

Hue and Cry for *Fritillaria Cirrhosa* D.Don, A Threatened Medicinal Plant in the Western Himalaya

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Short Report

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Abstract

The unique Himalayan ecosystems have given rise to highly adapted organisms and are repositories to the wild populations of diverse flora and fauna. The high value medicinal and aromatic plant species are an example of the same. Since time immemorial, these plants have been traditionally used by the local inhabitants and have eventually developed a high market value all over the world. Increasing market demand engenders over-extraction of species, unsustainable collection further catalyses decline in wild populations. The current communication raises high conservation concern on the rapid population decline of *Fritillaria cirrhosa* D.Don in the Western Himalaya. Harvested and traded with a new trade name i.e., '*Jangli lehsun*' probably to disguise common *Allium* species, the species is facing tremendous decline in wild populations due to its illegal harvesting and trade in Himachal Pradesh. Further, *Fritillaria cirrhosa* faces threat due to unorganized, over-extraction or unsustainable and premature harvesting of the bulbs, coupled with illegal and hidden markets functioning parallelly. To ensure the long-term conservation of *Fritillaria cirrhosa*, prioritised conservation strategies such as strengthening of the Biodiversity Management Committees, *in-situ* conservation through identification of medicinal plant conservation areas, capacity building through awareness programs for the key stakeholders and sustainable harvesting would be the practical solution.

Introduction

The high-altitude Himalayan ecosystems manifest outstanding diversity in terms of topography, flora, fauna and culture. These landscapes experience severe winters lasting over a period of six months, precipitation feeding the glaciers that form a life support system for the major rivers throughout the year. Such harsh conditions have given rise to highly adapted and hardy flora, fauna and people [1]. The advent of spring is a breath of life and therefore, a busy period for the inhabitants. Local communities very intimately depend on natural resources for their daily subsistence needs and fuel wood collection. Livestock grazing, cultivation and harvesting of crops are the predominant activities. Owing to the habitat heterogeneity, the mountain ecosystems are a repository to many endemic, rare and important flora including medicinal and aromatic plants (MAPs). The availability of MAPs along with isolation of these ecosystems for centuries in terms of culture, geography, politics and physiography has resulted in a unique health care system [2]. Earlier, very little was known and documented about traditional medicinal system i.e., the Tibetan Medicinal System (TMS) or Amchi system of medicine (*Sowa-Rigpa*) [3], with globalization and road accessibility, that is no longer the case. These regions too, are no longer cut off from global societies resulting in cultural and social transformations [4]. Meager opportunities for employment and fewer alternative sources of sustenance force the local inhabitants towards over-exploitation of the existing natural resources, aggravating their degradation [4]. One such example is the steadily increasing pressure on the medicinal plant populations from the wild. These ecosystems are naturally gifted with MAPs growing in wild even more than in cultivation and form an important source of sustenance and profit making for the locals however, unsustainable harvesting has resulted in rapid decline of the wild populations of these species. For instance, the annual demand of some important

MAPs such as, *Gentiana kurroo* Royle and *Picrorhiza kurroa* Royle ex Benth. is almost 5000 tonnes each and that of *Aconitum heterophyllum* Wall. ex Royle is 1000 tonnes, whereas the supply of *Gentiana kurroo*, *Aconitum heterophyllum* and *Picrorhiza kurroa* is only 100 tonnes per year [5]. According to Walter and Gillett [6], imbalance between demand and supply, unfortunately is one of the reasons for the documented extinction of more than 19 plant species in the wild from India, 41 species suspected of having recently become extinct, 102 species are believed to have moved to higher category of rarity, 152 species in threat of extinction if the unsustainable extraction continues and, about 251 species under high risk and only restricted to limited areas. Owing to high demand, small or restricted population, several MAPs have undergone rapid decline in wild population from the Indian Himalayan Region (IHR), for example, rampant collection of *Trillium govanianum* Wall. ex D.Don (Nagchatri) from the Western Himalaya has grown tremendously in the past few years. It is being sold at rates approximately INR 1000 to 1500 kg⁻¹ dry weight. The unregulated trade flourishes despite the ban by the Government of Himachal Pradesh on transportation of the plant material of Nagchatri [7]. Another well-known insect fungus commonly known as Keedajadi or Yartsagunbu (*Ophiocordyceps sinensis* syn. *Cordyceps sinensis*) with multiple medicinal uses, has received high attention in terms of demand and price in the Himalayan region, especially Uttarakhand, Nepal and China. The collection serves as a lucrative livelihood opportunity to the local collectors however, unrestrained extraction coupled with livelihood dependency has led to depletion of Keedajadi in the wild [8]. Similarly, the reported population of Indian spikenard or Indian Valerian (*Nardostachys jatamansi* (D.Don) DC.) has declined 70-80% in the wild from IHR [9]. Whereas, Salampanja or Hathajadi (*Dactylorhiza hatagirea* D.Don Soó) has created high demand in the Indian and International markets owing to its high medicinal and edible value [10] with annual demand reaching around 5000 tonnes [11]. The regeneration capacity of this high value orchid is rather poor due to pollinator specificity and requirement of mycorrhizal association [12] therefore, over extraction from the wild poses a serious threat.

***Fritillaria cirrhosa* D.Don: A high conservation concern**

The current communication highlights sudden spurt in demand and market trade of yet another MAP, *Fritillaria cirrhosa* (syn. *Fritillaria roylei* Hook.) with little knowledge of its usage as well as market or end users is a cause of grave concern in its distribution range in the Western Himalaya. Recently, as a part of Wildlife Institute of India's research project on medicinal and aromatic plants in Himachal Pradesh with logistics support from the Himachal Pradesh Forest Department (HPFD) and funds received from the United Nations Development Program and Global Environment Facility, the authors after a span of more than two years (2018-2021) report drastic decline in the population of *F. cirrhosa* in the Lahaul and Pangi landscapes of Himachal Pradesh (Figure 1). Pangi spreads over 1601 km² area is positioned approximately between 32°11'30"-33°13'06"N and 75°45'~77°03'33"E with 54 inhabited villages. Lahaul lies between 32°61'92" N and 77°37'84" E with 132 villages. These landscapes are located between the Dhauladhar-Pir Panjal and Zaskar ranges in Himachal Pradesh in the upper catchment of Chandrabhaga (Chenab) that forms a transition zone between the Greater and Trans-Himalaya.

Commonly known as Kakoli, *F. cirrhosa* is an Asian species of herbaceous plant belonging to Liliaceae (lily) family (Figure 2). The name *Fritillaria* derived from the Latin 'fritillus' meaning dice-box, possibly refers to the checkered pattern on the flowers. It is mainly distributed in Pakistan, China, India, Nepal, Bhutan and Myanmar. In India, it shows distribution in the states of Uttarakhand, Himachal Pradesh and Jammu & Kashmir [13] which grows mainly on rocky and grassy slopes in alpine and sub-alpine regions amidst shrubberies such as *Lonicera* spp., *Rosa* spp. and *Salix* spp. at an elevation ranging from 3000-4200m [14]. It generally flowers between May-July and fruits from September-October. This herbaceous plant has yellowish green to brownish purple bell-shaped solitary flowers, leaves are linear, lanceolate and long pointed. Also known as yellow Himalayan fritillary, *F. cirrhosa* forms an important component of a polyherbal formulation of eight herbs (asthavarga) [15]. The sub-terranean bulb is used as febrifuge, galactagogue, haemostatic, expectorant, aphrodisiac, anti-rheumatic, spermatogenic and tonic, the rhizome is useful in excessive thirst, rheumatic pain and heamatemesis [16-19].

Based on semi-structured questionnaire surveys, individual interviews, group discussions, scrutiny of export data obtained from respective forest divisions and visits to villages (29) and local markets (06) in Himachal Pradesh, the current study reports severe threat to the species predominantly due to premature collection of bulbs, over exploitation, unorganized harvesting and illegal trade in the landscapes. Harvested and traded with a new trade name i.e., '*Jangli lehsun*' probably to disguise common *Allium* species, the species is facing tremendous decline in wild populations due to its illegal harvesting and trade in the landscapes. Unfortunately, no information on the medicinal use has been reported from the local inhabitants however, the species sells in the market like a hot cake. Enthusiastic collection of premature bulbs during July (instead of September-October on bulbs maturity) has resulted in the absence of perennating buds for the next growing season. For instance, premature bulbs collected by a local was observed at the site with more than 5kg costing INR 60,000 in 2019 (Figure 3). Unfortunately, contrary to other MAPs, there is no harvesting and collection protocol developed for this species. This has created ambiguity in terms of the ultimate market and actual use of Jangli lehsun in the region. In order to reduce illegal harvesting of Jangli lehsun, HPFD issues permits to local plant collectors with permit fee of INR 10,000 quintal⁻¹; however, illegal trade continues to flourish owing to the hidden markets functioning parallelly. Further, as one moves up in the value addition hierarchy, the intermediaries and middlemen receive higher returns than the collectors at the grassroot level in the market chain [20]. The price along the trade chain was also studied from the production level in landscape villages, small aggregation markets in towns and large *mandis* (markets) in cities. The result illustrated an increase in the price of MAPs as it moves from village to city (Figure 4). Although, extensive field-based study on available growing stock and population status of *F. cirrhosa* would be essential in the landscapes, the present study concludes that the prevailing unselective and unsustainable harvesting may lead to the regional extinction of *F. cirrhosa* in its natural habitats in the Western Himalaya.

Owing to its population reduction by 58–77% during the last 20–30 years [13], the species has been assessed using IUCN Red List Criteria and has been listed as 'Critically Endangered' in Uttarakhand and

‘Endangered’ in Himachal Pradesh and Jammu and Kashmir [21]. The market demand of this species is increasing while the supply is gradually decreasing [22]. Thus, extensive regional assessments of MAPs in Himachal Pradesh [23-24] have also categorized this species as ‘Endangered’, hence, restoring wild populations is crucial.

Market and Trade

Fritillaria cirrhosa is one of the 18 species that are actively traded throughout the world and constitutes large scale industry; worth 400 million US dollar per annum demand in China [25]. In India, market value of dry bulbs is approximately 10,000–15,000 kg⁻¹ INR in local markets [26]. Although, *Fritillaria cirrhosa* is prohibited in India for export if the plants are collected from the wild. Raw drug obtained from cultivated material can however, be exported. According to Goraya and Ved [27], trade per annum and price of *F. cirrhosa* was found to be <10 MT with price ranging from 1200-6000 kg⁻¹ respectively. As per the HPFD during 2017 to 2021, the total estimated volume of the exported quantity of *Fritillaria cirrhosa* was 291.16 quintals in the Pangti landscape [20] (Table 1). Further, the average market price of *F. cirrhosa* was recorded between 9666.66±881.92 to 17666.66±1452.97 (Rs/kg±SD) in major markets viz., Udaipur (Lahaul), Killar (Pangti), Keylong, Manali and Amritsar [20] (Figure 4). According to Goraya and Ved [27], Jangli lehsun witnessed a sudden spurt between 2009-10 and 2014-15 in its distributional range in the states of Himachal Pradesh, Jammu & Kashmir and Uttarakhand for its bulbs. The wild populations of *F. cirrhosa* have succumbed to this high annual harvesting pressure pushing these species towards possible extinction.

Conclusion

Owing to its strict habitat requirements, domestication and cultivation is extremely difficult, therefore, majority of *F. cirrhosa* is still gathered from the wild. Thus, to reduce pressure on the wild populations, designing sustainable harvesting and collection protocols, and development of tools and techniques for its cultivation is the need of the hour. As this valuable species is under multiple threats due to its high demand and market, the present investigation concludes that sustainable management coupled with organized collection and utilization would be the practical solution in the conservation of *F. cirrhosa*. Subsequently, strengthening of Biodiversity Management Committee for establishing inventories on the existing natural resources of the region and spreading awareness on the dwindling populations can be the way forward. Identifying and building the capacities of stakeholders such as Forest Department staff, local collectors, amchis or traditional healers and medicinal plant traders in the process of conservation can help in community based natural resource management. Introduction of state of art technology in cultivation, harvesting and storage of MAPs in general and Jangli lehsun specifically, would also help to avail the best rates at the grass root level. Further, establishment of *in-situ* such as Medicinal Plant Conservation Areas and *ex-situ* methods of conservation are also suggested as potential source areas.

Declaration

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions: MM, AK did the literature review, collected and analyzed the data and wrote the manuscript. MS prepared the study area map and collected the field data. GSG, AK reviewed the manuscript and provided technical inputs.

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Data Availability Statement

Data supporting the results in the current study (presented mainly in Table 1 and Figure 4) are based on semi-structured questionnaire surveys, individual interviews, group discussions, scrutiny of export data obtained from Himachal Pradesh Forest Department and visits to villages and local markets in the study area. The information is not publicly available, however generated information during and/or analysed during the study can be availed from the corresponding authors with prior approval (preferably written) from the Himachal Pradesh Forest Department.

References

1. Bhatnagar YV, Mathur VB, McCarthy T. A regional perspective for Snow Leopard conservation in the Indian Trans-Himalaya. Presented at the National Workshop on Regional Planning for Wildlife Protected Areas, 6-8 August 2001, India Habitat Centre, New Delhi as part of GEF – India Eco-development Project Initiative, Wildlife Institute of India, Dehradun 2001.
2. Kala CP. Medicinal plants of the high altitude cold desert in India: diversity, distribution and traditional uses. *The International Journal of Biodiversity Science and Management*. 2006; 2 (1): 43–56.
3. Namgyal G, Phuntsog ST. *Amchi pharmacotherapeutics*: Central Council for Research in Ayurveda and Siddha. Cambridge Printing Works, New Delhi. 1990; pp330.
4. Norberg-Hodge H. The march of the monoculture. *The Ecologist*. 1999; 29. (2):194–7.
5. Mishra MK. Commercial trade in medicinal plants in India regulatory mechanism, trade enterprise, sensibilities and conservation concerns: an overview. In medicinal plants: a global heritage. *Proceedings of the international conference on medicinal plants for survival*. International Development Research Center, New Delhi. 1998; pp 142–157.

6. Walter KS, Gillett HJ. (eds.) 1997 IUCN Red list of threatened plants. IUCN, Gland, Switzerland and Cambridge, UK. 1998.
7. Uniyal SK, Datta A. Nagchhatri- a plant in Peril. *Journal of Biodiversity Management and Forestry*. 2012; (1). DOI:10.4172/2327-4417.1000101
8. Yadav PK, Saha S, Mishra AK, et al. Yartsagunbu. Transforming people's livelihoods in the Western Himalaya. *Oryx*. 2019; 53(2): 247-255.
9. Singh UM, Gupta V, Rao VP, et al. A review on biological activities and conservation of endangered medicinal herb *Nardostachys jatamansi*. *International Journal of Medicinal and Aromatic Plants*. 2013; 3(1): 113-124.
10. Badola HK, Pal M. Endangered medicinal plant in Himachal Pradesh. *Current Science*. 2002; 83. (7): 797–798.
11. Kala CP. Assessment of species rarity. *Current Science*. 2004; 86: 1058–59.
12. Bhatt A, Joshi SK, Garola S. *Dactylorhiza hatagirea* (D.Don) Soo- a West Himalayan orchid in peril. *Current Science*. 2005; 89: 610–612.
13. Chauhan RS, Nautiyal MC, da Silva JAT, et al. Habitat preference, ecological parameters and conservation of *Fritillaria roylei* Hook. an endangered medicinal herb of the asthavarga group. *Bioremediation, Biodiversity and Bioavailability*. 2011; 5(1): 73–76.
14. Pal M, Samant SS. Diversity, distribution and conservation of economically important medicinal and aromatic plants of the Indian Himalayan region. XII World Forestry Congress, Quebec, Canada. 2005.
15. Singh AP. Ashtavarga: Rare medicinal plants. *Ethnobotanical Leaflets*. 2006;(1): 11.
16. Joshi SK, Dhar U, Andola HC. In-vitro bulblet regeneration and evaluation of *Fritillaria roylei* Hook. - a high value medicinal herb of the Himalaya. *Acta Horticulturae*. 2007; 756: 75–84. DOI: 10.17660/ActaHortic.2007.756.8
17. Dhyani A, Nautiyal BP, Nautiyal MC. Importance of astavarga plants in traditional systems of medicine in Garhwal, Indian Himalaya. *International Journal of Biodiversity Science, Ecosystem Services & Management*. 2010;6(1–2): 13–19.
18. Bisht VK, Negi BS, Bhandari AK, et al. *Fritillaria roylei* Hook. in Western Himalaya: Species biology, traditional use, chemical constituents, concern and opportunity. *Research Journal of Medicinal Plants*. 2016; 10: 375-381. DOI: 10.3923/rjmp.2016.375.381
19. Marde R, Mishra RK. Kakoli- an important medicinal plant of Ayurveda suffering from identification syndrome. *International Journal of Unani and Integrative medicine*. 2019; 3(2): 08–12.
20. Kumar A, Sathyakumar S, Goraya GS, et al. Assessment of medicinal and aromatic plant species on their collection, usage, demand, markets, price trends and life cycle in Lahaul and Pangi landscape, Himachal Pradesh. A report submitted to Himachal Pradesh Forest Department and United Nations Development Programme. 2021; pp 141.
21. Ved DK, Kinhal GA, Ravikumar K, et al. Conservation assessment and management prioritization for medicinal plants of Himachal Pradesh, Jammu, and Kashmir, and Uttarakhand.

- In Workshop: Foundation for Revitalization of local Health Traditions, Bangalore, India. 2003.
22. Ved DK, Goraya GS. Demand and supply of medicinal plants. Medplant-ENVIS Newsletter on Medicinal Plants. 2008; 1(1): 2–4.
 23. Ved DK, Tandon V. Conservation assessment and management prioritization for high altitude medicinal plants of Jammu-Kashmir and Himachal Pradesh. Foundation for Revitalization of Local Health Traditions, Bangalore, India. 1998; pp 75.
 24. Goraya GS, Jishtu V, Rawat GS, et al. Wild medicinal plants of Himachal Pradesh: an assessment of their conservation status and management prioritization. Himachal Pradesh Forest Department, Shimla, India. 2013.
 25. Luo D, Liu Y, Wang Y, et al. Rapid identification of *Fritillaria cirrhosa* bulbs and its adulterants by UPLC-ELSD fingerprint combined with chemometrics methods. *Biochemical Systematic and Ecology*. 2018; 76: 46–51. <https://doi.org/10.1016/j.bse.2017.12.007>
 26. Kumar P, Partap M, Rana D, et al. Metabolite and expression profiling of steroidal alkaloids in wild tissues compared to bulb derived in-vitro cultures of *Fritillaria roylei*–High value critically endangered Himalayan medicinal herb. *Industrial Crops and Products*. 2020; 145: 111945. <https://doi.org/10.1016/j.indcrop.2019.111945>
 27. Goraya GS, Ved DK (2017) Medicinal Plants of India: An assessment of their demand and supply. National Medicinal Plants Board, Ministry of AYUSH, Government of India, New Delhi and Indian Council of Forestry Research and Education, Dehradun. Herbal Perspectives: Present and Future. Satish Serial Publishing House, Delhi, India. pp 37–46.

Tables

Table 1. Export of *Fritillaria cirrhosa* in Pangi, Himachal Pradesh.

Year	Exported quantity (quintal)	No. of collectors
2017-2018	108.41	25
2018-2019	46.25	16
2019-2020	51.5	13
2020-2021	85	02

Figures

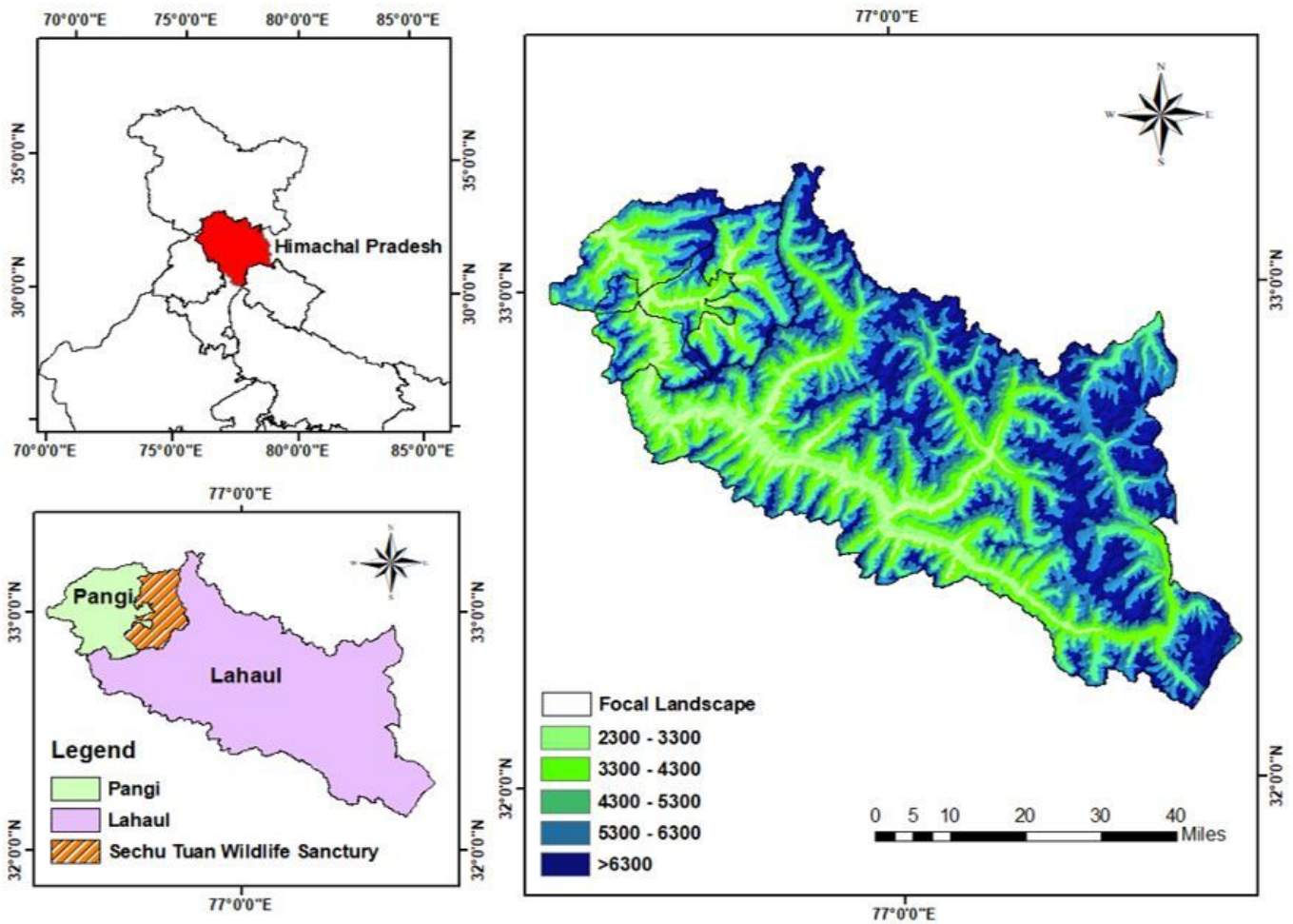


Figure 1

Map showing Lahaul and Pangi landscapes in Himachal Pradesh, India. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

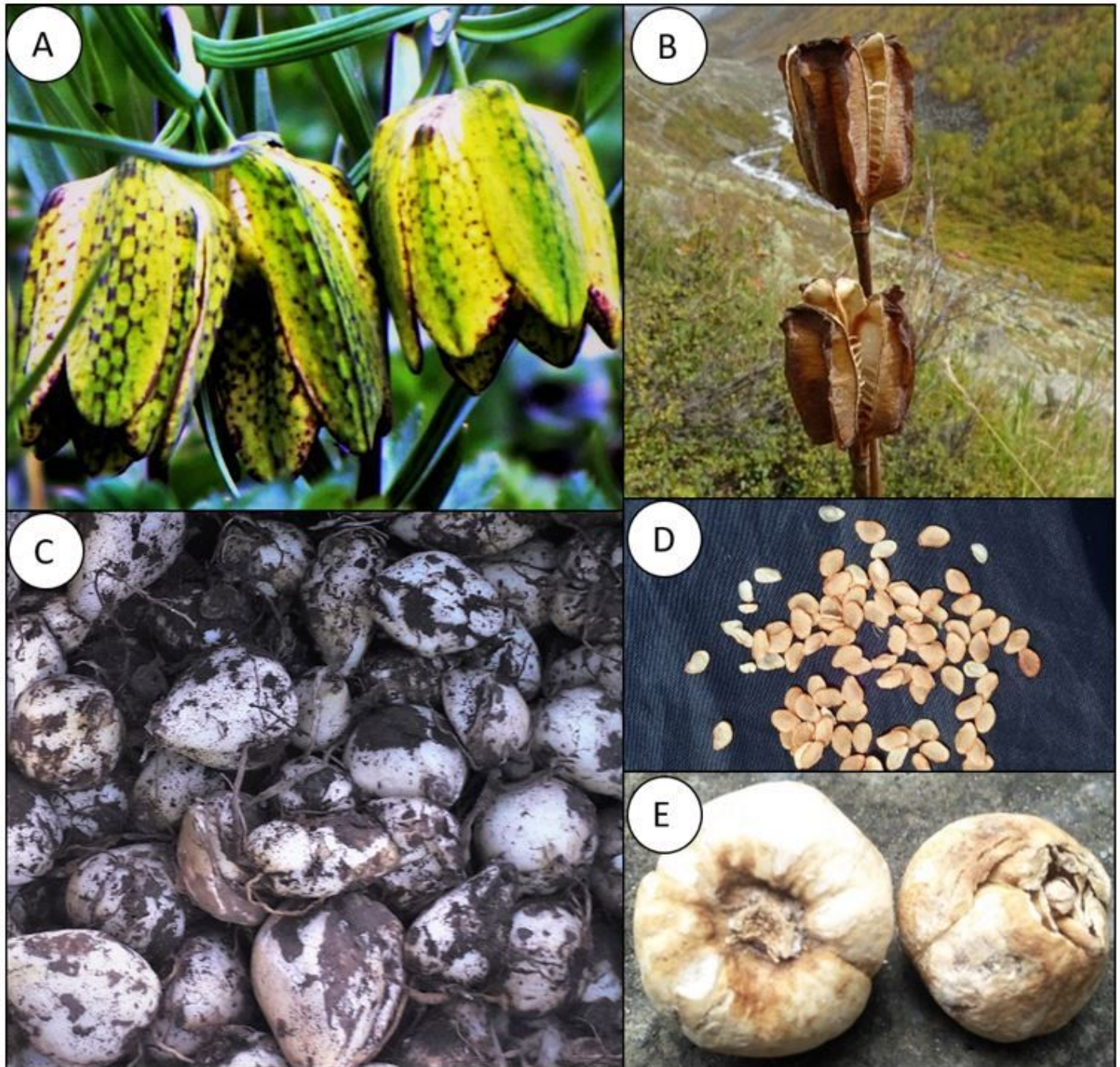


Figure 2

Fritillaria cirrhosa D.Don A- Flower, B- Follicle, C- Immature bulb, D- Seed, E- Mature bulb.



Figure 3

Premature bulbs (left) and dried bulbs (right) of Jangli lehsun collected by a local trader in Himachal Pradesh.

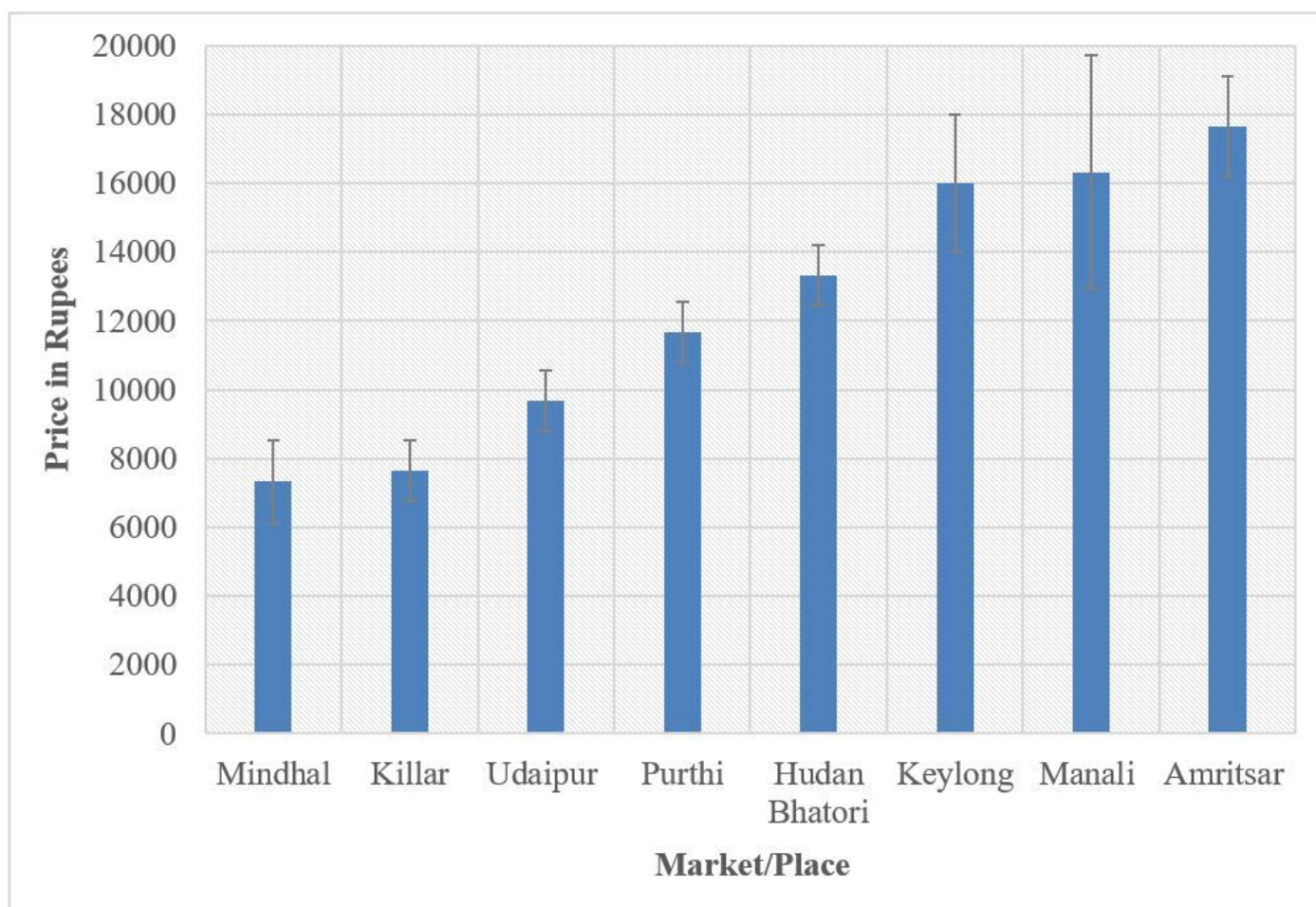


Figure 4

Market price (Rs./kg $\pm$ SE; n=15) of *Fritillaria cirrhosa* in different markets (village/town/city).