



Habitat protection of important medicinal plants by screening and cultivation of promising germplasm

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ABSTRACT

The conservation, habitat protection, cultivation, optimizing yield parameters for increased productivity can be the long term strategy of conserving and protecting the important high value drug plants such as *Valeriana jatamansi*, *Picrorhiza kurrooa* and *Aconitum heterophyllum*, which were once upon found in the abundance in the temperate region of western Himalayas in the Pir -panjal ranges of the Chamba of Himachal Pradesh. The study was conducted in the area of 32° 10// to 33°13// N latitude and 75°45// E to 77°33// E longitude limits ranging from the altitudes of 1200 to 4398 above msl. The wide area of availability of these species was surveyed and germplasm was collected. The highest survival percentage of *Valeriana jatamansi* species ranged from 80 to 95 percent it was followed by the survival percent of *Picrorhiza karrooa* species which ranged from 71.33 %-80.00 %. However, the survival percent *Aconitum heterophyllum* ranged from 67-78 percent.

Key words: *Aconitum heterophyllum*, Cultivation, Germplasm, Medicinal plant, *Picrorhiza karrooa*, *Valeriana jatamansi*

The rich biodiversity of India, which is around 8% percent of the world's total biodiversity, is under sever threat because of habitat destruction and over exploitation of resources (Anonymous 2002). Since, most of the raw material is sourced from developing countries and marketed in the developed world, mostly in US, Japan and European Union. In India itself, there are around 6500 pharmaceutical units which required thousand tonnes of raw material for their routine production. It is estimated that 1350 plant species of Himachal Himalayas are exported for the same kind of use.

The ancient scriptures and the mythology are replete with references about the healing plants from the Himalayas. Himachal Pradesh, a North-West Himalayan state having a geographical area of 55 673 km² (about 1.7% of the country's geographical area), aptly showcases this medicinal plant richness and diversity of the zone that is spread over its different agro-climatic zones and vegetation types stretching from an altitude of about 300 m to more than 6 000 m in the inner Himalayan ranges. The state harbours more than 3500 species of flowering plants, out of which about 800 species are estimated to be used in Ayurveda, Unani and Homeopathic drugs, spread across more than 100 plant families with the highest represented families being *Asteraceae*, *Rosaceae*, *Ranunculaceae* and *Fabaceae*.

Great variability exists among medicinal plant species available in the region, which, if screened can help to generate valuable varieties of future. Species such as Podophyllum, Kuth, Tagar, Asparagus, Dhup, Kashmal, Salamanca, Shiglimingli, Aatis, Karu, Ashwagandha, *Viola odorata*, *Terminalia* spp, *Aegle marmelose*, *Bacoppa* spp, *Celastrus* spp, Safed musli, Asparagus, Kaunch, Tulsi etc. and many more have great scope as commercial crops in near future. There is an ever-growing demand of drugs of Indian system of health care, which has resulted in the spurt of pharmacies in the country. These have increased to the tune of 6500 throughout the country. The sudden increase in demand has created a problem of supply and availability of quality raw material of medicinal plants. Moreover, there is no much information regarding the pictographic identification and germplasm. There is also no proper information about their cultivation and preservation. Rao and Saxena (1994) reported average annual (per hectare) income upto rupees twenty thousand through mixed cropping of high altitude medicinal herbs. At present these are being exploited from the natural habitats. This has resulted in speedy loss of valuable germplasm from Himalayas. The monthly collections of these drugs have gone down to its half in the past ten years. The major objective of the present study was to screen germplasm from the natural habitats and evaluate for the production and economic parameters of some high value

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medicinal and aromatic plants of temperate region from where the large scale exploitation is taking place.

MATERIALS AND METHODS

The present investigation was carried out to study the variation in germplasm and seedling parameters in *Valeriana jatamansi*, *Picrorhiza kurroa* and *Aconitum heterophyllum* found in the Pir-panjal ranges of the Chamba district of Himachal Pradesh. The natural niches of these species were identified and planting stock was harvested from each source to establish the progeny trial. Selected sources ranged from 32° 10// to 33° 13// N latitude and 75° 45// E to 77° 33// E longitude and altitude from 1200 to 4398 above msl. For each site, 900 plants were collected from each habitat, which were at least 20-30 km apart by distance and separated by natural boundaries such as hill top and valleys to avoid narrowing down the variation in sample due to relatedness or inbreeding. The bulk sample from each site was given a provenance title before bringing them to laboratory. The planting stock was raised in the nursery beds for further evaluation of the growth parameters and economic biomass production.

A study on the growth and biomass production was carried out in the experimental farm of Dr Y S Parmar University of horticulture and Forestry, India at Banioga in Chamba district at a location typically representing the natural zone of the species at an altitude of 2134 m above msl is situated between 31° 37// N latitude and 76° 33// E longitude. The average minimum and maximum temperature of the site was -4 and 29.2°C, respectively. The rooted nursery stock was planted in well prepared nursery beds in a randomized block design with three replicates. The leaf litter rich FYM was applied at the rate of 15 tonnes/ha in the nursery bed before transplanting the vegetative material. The roots were trimmed to avoid any weight to planting stock (Nautiyal 2004). The growth parameters were recorded in the month of September at the end of third year, i.e. at the maturity of the crop (The crop cycle of all these crop ranges from 3-4 years). The weeding and irrigation of beds were done manually at regular intervals as per requirements of the crops. The germination and plant growth parameters, viz. plant height, collar diameter, number of leaves, number of branches, number of roots, Eco-return/ha and root length were recorded for each species. The underground parts of the plant were separated at the collar level for recording fresh weight of shoot and underground parts separately. The shoot and underground parts were dried in hot air oven at 60 °C until constant weight to determine the mean dry weight of shoot and underground parts per plant. Based on the dry weight, dry matter content in shoot and underground parts of the plant was computed. The best selection from the all the collections were evaluated for their performance at the farmer's field under different soil types in the third year of the study in year 2011. The growth parameters pertaining to

the economic biomass were recorded for screening the most suitable collection for further multiplication and propagation.

RESULTS AND DISCUSSIONS

Sugandhwala (*Valeriana jatamansi*)

Survey : The temperate region of the Chamba district was surveyed for identification of niches and germplasm collection for further improvement and generation of quality planting stock of *Valeriana jatamansi*. Chanju, Khajiar, Bhandal, Tissa, Bharmour and Bairagrah were identified. The six broad collections from these areas were made and named as Khajiar (32°32//N, 76°03// at 2094 m above msl), Chanju (32°45//N, 76°15// at 1952 m above msl), Bhandal (32°50//N, 76°00// at 2680 m above msl), Holi (32°54//N, 76°10//2910 m above msl), Sakloga (32°49// N, 76°11// at 2138 m above msl), Bairagrah (32°54//N, 76°10// at 2945 m above msl), collections. These collections were evaluated for growth, regeneration and economic biomass production. The extraction of *Valeriana jatamansi* in large quantity from wild in Chamba district has been reported by Raina *et al.* (2011). *Ex situ* cultivation is recognized as a viable option for conservation of the species and meeting the demand of raw material by the industry (Khoshoo 1993, Badola and Pal 2002).

Screening of the germplasm: The planting stock was procured from the natural habitats and put under evaluation at the Banioga nursery of the project. The standard packages of practices of crop cultivation were applied to all the collections. The perusal of data in table 1 reveals that the economic yield varied from 30-50 q/ha. The highest yield per hectare was recorded to be maximum in case of Khajjiar collection of around 50 q/ha. The Khajjiar collection gave the maximum gross returns per ha, i.e. around ₹ 460 000/ha over three years of crop cycle, averaging around 150 600/ha/year (Table 1). The lowest yield/ha was recorded in the Sakloga collection. Yield of roots of *Nardostachys jatamansi* de has been reported to be 1 290 kg/ha/annum (Anonymous 2000). Overall, the plant parameters such as leaf size, leaf breadth, branch length etc. were also found maximum in the Khajjiar collection.

Out planting performance under different soil conditions: Sugandhwala improved composite stock was planted in the field to evaluate their performance. The survival percentage of the out field plantation ranged from 80 to 95 percent at the different sites. Sugandhwala improved composite stock of screened germplasm planted at site-2 recorded the maximum survival of 95.00 per cent. Singh *et al.* (2010) reported there was significant variation of plant growth and essential oil in the underground parts of *V. jatamansi* under different moisture regimes and months of the year.

Kutki (*Picrorhiza kurroa*)

Survey: The different regions having the natural population of the species were identified with the help of local plant collectors and were surveyed for collection,

Table 1 Economics of cultivation of different collections of sugandhwala

Collection	Plant height (cm)	Plant diameter (mm)	Number of leaves per plant	Leaf breadth (cm)	Leaf length (cm)	Total root (cm)	Main root (cm)	Branch length (cm)	Morphology of the leaf	Yield per ha (q/ha)	Cost of cultivation of sugand	Eco. return/ha over 3 years (₹12000 q)	Net returns (3 years)
Khajiar	23	42	13	8.8	9	21	42	12.2	Leaf size large	50	140000	60000	460000
Bairagrah	15	34	19	5.8	7	23	34	11.3	Leaf size medium	45	140000	540000	400000
Bhandal	20	43	22	6	6	22	35	11.3	Leaves medium to large with cut on edge	40	140000	480000	340000
Chanju	15	40	16	6.3	7	20	33	9.67	Small size leaves	32	140000	384000	244000
Holi	11	17	12	4.5	5	16	36	6.47	Leaf size medium to large	34	140000	408000	268000
Sakloga	16	27	14	3	4	21	32	4.93	Small sized leaves	30	140000	360000	320000

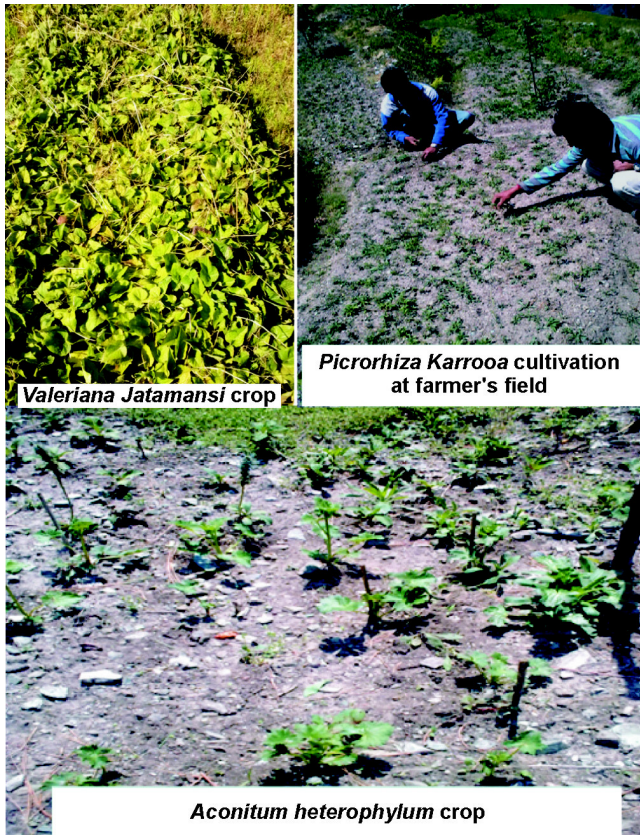
domestication, improvement and generation of quality planting stock of kutki. The collections were made from the four niches, viz. Salooni, Tissa, Bharmour, and Charada area of the district. The four collections from these areas were made and named as Chanju ($32^{\circ}45//N$, $76^{\circ}15//$ at 1952 m above msl), Sakloga ($32^{\circ}49//N$, $76^{\circ}11//$ at 2138 m above msl), Bairagrah ($32^{\circ}54//N$, $76^{\circ}10//$ at 2945 m above msl) and Chainii pass ($32^{\circ}58//N$, $76^{\circ}12//$ at 3120 m above msl)

collections. These collections were planted at the project site for evaluation of economic biomass, regeneration and growth parameters. *Ex situ* cultivation is recognized as a viable option for conservation of the species and meeting the demand of raw material by the industry (Khoshoo 1993, Badola and Pal 2002).

Screening of the germplasm: The germplasm of *Picrorhiza kurroo* was procured from the natural habitats

Table 2 Performance of different collections of *Picrorhiza kurroo*

Collection	Plant height (cm)	Plant diameter (mm)	Number of leaves per plant	Leaf breadth (cm)	Leaf length (cm)	Total root length (cm)	No of branch	Plant dry weight	Morphology of the leaf	Yield per ha (q/ha)	Cost of cultivation	Total return/ha (₹ 3000 /q)	Net returns per ha (₹) three years
Sakloga	31.5	35.5	34	2.8	4.3	20	3	15	Leaf size medium and notched at edges	20	239000	600000	361000
Chainii pass	24.66	39.3	45	3.8	4.3	19	4	12	Leaf size medium less notched at edges	22	239000	660000	421000
Bairagrah	33.33	50.6	67	5	5.6	21	7	18	Large leaves with shine and notched at edge	24	239000	690000	451000
Chanju	25.33	44.3	46	3.3	3.9	20	4.3	17	Small sized leaves	21	239000	630000	391000



and put under evaluation at the experimental farm at 2134 m above msl. The standard packages of practices of crop cultivation were applied to all the collections. The over all gross returns from kutki ranged from ₹ 600 000 per ha to

690 000 per ha over three years of crop cycle (Table 2). The Bairagrah collection recorded the maximum yield per ha to the tune of 24 q/ha giving total net returns of ₹ 451 000 per ha. The lowest yield/ha was recorded in the Sakloga collection. Nautiyal *et al.* (2004) reported that the yield of Sugandhwala to the tune of 11 q/hectare of dry roots and rhizomes in the third year when the crop is raised through rhizomes; however, 10–11 q/hectare dry weight of roots and rhizomes are obtained in lesser period when the plant is propagated using stolons. They further opined that yield proportionally increases with elevation.

Out planting performance under different soil conditions:

The planting material of kutki generated under the project was planted at the different altitudinal ranges covering Jassorgrah, Banioga, Khajiar and Jhajjakothi area in year, 2011. The survival per cent ranged from 71.33% -80.00% percent. The improved composite stock *Picrorhiza kurrooa* recorded the maximum survival of 80 per cent at site one located at 2200m above msl. The higher altitudinal ranges recorded the higher percent of survival than the lower altitudinal ranges. The yield is proportionally increases with elevation (Nautiyal *et al.* 2004).

Atish (Aconitum heterophyllum)

Survey: Collections from three niches viz Pangi, Bairagrah and Chianii pass were made in year 2008-09. These collections were put under evaluation for their regeneration and growth characters. These collections had been assigned names as Pangi(33°01//N, 76°14// at 4398 m above msl), Bairagrah (32°54//N, 76°10// at 2945 m above msl) and Shutrandi (32°57//N, 76°14// at 3485 m above msl) collections. These collections were further put under

Table3 Performance of different selections of *Aconitum heterophyllum*

Collection	Plant length (cm)	Plant diameter (mm)	Number of leaves per plant	Leaf breadth (cm)	Leaf length (cm)	Total root length (cm)	Morphology of the leaf	Yield per ha (kg/ha)	Seed per ha (kg/ha)	Cost of cultivation ('000)	Total returns /ha (turber+ seed) (₹4000/kg+1000 kg)	Net returns per ha (₹) over three years
Pangi	80 80 67	20.4	519	4.8	5.25	9	Leaf round with sharp tip with deep cut	100	3.67	230	436700	206700
Shutrandi		19.33	23	5.79	6.25	11	Leaf narrow from top and broad at base with deep cut	120	4	230	520000	290000
Bairagrah		23.6	34	6.83	5.56	10	Round shine leaf and deep cut	101	3.8	230	442200	212200

evaluation standardization of growth biomass parameters. *Ex situ* cultivation is recognized as a viable option for conservation of the species and meeting the demand of raw material by the industry (Khoshoo 1993, Badola and Pal 2002).

Screening of the germplasm: The germplasm of atish was procured from the natural habitats and put under reevaluation at the project nursery. The standard package of practices was applied for cultivation to all the collections. The Shutranti collection gave the maximum gross returns per ha, i.e. around ₹ 5 20 000 per ha over three years of crop cycle (Table 3). The lowest yield per ha was recorded in the Pangri collection. The Shutranti collection recorded the maximum yield per ha to the tune of 120 kg/ha giving total net returns of ₹ 290000 per ha only. Butola and Badola (2011) reported the similar kind of results while studying the three endangered temperate species. However, Nautiyal (2004) recorded the production of 518 kg/hectare to 579 kg/hectare, respectively, from seedlings and tuber cuttings has been recorded after third year of cultivation under experimental conditions. Temperature is a major factor, which is the main determinant of phenological plant development (Worral 1993, Sparks 2002).

Out planting performance under different soil conditions: *Aconitum heterophyllum* showed very good growth at different altitudinal ranges and has got the potential to be adopted as cash crop. Crop annual growing period of the crop is very short and has very limited area of production due specific

environment requirements. Crop cultivation was done at two sites at Site-1 at 2200 m above msl and site-2 at 2020 above msl. The perusal of data reveals that the survival to the tune of 67-78 was recorded at both the sites. Site-1 recorded the maximum survival percent of 78%.

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