS-Bhuj to test the changes in fodder quality of cactus pear with the increase in phenological age.

1.2.1. Methodology:

Five cactus pear accessions including CAZRI Botanical Garden (CBG), Bianca, 1270, 1271 and 1308 were selected to be included in this study. Cactus cladodes of each accession were collected from standing crop at different phenological phase: young, intermediate and mature. Young phase was divided into two groups based on the fresh weight (<50 g, 50-100 g), intermediate phase was further divided into two groups (100 g-200 g, 200-500 g) and the mature phase belongs to those weighing (fresh weight) >500 g (Fig. 4). Each phase and groups were replicated 10 times.

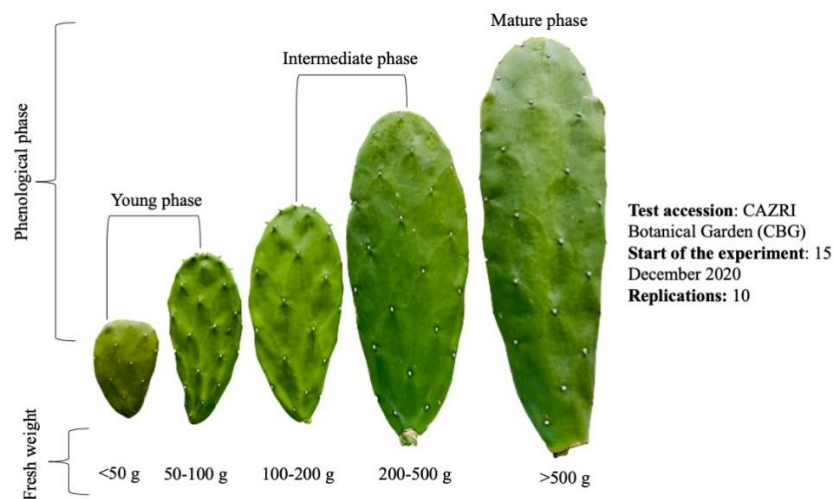


Fig. 4. Phenological phases of cactus pear based on fresh weight.

The fodder quality parameters of the cactus cladodes were analyzed during different phenological phases including: Dry matter content, Organic matter and crude protein content Natural and Acid detergent fiber (Ndf, ADF), Cellulose, Hemicellulose and pectin content, Acid digestible lignin (ADL), Total carbohydrates, pH of the cladodes, Ether extract and Ash content.

1.2.2. Preliminary results:

Total carbohydrates

- No significant differences among cactus pear accessions were observed until it reaches maturity ($P < 0.05$)
- No significant differences among phenological phases (Fig. 5)

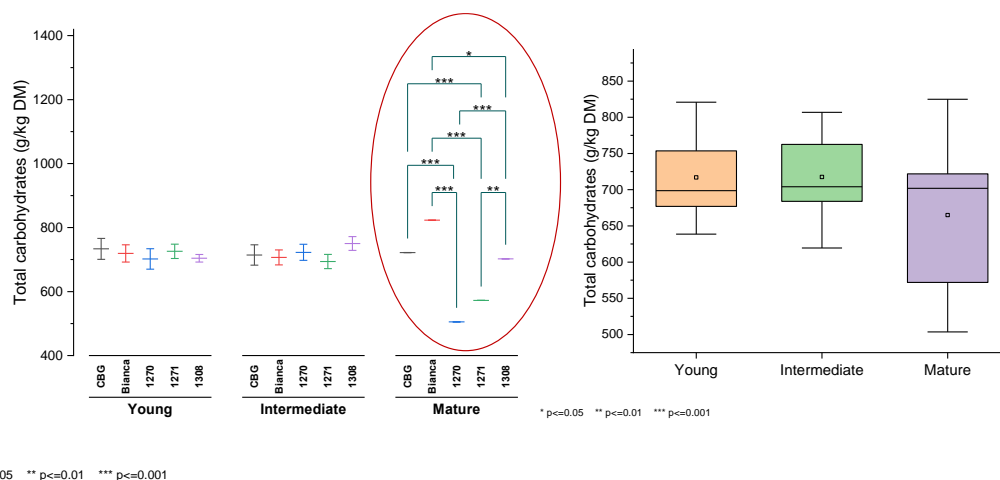


Fig. 5. Concentrations of total carbohydrates related to phenological stages of five cactus pear accessions.

Ash content

- Ash content increased as a function of maturation stage ($P < 0.05$)
- No significant differences among cactus pear accessions (Fig. 6)

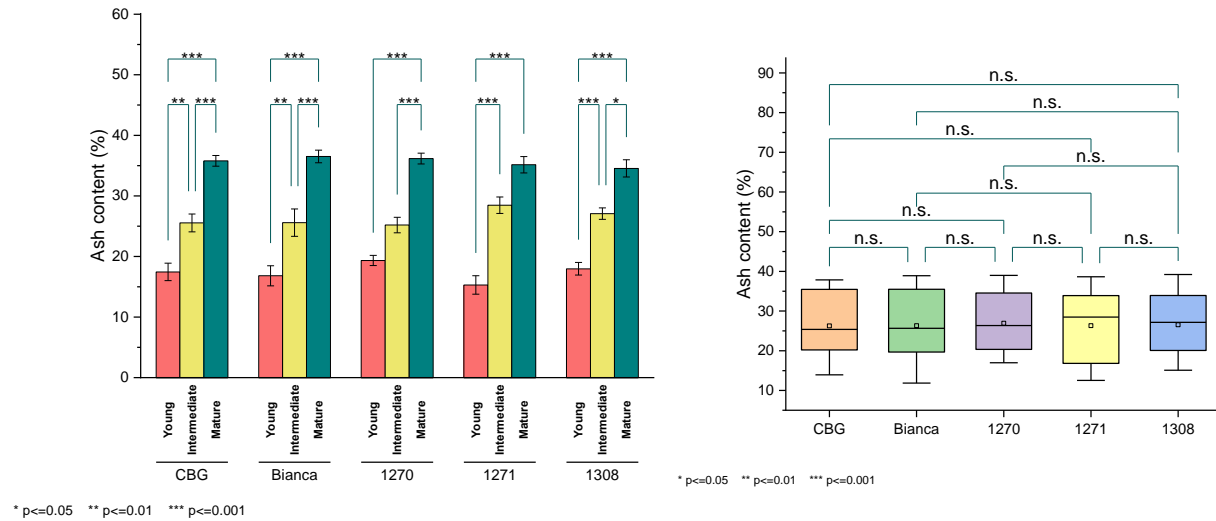


Fig. 6. Ash content related to phenological stages of five cactus pear accessions.

Dry matter content

- In all the stages, dry matter content (DM) was low.
- When low DM cactus supplied to animals in large quantities, DM requirements can be compromised, On the other hand, low DM content means great contribution of water (Fig. 7).

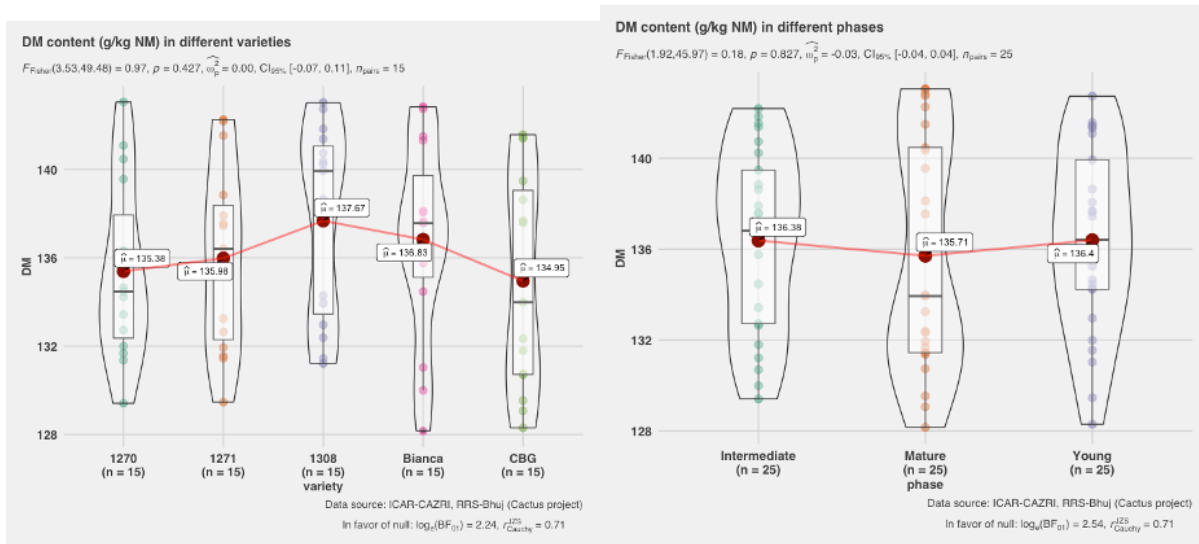


Fig. 7. Dry matter content related to phenological stages of five cactus pear accessions.

Organic matter content and crude protein content

- No significant differences among cactus pear accessions, phenological phases and their interaction were found.

pH of the cladodes

- pH of the cladodes decreased significantly with maturity ($P < 0.05$) while no significant differences among varieties were observed (Fig. 8)

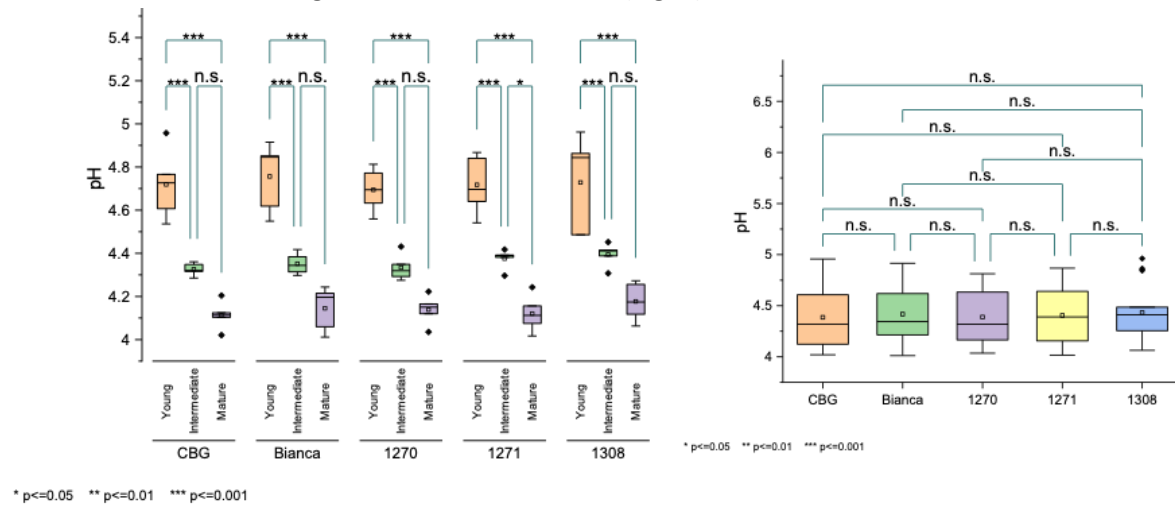


Fig. 8. The cladodes pH related to phenological stages of five cactus pear accessions.

Cellulose content

- Increases with maturity ($P < 0.05$)
- No significant differences among cactus pear accessions (Fig. 9).

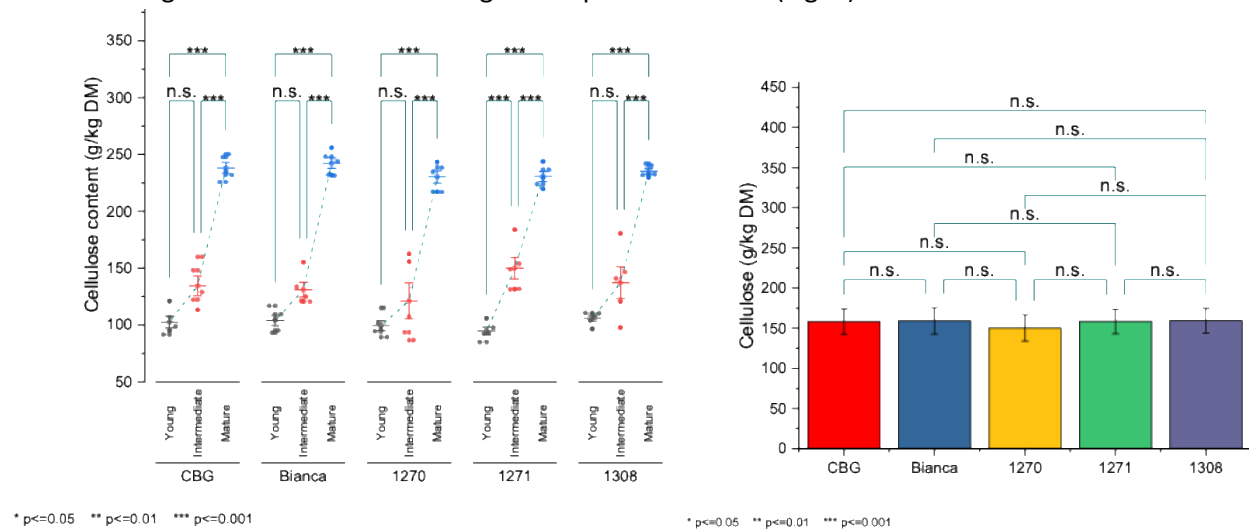


Fig. 9. Cellulose content related to phenological stages of five cactus pear accessions.

Hemicellulose content

- No significant differences among cactus pear accessions, phenological phases and their interaction were recorded.

Natural detergent fiber

- Significant increase with maturity ($P < 0.05$)

- Maturation=increase of cellular wall, CEL and HEL (constitutes NDF)
- No significant differences among cactus pear accessions were detected (Fig. 10).

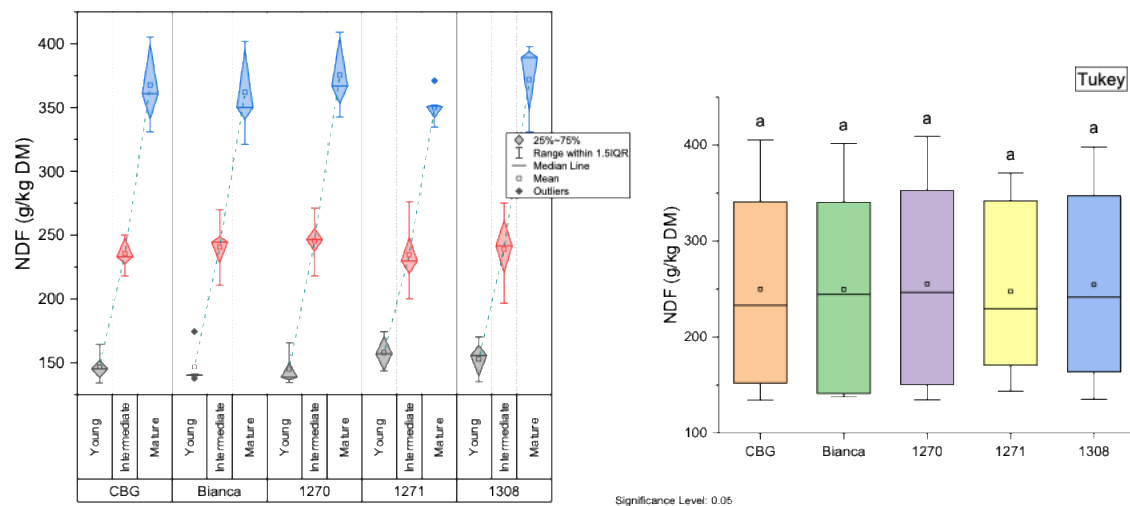


Fig. 10. Natural detergent fiber content related to phenological stages of five cactus pear accessions.

Acid detergent fiber

- Significant increase with maturity ($P < 0.05$)
- No significant differences among cactus pear accessions were recorded (Fig. 11).

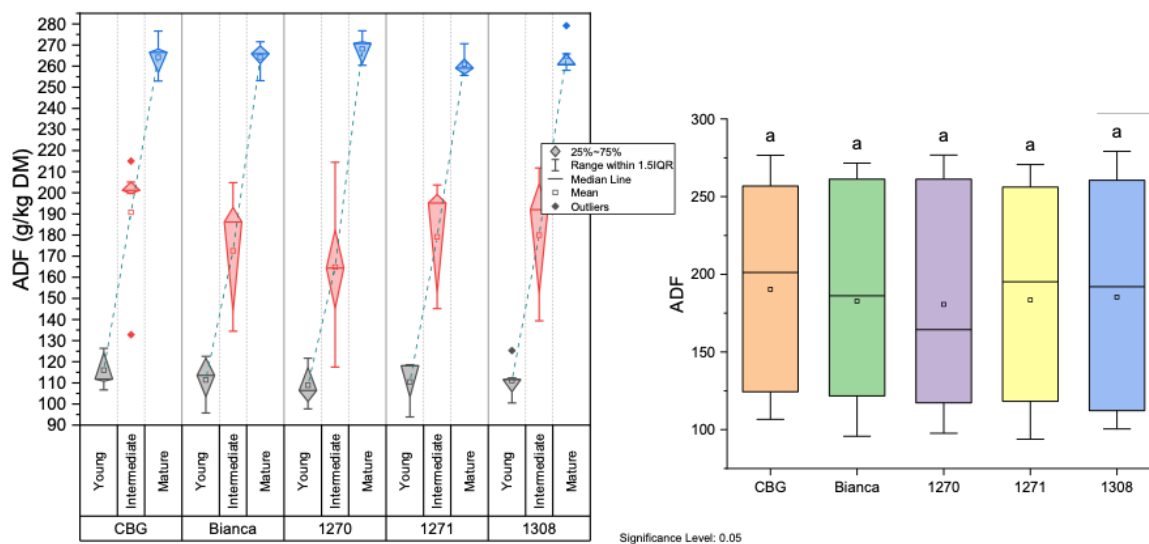


Fig. 11. Acid detergent fiber content related to phenological stages of five cactus pear accessions.

Pectin content

- Significant differences among phases ($P < 0.05$), pectin is structural component of cell wall it has a great role in to increase digestibility of DM and NDF, therefore, feed with high pectin indicates great potential as ruminant diets.

Acid digestible lignin

- Significant acid digestible lignin (ADL) increases with maturity associated with reduction in fiber and protein content ($P < 0.05$) was observed, high ADL barrier to adhesion of microorganisms and the enzymatic hydrolysis of CEL and HEL
- No significant differences among cactus pear accessions were recorded (Fig. 11).

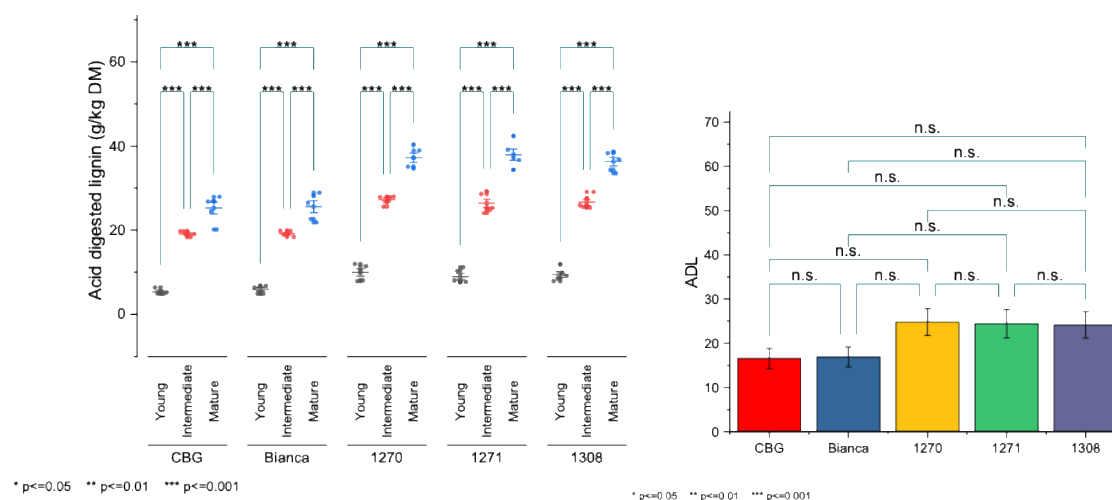


Fig. 12. Acid detergent lignin content related to phenological stages of five cactus pear accessions.

Ether extract

- No significant differences among cactus pear accessions, phenological phases and their interaction were recorded.

2. Promotion of cactus pear under different agro-ecological production systems across India

A total number of more than 36,700 cactus cladodes have been distributed to farmers/ stakeholders despite the challenges of interacting face to face with farmers due to COVID-19 pandemic (Table 1).

Table 1: Number of cladodes provided through the project during April to December 2021.

Location	Stakeholders	Description	Number of cladodes supplied
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Jhansi, Uttar Pradesh	Farmers	Trainees (20) of fodder production and utilization Gaushala manager/Farmer (50 each)	1,000
		Village Ambabai farmers (10 farmers & 50 each)	500
		Farmers of Parasari Village Datia under MGMG programme (15 farmers & 50 each)	750
		Farmers, Padri & Simardha village, district Jhansi (IFS project)	500
		Farmer of Village Rund Karari, Jhansi (14 Farmer & 50 each)	700
		100 farmers during field days on Cactus on 14th July 2021 (20 each)	2,000
		10 farmers of village Ghisalni District Datia under MGMG program (20 each)	200
		80 farmers during field days on Cactus on 14th July 2021 (30 each)	2,400
		80 farmers during field days on Cactus on 20th August 2021 (20 each)	1,600
		60 farmers during field days on Cactus on 20th August 2021 (30 each)	1,800
		ATMA Sheopur Madhya Pradesh (20 Farmer & 10 each)	200
		16 farmers during Scientists-Farmers Interaction on Cactus on 31 st July.2021 (25 each)	480
		50 farmers during Scientists-Farmers Interaction on Cactus on 23rd Sept. 2021 (25 each)	1,250
	Gaushala or cow shelter	Prince Jain, kamdhenu gaushala, Sakrar, Jhansi	2,050
		Gauvansh Vihar Sukuma dukuma , Jhansi	8,000
		Gaushala Pal colony, Jhansi	500
	Universities/NGOs/institutes	Prince Jain, kamdhenu gaushala, Sakrar, Jhansi	2,050
		Gauvansh Vihar Sukuma dukuma , Jhansi	8,000
		Gaushala Pal colony, Jhansi	500
Bhuj, Gujarat	Farmers	Farmers in the different villages: Nana ratadiya, Kotda chakar, Kotda chakar, Adipur, Kukma, Nakhatrana,Gujarat, Anjar, Gandhidham, Anjar, Gandhidham, Mandvi, Lakhpatri, Ajmer,	1,810

		Gandhidham, Dhol, Jaipur, Sumrasar sekh and Sinugra	
	Universities/NGOs/institutes	Central Agroforestry Research Institute Jhansi (CARI)	440
Total			36,730

3. Adoption of Technology and Practices (case studies)

3.1. Cactus pear farming profits and constraints in arid Kutch

A case study on cactus farming is being discussed in relation to the profits and constraints involved in cactus farming in arid Kutch. Mr. Varun Sharma is one of the progressive farmers in arid Kutch. His farm is located at Kukma village in Kutch, Gujarat state of India. He is an educated farmer who has been actively involved in farming for 5 years. His income from farming constitutes 40% of his total income. He owns a total area of 10.9 ha, out of which 10.1 is the cropped area. The main crops grown in the field are dates, peanut, wheat, flax seed and cactus. He owns 55 number of cows and the average milk production (kg per head per year) is 2736 kg. The cows are fed with concentrates, dry feeds, crop residue, and green fodder such as cactus and alfalfa. Cactus is grown as monoculture crop in 0.06 ha of land. He has been cultivating cactus since the past two years. The cactus is being cultivated with organic inputs only. Around 0.9 tonnes of cactus has been harvested per total area. The cactus pads are being cultivated to feed his own cows and are not yet sold to the market. Relative to other conventional green fodder, a total saving of Rs. 22000 can be made per year with cactus cultivation (Fig. 13). The main constraints associated with cactus cultivation in Kutch region are lack of awareness, price fluctuations, lack of marketing channels etc.



Fig. 13. Cactus pear field of Mr. Varun Sharma

3.2. Cactus pear as source of green fodder in Gaushala (Cow shelter)

The Bundelkhand region is characterised by dry and uncertain rainfall area. The livestock population is high with scarcity of fodder particularly in lean period (summer season). Shri Prince Jain resident of village Sakrar, District Jhansi is a hardworking and progressive farmer. He is operating a gaushala and also a member of self-help group.

Training & Motivation

- ❖ In gaushala green fodder supply often becomes a problem. As such there was need of alternate/additional source of green fodder.
- ❖ ICAR-IGFRI identified his problem to operate the gaushala and major one was the need of green fodder. A demonstration trial of spineless cactus was conducted on his field to motivate him and many other farmers of that area.

Adoption of Technology and Practices

- ❖ A field trial was conducted in an area of 0.3 ha on cactus pear which is used as green fodder.
- ❖ Cactus pear was grown on waste land which was not utilized before it for any purpose. After one and half year it became ready for feeding purpose and it also reduces the consumption of straw by 10-15 %. He noticed a marked improvement in milk yield (3 -4 %) and overall health condition of animals (Fig. 14). The fodder cactus was fed up to 30 % mixing with wheat straw. He got the potential of producing 80 kg of fresh weight per plant (3-year plantation) and 100m row length planted 1 m spacing of cactus provided 3 months fodder (30 %) for 3 ACUs. This has reduced his feeding cost by 15-20 % during summer months.
- ❖ Initially he also motivated other farmers by providing them cactus cladode without any cost and it reflects the success of this field demonstration. Later on, due to high demand, he started to supply it on sale basis. In first instalment he has sold 10,000 cactus cladodes fetching him 30,000 INR.

Benefits to farmer:

The farmers are getting major benefits *i.e.*, solve the problem of green fodder in lean period and increase the income by selling the cactus cladode. There is more demand of cactus cladodes from other gaushalas of vicinity.



Fig. 14. Cactus pear field of Mr. Shri Prince Jain resident of village Sakrar, District Jhansi

4. Capacity building programmes

4.1. Virtual mode (Webinar)

During the COVID-19 pandemic period, the technology related to cactus pear as an alternative fodder resource for summer and lean period was popularized through virtual mode. The trainings were imparted to all India Fodder Officers of various state line departments, forest & soil conservation department, agriculture and animal husbandry departments. Following on-line training cum workshop for accelerating fodder production in various states of the country were conducted. In total more than 300 participants registered in these on-line (webinar) trainings.

Table 3. Virtual meeting events conducted by Indian Grassland and Forage Research institute (IGFRI)

No.	Name of On-line Training	Organising Institution/ Agency	Period	Topic	Target stakeholders
1.	Webinar on 'Non-conventional fodders and their effectiveness in dairy farming (in Hindi)	ICAR-NDRI, Karnal, Haryana	June 21, 2021	Non-conventional fodder resources for enhancing fodder availability and livestock productivity	Dairy farmers, NGO officials, state line department personnel, Scientists of KVKs (Krishi Vigyan Kendras- Farm Science Centres) & ICAR-NDRI
2.	Online (NIAFTA) National Initiative for Accelerating Fodder Technology Adoption Kharif Workshop - 2021 for all India Fodder Production Officers	ICAR-IGFRI, Jhansi	July 12-14, 2021	Non-conventional fodder resources	Scientists of KVKs & SAUs, NGO officials, state line department personnels,
3.	Webinar on 'Training to KVK scientists & field personnel of Mizoram state, India'	ICAR-IGFRI, Jhansi	July 17, 2021	Production technology of important fodder crops with special reference to Mizoram	Scientists , KVKs of Mizoram & SAUs of NEH region of India
4.	Webinar on 'Trainers cum Farmers' training programme to farmers	Assam Agricultural University, Jorhat, Assam, India	July 19, 2021	Recent advances in fodder cultivation with special reference to ICAR – IGFRI Jhansi	Scientists, KVKs of Assam , AAU scientists &

	and agripreneurs of NEH region of India				ICAR of NEH region
5.	Webinar on 'Fodder Management for Sustainable Livestock Production in Arid Zone'	SKRAU, Bikaner, Rajasthan	July 24, 2021	Technological interventions for green fodder production in the state of Rajasthan, India	Scientists, KVKs of Rajasthan & RAU Bikaner

4.2. ICAR Scientist - Farmers Interaction

To motivate farmers to adopt cactus pear for getting fodder especially during lean period under different production systems, a number of farmers – scientist interaction programmes were organized and attended by different stakeholders:

4.2.1. Farmer-Scientist Interaction on Bio-fertilisers and fodder cultivation at Takori & Futera villages

ICAR-Indian Grassland and Fodder Research Institute, Jhansi has organised a Farmers' Awareness camp cum field day on the 'importance of bio fertilizers in soil health and fodder crop production' in the village Takori & Futera, Jhansi district on 9th & 14th July, 2021, respectively. The event other than highlighting use of biofertilizers, also highlighted various types of perennial fodders like BN hybrid & guinea grass and non-conventional fodders like spineless cactus, moringa, sugarbeet & lathyrus. About 150 farmers from Takori and nearby villages have participated in this event. In this programme, the team comprised Dr Sunil Kumar, Dr. Srinivasan R, Dr. Sita Ram Kantwa, Dr. G. Prabhu, Dr. Mahendra Prasad, Mr. Rahul Srivastava, Ms. Mansi Mishra, Mr. Prasant and Mr. Anurag Pateria explained the importance of soil health for sustaining and enhancing crop production and significance of biofertilizers towards environment friendly agricultural practices and fodder resources suitable for Bundelkhand region (Fig. 15). During this programme, farmers were also distributed with carrier based biofertilizers and perennial grasses planting materials (BN hybrid root slips) and spineless cactus cladodes. There was huge demand for cactus among the farmers.





Fig. 15. Glimpse of Farmer-Scientist Interaction at Takori and Futera Villages, District Jhansi (UP)

4.2.2. Farmer-Scientist Interaction on Spineless Cactus at Tendol village

A farmer - scientist interaction meeting on spineless cactus was organized under the ICAR IGFR – ICARDA collaborative programme on 31 July 2021 at BAIF Center, Village- Tendol, Baruasagar, District Jhansi under chairmanship of Dr. Sunil Kumar, Head of the Department of Crop Production. The farmers were educated about the importance of cactus, its nutritional value and growth and yield potential and trained for its cultivation, management, and harvesting, chaffing and feeding practices. The participating farmers were encouraged to adopt spineless fodder cactus especially on wastelands, field boundaries to get fodder during lean period.

In this Interaction, Mahendra Kumar Dwivedi (District Program Officer, BAIF, Jhansi), Manohar Lal (BAIF Centre Incharge), Prashant Kumar and Praveen Kumar Yadav also gave various information to the farmers. In this Interaction, 25 farmers of Tendol village from Bundelkhand region participated in this interaction and the farmers, considered spineless cactus as very important fodder, demanded cladodes from the institute for planting in their fields and waste lands. Along with this, the cactus cladode and Bajra Napier (BN) hybrid rooted slips were provided to all the farmers (Fig. 16). In future also farmers were invited to have more planting material so that green fodder can be arranged for the animals in summer season. Spineless cactus can be a good option to solve the problem of shortage of fodder.



Fig. 16. Glimpse of Farmer-Scientist Interaction on Spineless Cactus at Tendol village

4.2.3. *Farmer-Scientist Interaction on Spineless Cactus at Unnao Balaji village*

Under the aegis of ICAR-Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh and Krishi Vigyan Kendra, Datia, Madhya Pradesh, a farmer-scientist Interaction on spineless cactus was organized. It was conducted at Unnao Balaji, Datia under the chairmanship Dr. Sunil Kumar, Crop Production Division, ICAR-IGFRI Jhansi. Dr. Sunil Kumar emphasized the importance of spineless cactus as a non-traditional fodder and said that spineless cactus can be cultivated in the form of fences, on fallow and waste lands and also interacted about the nutrient quality of cladodes, plant types (species and varieties), planting, management, harvesting and feeding of the cladodes.

In this event Dr. Rupesh Jain, Animal scientist from KVK Datia, Dr. Mukesh Chaudhary, Dr. Mahendra Prasad, Prashant Kumar, Prem Narayan Ahirwar, Manu Patel, and Anurag Pateria from ICAR-IGFRI Jhansi also participated and interacted with the farmers. In this interaction, 60 farmers participated from Unnao Balaji and surrounding villages (Fig. 17). Farmers were convinced for growing spineless cactus on their landuse for fodder production during lean period. They demanded cladodes from the institute for planting

in their fields. Cactus cladodes and BN hybrid rooted slip were distributed to all the farmers during the event.



Fig. 17. Glimpse of Farmer-Scientist Interaction on Spineless Cactus at Village Unnao Balaji, District Datia, MP

4.3. Farmers Field days

4.3.1. *Field Day at Central Research Farm ICAR-IGFRI, Jhansi, Uttar Pradesh*

A cactus pear field day was organized on 20 August 2021 at the Central Research Farm ICAR-IGFRI Uttar Pradesh. It was organized at the cactus field in Technology Demonstration Block of ICAR-IGFRI. Nearly 80 farmers and farm women participated in field day. IGFRI cactus team and other scientists also participated in the event. The participants first visited the cactus field and interacted with scientists. Dr. Sunil Kumar HDCP and PI, IGFRI-ICARDA cactus project urged farmers to plant spineless fodder cactus on waste lands, field boundaries and fallow lands and use it as fodder during lean period when no other fodder is available. Farmers showed keen interest in cactus and its cladodes were also distributed to willing farmers. Farmers were also educated how to grow, harvest, chaff and fed spineless cactus to animals (Fig. 18). The programme was coordinated by Dr. D R Palsaniya and Prashant Kumar expressed vote of thanks.



Fig. Glimpse of Cactus Field Day at Central Research Farm, ICAR-IGFRI, Jhansi

4.3.2. Field Day at village Sakrar, Jhansi, Uttar Pradesh

A cactus pear field day was organized on 16.09.2021 at village Sakrar in Jhansi district of Uttar Pradesh. It was held at the field of cactus growing progressive farmer Mr. Prince Jain. Nearly 60 farmers, female farmers and Gaushala (cow-shelter) persons participated in field day. Dr. Amresh Chandra, Director, ICAR-IGFRI (Jhansi) was the chief guest. Drs. Sunil Kumar, RV Kumar, K.K. Singh, Shahid Ahmad, AK Dixit, Mahendra Prasad, Mukesh Choudhary, G Prabhu, Prashant Kumar and Prem Narayan Ahirwar also participated in the event. Dr. Amresh Chandra appreciated the work done and called farmers for adoption of spineless fodder cactus on their available land for this purpose. He also highlighted the IGFRI fodder production, conservation and utilization technologies. The cactus team including Drs Sunil Kumar (PI), Dr. Shahid A. (CoPI), Dr D.R. Palsaniya (CoPI) participated in scientists – farmer's interaction during this event. Dr. Sunil Kumar provided an overview of the cactus project and informed the farmers/livestock keepers about the importance of cactus as alternative fodder resource in rainfed dry areas. Farmers showed keen interest in cactus and its cladodes were also distributed to willing farmers. Farmers were also trained for establishment of cladodes, harvesting, chaffing and feeding to animals. The programme was coordinated by Dr. D R Palsaniya and Shahid A expressed vote of thanks (Fig. 18).



Fig. 18. Glimpse of Cactus Field Day at village Sakrar, Jhansi, Uttar Pradesh

4.3.3. *Field Day at ICAR-Central Arid Zone Research Institute, RRS-Bhuj, Gujarat*

A cactus pear farmers' field day was organized on 27th October 2021 at ICAR-Central Arid Zone Research Institute, RRS-Bhuj. The theme of the field day was "Cactus farming: profits and ideas". A total of 120 farmers actively participated the training programme. Out of 120 farmers, 94 were male and 26 were female participants (Fig. 19). The programme included lectures from experts, video highlights on cactus farming, hands-on training on propagation of cactus, live discussion, field demonstration and a lunch. The programme continued for three hours before lunch.



Fig. 19. Glimpse of Cactus Field Day at ICAR-Central Arid Zone Research Institute, RRS-Bhuj, Gujarat

5. Publications and Capacity development materials

5.1. ISI papers

5.1.1. *One ISI paper published in Agronomy Journal*

Kumar, S., Louhaichi, M., Dana Ram, P., Tirumala, K.K., Ahmad, S., Rai, A.K., Sarker, A., Hassan, S., Liguori, G., Probir Kumar, G., Govindasamy, P., Prasad, M., Mahawer, S.K., Hulgathur Appaswamygowda, B. 2021. Cactus Pear (*Opuntia ficus-indica*) Productivity, Proximal Composition and Soil Parameters as Affected by Planting Time and Agronomic Management in a Semi-Arid Region of India. *Agronomy*, 11, 1647. <https://doi.org/10.3390/agronomy11081647>

5.1.2. *One ISI paper submitted to Archives of Agronomy & Soil Science Journal*

Kumar, S., D. R. Palsaniya, T. Kiran Kumar, A. K. Misra, Shahid Ahmad, A.K. Rai, A. Sarker, M. Louhaichi, S. Hassan, G. Liguori, P. K. Ghosh, Prabhu Govindasamy, Sonu Kumar Mahawer and Bhargavi, H.A. (2021). Morphological variability, genetic diversity, survival and performance of *Opuntia ficus-indica* L. in a semi-arid region of India. *Archives of Agronomy & Soil Science* (Under advance stage of review).

5.2. Proceeding papers

Two proceedings papers were accepted and they will be presented at the X INTERNATIONAL CONGRESS ON CACTUS PEAR AND COCHINEAL, which will be held in João Pessoa, Paraíba, Brazil, from 28 to 31 March 2022.

- ❖ Naorem, A., Patel, S., Hassan, S., Louhaichi, M., Sarker, S. Response of cactus pear (*Opuntia-ficus indica*) to boron and FYM application under the arid soils condition of Kutch, Gujarat
- ❖ Palsaniya, D. R., Kumar, S., Misra, A. K., Ghosh, P. K., Louhaichi, M., Hassan, S., Sarker, A., Ahmed, S., Kumar, T. K. Spineless fodder cactus under different land use and production systems in rainfed Semi-Arid Tropics of India

5.3. Local media

Cactus in Hindi News Papers during the period under report

कांटा रहित नागफनी पर कृषक वैज्ञानिक परिचर्चा का आयोजन

अवधनामा संवाददाता

झाँसी। भारतीय कृषि अनुसन्धान परिषद्-भारतीय चरागाह एवं चारा अनुसन्धान संस्थान झाँसी द्वारा संस्थान निदेशक के मार्गदर्शन में इकाई



परियोजना के अंतर्गत भारतीय चरागाह एवं चारा अनुसन्धान संस्थान झाँसी उत्तर प्रदेश और कृषि विज्ञान केंद्र दक्षिण मध्य प्रदेश के तत्वाधान में कांटा रहित नागफनी पर कृषक- वैज्ञानिक परिचर्चा का आयोजन उज्जैन बालाजी दलिया में विभागाध्यक्ष फसल उत्पादन विभाग एवं प्रधान वैज्ञानिक डॉ सुनील तिवारी, भारतीय चरागाह एवं चारा अनुसन्धान संस्थान की अध्यक्षता में किया गया। इस अवसर डॉ सुनील तिवारी जी ने गैर

परम्परागत चारे के रूप में कांटा रहित नागफनी पर चर्चा करते हुए बताया कि परती व खराब पड़ी जमीनों या खेत के चारों तरफ बाड़ों के रूप में कांटा रहित नागफनी की खेती की जा सकती है और साथ ही साथ नागफनी के पत्ते (क्लैडोड) की पोषक गुणवत्ता, पौधे के प्रकार (प्रजातियों एवं किस्मों), क्लैडोड की अवस्था, मौसम और कृषि सम्बन्धी स्थितियों के बारे चर्चा की गयी। इस परिचर्चा में बुंदेलखंड क्षेत्र से उजाव बलानी जी गांव के 60 किसानों ने भाग लिया एवं किसानों ने कांटा रहित नागफनी को चारे के रूप में बहुत महत्वपूर्ण मानते हुए अपने खेतों तथा उजड़ खाबड़ जमीनों में लगाने के लिए संस्थान से रोपण के लिए क्लैडोड की मांग की। इसके साथ ही सभी किसानों को नागफनी क्लैडोड व संकर नैपियर की जड़ें प्रदान की गयीं।

Cactus News published (in Hindi)-
AvadhNama, Lalitpur on 23th August,2021

अमर उजाला

आमर
मई 21, 2021
पृष्ठ 10
आमर उजाला

प्रती
विद्यमान, 18 सितंबर 2021
पृष्ठ 10
आमर उजाला

एनएसी पर विवाद विदेशमंत्री ने कहा, चीन-भारत को आपसी सम्मान पर रिस्ते बनाने की जरूरत...11



Cactus News published (in Hindi)- Amar Ujala, Jhansi
on 18th September, 2021



Cactus News published (in Hindi)- Dainik Jagran,
Jhansi on 18th September, 2021



Cactus News published (in Hindi) - Udyog Hakikat Jhansi
on 15th September, 2021

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