Defence Life Science Journal, Vol. 9, No. 4, October 2024, pp. 361-366, DOI : 10.14429/dlsj.9.19863

Understanding Farmers Problems and Training Needs on Apricot Production in Trans-Himalayan Ladakh, India

Dolma Lhadon, Kunzes Dolma, Anand K Katiyar, OP Chaurasia, and Tsering Stobdan*
DRDO-Defence Institute of High Altitude Research, Leh Ladakh -194 101, India
**E-mail: stobdan.dihar@gov.in*

ABSTRACT

A survey was conducted among 500 apricot growers in Ladakh to identify constraints faced in their production system and their grassroots training needs. Of the growers surveyed, 47.8 % of respondents were having less than 20 apricot trees. Most (53.8 %) grew apricots for drying, 31.2 % for fresh consumption, and 15 % for kernel oil. A significantly high number of respondents (44.8 %) reported 11-30 % fruit wastage, while 31.4 % reported 31-50 % fruit wastage. Lack of marketing opportunities and harvesting tools were cited as the main reasons for fruit wastage. The growers do not follow the standard growing practices, and the knowledge about insect pests and diseases is poor in the region. The most significant constraints in apricot production were lack of appropriate fruit drying technology, followed by high insect pest infestation, lack of marketing opportunities, lack of fencing around the field, insufficient water for irrigation purposes, and non-availability of nursery plants. Growers were open to a wide variety of sources of information on apricot production, with the most commonly selected response being friends/ relatives (53.2 %), followed by television (22.4 %), training and awareness camps (15.8 %), and radio (3.6 %). The findings will help researchers, extension personnel, administrators, and policymakers to bring reforms to the apricot industry.

Keywords: Horticulture; Ladakh; *Prunus armeniaca*; Organic; Trans-Himalaya

1. INTRODUCTION

The apricot (*Prunus armeniaca* L.) is a traditional fruit crop of the Ladakh region, and it is locally known as *Chuli*. Except for trial purposes, the region has yet to witness the introduction of cultivars from outside the region. Historically, dried apricot, popularly known as *Nyari Khambu* in Tibet[1], was one of the four natural products of Ladakh that were traded with neighboring countries[2]. *Raktsey Karpo*, apricots with white seed stone, is unique to Ladakh[3]. It is the most preferred cultivar for fresh consumption[4].

Apricot is one of the few temperate fruit trees unaffected by overproduction, and often, premium prices are reported for fresh and processed fruits[5]. Apricots of Ladakh are harvested between mid-July and early September, thus have a distinct competitive advantage as it do not coincide with the main apricot season in the market. However, today, the popularity of Ladakhi apricots remains restricted to the region primarily due to a lack of awareness. However, in recent years, Ladakh's apricots have received attention from the government and the industry. The maiden export of Ladakh apricot began in 2021. During the 2022 and 2023 seasons, 35 and 58 tonnes of fresh apricots, respectively, were sent to the international and domestic markets outside Ladakh. Therefore, Ladakh has immense scope for emerging as a major apricot-producing region.

Ladakh has many natural advantages for apricot fruit production. The region experiences long day hours with high light intensity, relatively warm days, cool nights, and low relative humidity from May to October. However, fruit trees are being grown in the region as individual trees or small groups of trees. Despite vast potential for quality fruit production, the region's fruit industry is nascent[6]. Advances in horticultural production technology are often hindered by slow grower adoption. Several factors can hamper adoption, including overly complex systems, cost, risk aversion, and perceived negative return on investment[7].

The actual status of growers' needs, behaviours, desires, motivations, and frustrations can be determined by a grassroots survey. Such a survey is generally quite detailed and shows the present condition of the industry. Survey results are expected to help extension personnel understand the critical management concerns of production with diverse growing practices and identify opportunities to address concerns through education and training[8]. The present study aimed to identify constraints growers face in their production systems, and their training needs at the grassroots level. With the data at hand, our goal was to present the factual position of the apricot industry in Ladakh to enable the researchers, extension personnel, administrators, and policymakers to bring reforms to the apricot industry. It also helps assess what traditional

Received : 06 February 2024, Revised : 11 July 2024
Accepted : 12 July 2024, Online published : 26 September 2024

practices to keep doing, what to stop, and what modern practices to start doing. To our knowledge, no such survey was conducted in the region.

2. METHODOLOGY

The study was carried out through personal interviews with apricot growers in the Leh district of the Union Territory of Ladakh. A total of 26 questions were structured. Leh district comprises four valleys, and the present survey was conducted in three fruit-growing valleys. The surveyed valley and number of respondents were Sham (n=263), Nubra (n=153), and Leh (n=84).

The authors visited the villages and held face-to-face interviews with the growers. The survey was initiated on 28 February 2023 and closed on 18 August 2023, at which time 500 apricot growers responded. The survey respondents included 253 female and 247 male. The respondents ranged from 26 to 79 years, with an average age of 51.3±13.6 years.

3. RESULTS AND DISCUSSION

3.1 Number of Trees and Cultivars Grown

Of the growers surveyed, 47.8 % of respondents were having less than 20 apricot trees. Growers having more than 50 apricot trees constitute 28.6 % of the respondents, and the remaining 23.6 % have 21 to 50 trees. Apricot growers in Sham Valley had comparatively more trees; 30 % had 21 to 50 trees, and 40 % had more than 50 trees (Table 1). Therefore, the majority of the farmers in the Leh district are small apricot growers. *Halman* is the most predominantly grown apricot cultivar (43.3 %), followed by *Khantey* (23.8 %) and *Narmo* (16.6 %). The cultivar *Raktsey Karpo*, which is Ladakh's first GI-tagged product, constitutes 10.8 % of the total apricot trees. Only 24.6 % of the respondents were aware of the GI-tagging of the cultivar.

3.2 Purpose of Growing Apricots

Most (53.8 %) of the survey respondents were growing apricots for drying purposes, 31.2 % for fresh consumption, while the remaining 15 % reported that their primary purpose of growing apricots was kernel oil extraction (Table 1). However, a majority (71.4 %) of the respondents in Leh Valley reported that their primary purpose of growing apricots was for self-consumption as fresh fruit. The scenario will change with the ongoing efforts to send fresh apricots to international and domestic markets outside the region.

3.3 Fruit Wastage and the Reasons Thereof

The disorganised nature of the sector and adherence to certain inefficient production and processing techniques currently result in high fruit wastage. A vast majority (44.8 %) of the survey respondents reported 11-30 % fruit wastage, while 31.4 % of respondents reported 31-50% fruit wastage (Table 2). The percentage of respondents reporting low (<10 %) fruit wastage was significantly low in Sham Valley (10.3 %) compared to Nubra (26.1 %) and Leh Valley (25 %).

Table 1. Number and type of trees, purpose of growing, and general awareness about apricot cultivation (% respondents)

Information sought	Options	Valley			Total (n=500)
		Sham (n=263)	Nubra (n=153)	Leh (n=84)	
Number of apricot trees	<5	1.5	19.0	25.0	10.8
	6-20	28.5	39.2	59.5	37.0
	21-50	30.0	19.0	11.9	23.6
	>50	40.0	22.8	3.6	28.6
Types of apricot cultivars	*Halman*	51.2	35.4	9.6	43.3
	Raktsey Karpo	8.5	13.5	16.3	10.8
	Narmo	14.9	18.5	22.8	16.6
	Khantey	24.7	19.7	49.3	23.8
	Others	0.7	12.9	2.0	5.5
The primary purpose of growing apricots	Self-consumption as fresh fruit	9.5	26.8	71.4	25.2
	Self-consumption as dried fruit	11.4	9.1	1.2	9.0
	Sale as fresh fruit	5.7	2.6	13.1	6.0
	Sale as dried fruit	56.3	48.4	2.4	44.8
	Oil extraction	17.1	13.1	11.9	15.0
Awareness about GI tagging of *Raktsey Karpo* cultivar	Yes	24.0	24.2	27.4	24.6
Extracting of kernel oil by traditional methods	Yes	65.8	39.9	3.6	47.4

Lack of marketing opportunities and harvesting tools were cited as the main reasons for fruit wastage by 25 % and 20.2 % of the surveyed respondents. The scenario will change with the ongoing efforts to send fresh apricots to international and domestic markets outside the region. Lack of processing facilities and insufficient fruit drying facilities were cited by 18.2 % and 14.8 % of the respondents as the main reasons for fruit wastage. Shortage of laborers during the short harvesting was cited as the main reason by 11.6 % of respondents. High fruit wastage and the reasons cited by the surveyed respondents suggested the need for adopting integrated post-harvest management and establishing a marketing infrastructure for apricots. There is a need to impart training on post-harvest management to the fruit growers.

Table 2. Fruit wastage and the reason thereof (% respondents)

Question/ information sought	Options	Valley			Total
		Sham	Nubra	Leh	
Percent apricot fruits get wasted	<10%	10.3	26.1	25.0	27.6
	11-30%	55.9	34.0	29.8	44.8
	31-50%	29.7	32.0	35.7	31.4
	51-70%	3.4	7.2	7.1	5.2
	>70%	0.7	0.7	2.4	1.0
The main reason for the wastage of fresh apricot fruits	Lack of harvesting tools	23.2	23.5	4.8	20.2
	Lack of marketing opportunity	21.3	34.6	19.0	25.0
	Lack of processing facilities	17.5	24.2	9.5	18.2
	Shortage of labourers during fruit harvesting	16.0	2.6	14.3	11.6
	Insufficient fruit drying facilities	16.3	13.7	11.9	14.8
	Others	5.7	1.4	40.5	10.2

3.4 Adoption of Standard Growing Practices

Practices such as training, pruning, manuring, and mulching are widely followed in all apricot-growing regions in the world. However, most of the apricot growers in the present study do not follow the standard growing practices (Table 3). Only 14.4 % of the respondents in Nubra Valley and 16.7 % of the surveyed farmers grew apricot trees in the orchard system. However, in Sham Valley, most (77.2 %) surveyed respondents grew apricots in an orchard system. Training and pruning are very important activities in apricot tree production, which depends on human labour. However, 43.4 % of the respondents reported that they do not undertake training and pruning regularly. Manuring was not done by (26.4 %) of the respondents. Most (99.2 %) of the growers were not applying chemical fertiliser, possibly due to the ongoing organic farming movement in the region. Most respondents reported not using mulching (98.4 %) and drip irrigation systems (99.2 %). There is a need to impart training on standard cultural practices.

Table 3. Adoption of standard growing practices (% respondents)

Question/ Information sought	Valley			Total
	Sham	Nubra	Leh	
Growing apricots in the orchard system	77.2	14.4	16.7	47.8
Application of manure every year	68.8	83.0	71.4	73.6
Application of chemical fertiliser	0.4	1.3	2.2	0.8
Regular training and pruning apricot trees	47.1	32.0	52.4	43.4
Use of mulching in the orchard	0.4	3.3	2.4	1.6
Use drip irrigation system in the orchard	0	1.3	2.4	0.8

3.5 Damage and Pest Management Knowledge

Aphid and codling moth (*Cydia pomenella*) are the major insect pests of apricots in the Ladakh region. Growers were asked if they knew the name of any insect pest and disease of apricot trees. The majority (78 %) of the respondents were not able to mention the name of a single insect pest, and over (98 %) of surveyed farmers did not know the name of any disease of apricots (Table 4). Therefore, knowledge about insect pests and diseases was poor in the region, which could be due to the low incidence of insect pests and diseases. Loss due to disease has not been reported from the region. The growers (89.4 %) felt that insect pest infestation has been increasing in recent years. When the growers were asked what percent of apricot fruits were damaged due to infest-pest infestation, 49.4 % of respondents reported less than 10 % damage. Fruit damage of 11-30 % was reported by 40.6 % of the surveyed respondents. The majority of the growers from Leh Valley (71.4 %) responded that the damage was less than 10 %. Leh is not a traditional fruit-growing valley; thus, less incidence of insect pests could be due to low initial inoculum. Over 51 % of damage was reported by only 1.8 % of the surveyed respondents.

Orchard sanitation is an effective method of managing insect pests and diseases. Sanitation practices aimed at reducing the initial inoculum causing insect infestation and diseases. When growers were asked questions about orchard sanitation, most (74 %) of the surveyed respondents said they regularly undertake orchard sanitation. Orchard sanitation was more practiced in Sham and Leh Valley

than in Nubra Valley. Most of the growers (99.2 %) do not use chemical pesticides to manage insect pests, which could be due to the low incidence of insect pests and the recent organic initiatives in the region.

Table 4. Knowledge, damage, and management of insectpests and diseases (% respondents)

Question/ Information sought	Options	Valley			Total
		Sham	Nubra	Leh	
Growers know the name of any insect pest of apricot trees	Yes	22.8	25.5	13.1	22.0
Feeling that the insect infestation is increasing in recent years	Yes	93.9	93.5	67.9	89.4
Percent apricot fruit damaged due to insect infestation	<10%	49.8	36.6	71.4	49.4
	11-30%	46.0	39.9	25.0	40.6
	31-50%	3.8	18.3	3.6	8.2
	51-70%	0.4	3.9	0	1.4
	>70%	0	1.3	0	0.4
Growers know the name of any disease on apricot	Yes	1.5	1.3	2.4	1.6
Undertaking regular orchard sanitation	Yes	84.4	47.7	89.3	74.0
Spray of pesticides in the orchard	Yes	0.8	1.3	0	0.8

3.6 Interest and Preferences in Planting Fruit Trees

Growers were asked about their interests and preferences in growing fruit crops (Table 5). Most (94.6 %) of the growers wanted to plant more apricot trees. *Halman* was the most preferred cultivar by a majority (60.2 %) of the farmers, while 35.4 % of the growers wanted to plant the *Raktsey Karpo* cultivar. Growers get Rs 100-120 per kilogram fruits of the two cultivars right at their farm. However, when asked which apricot cultivars they like the most for fresh consumption, most respondents said they like *Raktsey Karpo* (59.6%), followed by *Halman* (35.4 %). *Raktsey Karpo* and *Halman* are the two most popular cultivars known for their fruit quality. Liking *Raktsey Karpo* fruit may be because of its sweetness, juiciness, aroma, flesh color, and stone color[4].

When asked which fruit tree they preferred to grow, the majority of the respondents showed a preference for apricot (72.2 %), followed by apple (27 %), and a minority (0.8 %) preferred to grow other temperate fruits. Apricots and apples are the two main fruit crops of the region, and hence preference for these two crops by over 99 % respondents. Minor quantities of grapes, peaches, cherries, and plums are found in the region, having a competitive advantage as off-season fruit[6].

Table 5. Interest and preferences in planting fruit tress (% respondents)

Question/ Information sought	Options	Valley			Total
		Sham	Nubra	Leh	
Wanting to plant more apricot trees	Yes	95.4	98.7	84.5	94.6
Liking for apricot variety for fresh consumption	*Halman*	26.6	66.0	7.1	35.4
	Raktsey Karpo	69.6	24.8	91.7	59.6
	Narmo	1.1	2.0	0	1.2
	Khantey	1.1	0	0	0.6
	Others	1.6	7.2	1.2	3.2
Preference for growing apricot cultivar	*Halman*	68.4	76.5	4.8	60.2
	Raktsey Karpo	28.4	16.3	91.7	35.4
	Narmo	1.5	0.7	1.2	2.2
	Khantey	1.1	5.9	0	2.4
	Others	0.5	0.7	2.3	0.8
Preference for growing fruit trees in their orchard	Apricot	83.2	79.1	25.0	72.2
	Apple	16.8	18.3	75.0	27.0
	Others	0	2.6	0	0.8

3.7 Constraints in Growing Apricots

Growers were asked to identify one major constraint in growing apricots (Table 6). Surveyed respondents (35 %) reported the problems in the drying of apricots as the major challenge. Apricot drying is an important economic activity. In Malta region of Turkey, 90 % of the apricots produced are dried[9]. Of the growers surveyed, 17.6 % of the respondents reported high insect pest infestation as the major constraint.

Despite having a huge potential for marketing as off-season fruit, the lack of marketing opportunities was cited as the main constraint by 15.6 % of respondents. The scenario will change with the ongoing efforts to send fresh apricots to international and domestic markets outside the region. The protection of young trees from damage by wild and domestic animals is essential for successful orchard establishment, and the lack of fencing around the field were cited as the main constraints by 10.6 % of respondents. Insufficient water for irrigation purposes was cited as the major challenge by 7.4 % of respondents. Although apricot is considered a drought-tolerant crop, commercial apricot production depends on irrigation application. Non-availability of nursery plants was cited as the major constraint by 4 % of growers, and the remaining 9.8 % of respondents cited other issues as the major constraint. Therefore, upcoming research and outreach objectives should emphasise the major constraints the apricot growers face. If fruit drying, incidence of insect pests, marketing opportunities, fencing, and availability of nursery plants are addressed, the growers would keenly feel its impact.

Table 6. Major constraints in growing apricots (% respondents)

Question/ Information sought	Options	Valley			Total
		Sham	Nubra	Leh	
Major constraints in growing apricots	Nursery plant not available	1.1	3.9	13.1	4.0
	High insect infestation	12.9	30.7	8.3	17.6
	Insufficient water for irrigation	7.6	3.3	14.3	7.4
	Lack of marketing opportunity	17.5	18.3	4.8	15.6
	Problem in drying	45.2	29.4	13.1	35.0
	Long gestation period	0.4	0	1.2	0.4
	Lack of fencing around the field	9.5	9.8	15.5	10.6
	Others	5.8	4.6	29.7	9.4

3.8 Source of Nursery Plant and Information

Growers were given a list of five sources of apricot nursery plants and asked which was their main source (Table 7). Most (72 %) of the growers responded that they raise their nursery plants. Friends and relatives were the main source of plants for 14.6 % of growers, and 11.6 % of the surveyed respondents cited the local market as the main source of nursery plants. The Government Horticulture Department was the primary source of nursery plants for just 1.6 % of respondents. Nursery plants are not readily available in the region. Therefore, the establishment of nurseries needs to be promoted in the region.

Growers were given a list of four resources Extension personnel typically use and asked which source was the primary source of information on the management of apricot trees. Overall, growers seemed to be open to a wide variety of sources of information, with the most commonly selected response being friends/ relatives (53.2 %), followed by television (22.4 %), training and awareness camps (15.8 %), and radio (3.6 %).

Table 7. Source of nursery plant, information and training on growing apricot (% respondents)

Question/ Information sought	Options	Valley			Total
		Sham	Nubra	Leh	
The main source of apricot nursery plants	Own raised	80.2	71.2	47.6	72.0
	Friends/ relatives	12.2	20.3	11.9	14.6
	Government Department	0.4	0.7	7.1	1.6
	Local market	6.8	7.8	33.3	11.6
	Others	0.4	0	0	0.2
What is the main source of information on the management of apricot trees?	Radio	1.9	4.6	7.1	3.6
	Television	24	12.4	35.7	22.4
	Friends and relatives	51.7	65.4	35.7	53.2
	Training & awareness camps	16.7	15.7	13.1	15.8
	Others	5.7	1.9	8.4	5.0

CONCLUSION

Ladakh has many natural advantages for apricot production. Despite having a huge potential to be on the world map for quality organic apricot production, the apricot industry in the region is at a nascent stage. A survey of 500 farmers in the present study found that most farmers in the region were small apricot growers, and 47.8 % of respondents had less than 20 apricot trees. Knowledge and adoption of standard growing practices such as training, pruning, manuring, mulching, and management of insect pests were poor among the apricot growers. The biggest constraints in apricot production were the lack of appropriate fruit drying technology followed by high insect pest infestation, lack of marketing opportunities, lack of fencing around the field, insufficient water for irrigation

purposes, and non-availability of nursery plants. There is a need to impart training on standard cultural practices and post-harvest management to the fruit growers. Growers were open to a wide variety of sources of information, with the most commonly selected response being friends/ relatives (53.2 %), followed by television (22.4 %), training and awareness camps (15.8 %), and radio (3.6 %). Most growers do not always keep accurate accounts, so the figures are only estimates. However, the findings will help researchers, extension personnel, administrators, and policymakers to bring reforms to the apricot industry.

REFERENCES

1. Stobdan, T.; Namgial, D.; Chaurasia, O.P.; Wani, M.; Phunchok, T. & Zaffar, M. Apricot (*Prunus armeniaca*L.) in trans- Himalayan Ladakh, India: Current status and future directions. *J. Food. Agric. Res*., 2021, **1,** 86-105.
2. Cunningham, A. Ladakh: Physical, statistical, and historical with notices of the surrounding countries. Gulshan publisher, GowKadal, Srinagar, India,1854, 483 p.
3. Angmo, P.; Angmo, S.; Upadhyay, S.S.; Targais, K.; Kumar, B. & Stobdan, T. Apricots (*Prunus armeniaca* L.) of trans-Himalayan Ladakh: Potential candidate for fruit quality breeding programs. *Sci. Hortic*., 2017**, 218,** 187-92. doi: 10.1016/j.scienta.2017.02.032
4. Naryal, A.; Angmo, S.; Angmo, P.; Kant, A.; Chaurasia, O.P. & Stobdan, T. Sensory attributes and consumer appreciation of fresh apricots with white seed coats. *Hortic. Environ. Biotechnol*., 2019, **60,** 603-10. doi: 10.1007/s13580-019-00146-4
5. Hormaza, J.I.; Yamane, H. & Rodrigo, J. Apricot. *In* Fruit and nuts. Genome mapping and molecular breeding in plants, Vol 4, edited by Kole, C. Springer, Berlin, Heidelberg, 2007. pp 171-87. doi: 10.1007/978-3-540-34533-6_7
6. Stobdan, T. Agriculture in Ladakh: A step towards sustainable mountain development. Beeja House, New Delhi, 2023. 236p.
7. Ellis, K.; Baugher, T.A. & Lewis, K. Results from survey instruments used to assess technology adoption for tree fruit production. *Hort. Technology*, 2010, **20,** 1043-8. doi: 10.21273/HORTTECH.20.6.1043
8. Piñero, J.C. & Keay, J. Farming practices, knowledge, and use of integrated pest management by commercial fruit and vegetable growers in Missouri. *J. Integr. Pest Manag.*, 2018, **9,**1-11. doi: 10.1093/jipm/pmy011
9. Ucar, K.; Saner, G. & Engindeniz, S. The comparative economic analysis of organic and conventional dried apricot production: A case study for Turkey. *Fresenius Environ. Bull.*, 2017,**26,** 4555-60

CONTRIBUTORS

Ms Dolma Lhadon is Junior Research Fellow and PhD candidate in the Horticulture Division of Defence Institute of High Altitude Research. Currently, she is working on organic farming in trans-Himalayan Ladakh. She holds MSc in Horticulture from SKUAST-K, Srinagar.
She conducted the survey, analysed the data, and contributed towards literature collection and manuscript preparation.

Ms Kunzes Dolma is JuniorResearch Fellow and Ph.D candidate in the Horticulture Division, DRDO-Defence Institute of High Altitude Research, Leh. She currently works on organic farming in trans-Himalayan Ladakh. She holds M.Sc in Botany from Panjab University.
She contributed towards literature collection and data analysis

Dr O.P. Chaurasia is Scientist 'G' and Director, DRDO-Defence Institute of High Altitude Research, Leh. He obtained his PhD (Botany) from Magadh University Bodh Gaya, Bihar. He has extensively surveyed trans-Himalayan belts of Ladakh and Lahaul-Spiti and documented the fragile plant biodiversity and its ethnobotanical wealth.
He contributed in manuscript preparation.

Dr Tsering Stobdan is Scientist 'F' and Head, Horticulture Division at DRDO-Defence Institute of High Altitude Research, Leh. He received his PhD from Indian Agricultural Research Institute, New Delhi. His areas of expertise are temperate horticultural crops and protected cultivation.
He conceived the study and contributed in manuscript preparation.