Development of Agro-Technique for some Important Maps of Kashmir Himalaya

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Abstract

Development of agro-technique is one of the basic conservation strategies for sustainable development and used of medicinal plants. Keeping in view the immense importance of development of agro-techniques the present study was carried out. Agro-techniques have been standardized for various Medicinal and Aromatic Plants (MAPs). Present study revealed that sandy soil was the suitable for successful establishment of most of the transplants. Organic manure, timing of transplantation and proper irrigation prove crucial for establishment of these prized plants upon transplantation. Most of the transplants thrive well in plain beds with raised bunds. The present communication will prove helpful for mass cultivation of these MAPs under *ex-situ* conditions.

Keywords: Agro-technique, medicinal plants, sandy soil

Introduction

Medicinal plants constitute a considerably large component of natural vegetation. Several of these species are in great demand for domestic consumption as well as for commercial use by the herbal industry (Somashekhar and Sharma, 2002). About 800 species are estimated to be in trade with a turnover of Rs.4000 crores per year. This high demand by the herbal industry has put enormous pressure on the wild populations leading to destructive collection of the produce. Absence of commercial cultivation of these species, results in increased dependence on the wild collections, which has further aggravated the situation . Today, a large number of medicinal plants species are considered threatened due to such high demand and destructive collection practices. Thus, the conservation efforts are of immediate need to save these species in the wild by maintaining their wild populations, without which the species may be wiped out (Somashekhar and Sharma, 2002).

Conservation of species diversity is one of the main goals of the 2010 biodiversity target. *Ex-situ* conservation is an integral part of conservational strategies and is becoming more important as a backup technology (Lozoya, 1994; Nautiyal and Nautiyal, 2004).Information on the propagation of medicinal plants is available for less than 10% and agro-technology is available only for 1% of the total known plants globally. This trend shows that developing agro-technology should be one of the thrust areas for research (Kuniyal *et al*., 2005). Furthermore, in order to meet the escalating demand of medicinal plants, farming of these plant species is imperative. Apart from meeting the present demand, farming may conserve the wild genetic diversity of medicinal plants. Farming permits the production of uniform material, from which standardized products can be consistently obtained. Cultivation also permits better species identification, improved quality control, and increased prospects for genetic improvements (Khan and Khanum, 2000). Selection of planting material for large-scale farming is also an important task. The planting material therefore should be of good quality, rich in active ingredients, pest- and disease-resistant and environmental tolerant (Kala *et al.,* 2006). Keeping in view the rising demands of MAPs and increasing threats in their natural habitats, the present study was carried out to develop the *ex-situ* conservation protocols for their sustainable development and use.

Materials and Methods

During the present investigation extensive surveys were conducted in Kashmir Himalaya for the collection of Medicinal and Aromatic Plants (MAPs) from their natural habitats. Different vegetative propagules or sexual seeds and in some cases sapling were collected and were transplanted at Kashmir University Botanical Garden (KUBG). The plants were transplanted in the beds with different dimensions, topology, soil texture, nutrient concentration, moisture content, etc.

Results

The work on development of agro-techniques for the successful survival and mass cultivation of selected MAPS at KUBG was carried out (Plate 1). During the present study different agro-techniques such as soil: sand combinations, nutrient requirements, type of bed, irrigation practice, time of collection and sowing of propagules, etc. were employed. During the course of present investigation rhizome, bulb, corm and saplings of different species were used for the successful survival and mass multiplication of the selected species in Kashmir University Botanical Garden. Some of the representative species are as:

1. *Colchicum luteum* Baker

Mode of propagation: The plant species was successfully propagated through corms.

Soil requirements: Sandy soil was found to be the most efficient for successful cultivation of the species.

Nutrient requirements: Humus rich soil was found to be effective.

Time of sowing of corms: Corms were sown in the month of November- December and March- April. However, pre winter sowing showed better results.

Type of bed: Sloppy bed.

Irrigation practice: The crop is very sensitive to water logging, so field should be free from excess water.

The corms of the species were collected from the natural habitats and were sown in sloppy beds with sandy soil. The beds should be well drained in order to protect the corm from rotting.

2. *Inula royleana* C.B.Clarke

Mode of propagation: Both vegetative (Rhizome) and sexual means (Seeds)

a. Vegetative propagation

Young saplings or rhizomes of the species were collected from the natural habitats and were transplanted in the KUBG.

Soil requirements: Sandy soil was found to be the most suitable for the successful survival of the saplings and also for the sprouting of the rhizomes.

Nutrient requirements: A high quantity of organic manure is required for its cultivation at low altitudes.

Time of sowing of saplings and rhizome: Saplings in the month of June and rhizomes in the month of October.

Type of bed: Plain beds with raised bunds.

Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Irrigation should be done twice a week for a month; afterwards frequency of irrigation should be reduced to once a month.

b. Through sexual seeds

Seeds collected from the natural habitats were sown in the KUBG. It was found that both seed germination and percentage seedling survival was higher when sown at 0.5-0.7cm depth.

Soil requirements: Loamy soil was found to be most effective for seed germination and seedling survival.

Nutrient requirements: A high quantity of organic manure is required.

Time of collection of seeds: Seeds were collected in the month of September- October.

Type of Bed: Plain beds with raised bunds.
Irrigation practice: Beds should be irrigated immediately after seeds were sown and this practice should be continued for first 3-4 days and after wards twice a week.

3. ***Dioscorea deltoidea*** Wall. ex Kunth
Mode of propagation: The plant species was successfully propagated through the use of tubers.
Young saplings or tubers of the species were collected from the natural habitats and were transplanted in the KUBG. The established seedling were supported in order to avoid the lodging and subsequent death.
Soil requirements: Sandy loam soil is most suitable for its cultivation.
Nutrient requirements: Farmyard manure is added to the soil at the time of pre-planting.
Time of sowing of saplings and tuber: Saplings in the month of May and rhizomes in the month of August.
Type of Bed: Plain beds with raised bunds.
Irrigation practice: The tuber is very sensitive to water logging, so field should be free from excess water.

4. ***Inula racemosa*** **Hook. F.**
Mode of propagation: Both vegetative (Rhizome) and sexual means (Seeds)
a. Vegetative propagation
Young saplings or rhizomes of the species were collected from the natural habitats and were transplanted in the KUBG.
Soil requirements: Well-drained, clay-loam soils are ideal for the rhizome sprouting and seedling survival
Nutrient requirements: The farmyard manure is added to the soil before sowing of saplings or rhizome.
Time of sowing of saplings and rhizome: Saplings in the month of April and rhizomes in the month of August.
Type of bed: Plain beds with raised bunds.
Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Irrigation should be once, twice a week for a month; afterwards frequency of irrigation should be reduced to once a month.
b. Through sexual seeds
Seeds collected from wild were sown in the KUBG. It was observed that both seed germination and percentage seedling survival was higher when sown at 0.7-1.0 cm depth.
Soil requirements: Loamy soil was found to be most effective for seed germination and seedling survival.
Nutrient requirements: A high quantity of farmyard manure was found to be effective.
Time of collection of seeds: Seeds were collected in the month of September.
Type of Bed: Plain beds with raised bunds.
Irrigation practice: Light irrigation at an interval of three to four weeks.

5. ***Picrorhiza kurroa*** **Royle ex Benth.**
Mode of propagation: The plant species was propagated through the use of rhizome (Stolons).
Young saplings or rhizomes of the species were collected from the natural habitats and were transplanted in the KUBG.
Soil requirements: Sandy textured loam soil is the best suitable for its cultivation.
Nutrient requirements: Farmyard manure or high quantity of forest leaf litter is mixed with the soil before transplantation.
Time of sowing of saplings and rhizome: Saplings in the month of July and rhizomes in the month of October. However, it should be noted that minimum rhizome length should be 2-3cm.
Type of Bed: Plain beds with raised bunds.

Irrigation practice: Irrigation should be on alternate days.

Note: Although the plantlets were raised from the rhizomes and also the saplings collected from the natural habitats were successfully grown but the plant species do not survive for more than 2 years in the KUBG. In the future course special agro-techniques will be employed for long term survival of the species.

6. *Arnebia benthamii* (Wallich ex G. Don and I. M. Johnston)

Mode of propagation: The plant species was successfully propagated through the use of rhizome.

Young saplings or rhizomes of the species were collected from the natural habitats and were transplanted in the KUBG.

Soil requirements: Sandy soil is the best suitable for its cultivation.

Nutrient requirements: Farmyard manure was found effective in propagation of the species.

Time of sowing of saplings and rhizome: Saplings in the month of July and rhizomes in the month of October. However, it should be noted that each rhizome cutting have minimum of 3-4 buds.

Type of bed: Raised beds.

Irrigation practice: Light irrigation at an interval of three to four weeks.

7. *Rheum webbianum* Royle.

Mode of propagation: Both vegetative (Rhizome) and sexual means (Seeds)

a. Vegetative propagation

Young saplings or rhizomes of the species collected from the natural habitats were transplanted in the KUBG.

Soil requirements: Well-drained, sandy porous soil was found to be ideal for the rhizome sprouting and seedling survival.

Nutrient requirements: The farmyard manure or litter is added to the soil before sowing of saplings or rhizome.

Time of sowing of saplings and rhizome: Saplings in the month of July and rhizomes in the month of October.

Type of bed: Plain beds with raised bunds.

Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Irrigation should be twice a month

b. Through sexual seeds

Seeds collected from wild were sown in the KUBG. It was observed that both seed germination and percentage seedling survival was higher when sown at humus rich soil.

Soil requirements: Loamy soil was found to be most effective for seed germination and percentage seedling survival.

Nutrient requirements: A high quantity of farmyard manure was found to be effective.

Time of collection of seeds: Seeds were collected in the month of September- October.

Type of Bed: Plain beds with raised bunds.

Irrigation practice: Light irrigation at an interval of three to four weeks.

8. *Atropa acuminata* Royle.

Mode of propagation: Both vegetative (Rhizome) and sexual means (Seeds)

a. Vegetative propagation

Rhizomes or young saplings of the species were collected from the natural habitats and were transplanted in the KUBG.

Soil requirements: Clay-loamy soils are ideal for the rhizome sprouting and seedling survival.

Nutrient requirements: The litter is added to the soil before sowing of saplings or rhizome.

Time of sowing of saplings and rhizome: Saplings in the month of May and rhizomes in the month of August.
Type of bed: Plain beds with raised bunds.
Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Irrigation should be twice a week.

b. Through sexual seeds

Seeds collected from wild were sown in the KUBG.
Soil requirements: Loamy porous soil was found to be most effective for seed germination and percentage seedling survival.
Nutrient requirements: Manure and litter was found to be effective.
Time of collection of seeds: Seeds were collected in the month of September.
Type of bed: Plain beds with raised bunds.
Irrigation practice: Irrigation at an interval of three to four days a week.

9. *Ajuga bracteosa* Wallich ex Benth.

Mode of propagation: Both vegetative (stoloniferous branches of rhizome) and sexually (Seeds)

a. Vegetative propagation

Rhizomes or young plants of the species were collected from the natural habitats and were transplanted in the KUBG.
Soil requirements: Coarse sandy soil is ideal for the rhizome sprouting and seedling survival.
Nutrient requirements: Low to moderate manure is added to the soil before sowing of saplings or rhizome.
Time of sowing of saplings and rhizome: Saplings in the month of May and rhizomes in the month of August.
Type of bed: Raised sloppy beds
Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Afterwards the irrigation should be reduced as the plant is very sensitive to the excessive water.

b. Through sexual seeds

Seeds collected from wild were sown in the KUBG.
Soil requirements: Sand and soil in the ratio of 2:1 was found to be most effective for seed germination and percentage seedling survival.
Nutrient requirements: Litter was found to be effective for seed germination.
Time of collection of seeds: Seeds were collected in the month of July- August.
Type of bed: Raised sloppy beds.
Irrigation practice: Irrigation should be 2 days a week.
Note: It was found that species thrive well when raised through seeds than rhizome in KUBG.

10. *Fritillaria roylei* Hook.

Mode of propagation: Vegetatively (Bulb)
Bulb or young saplings of the species were transplanted in the KUBG.
Soil requirements: Sandy and porous soil was found to be the most suitable for the successful sprouting of the bulbs and also for seedling survival.
Nutrient requirements: A high quantity of organic manure is required for its cultivation at low altitudes.
Time of sowing of saplings and rhizome: Saplings in the month of May and bulb in the month of September-October.
Type of bed: Raised beds.

Irrigation practice: The saplings or bulbs should be irrigated immediately after transplantation. Irrigation should be done thrice a week for a first 15 days; afterwards frequency of irrigation should be reduced to once a month.

11. *Skimmia anquetillia* Taylor and Shaw.

Mode of propagation: Vegetatively (Root)

Roots or young saplings of the species were transplanted in the coniferatum section of KUBG.

Soil requirements: Loamy soil was found to be the most suitable for the successful seedling survival.

Nutrient requirements: A high quantity litter isrequired for its cultivation at low altitudes.

Time of sowing of saplings and rhizome: Saplings in the month of May- June.

Type of bed: Raised sloppy beds around conifers.

Irrigation practice: The saplings should be irrigated immediately after transplantation. Irrigation should be done twice a week for a month; afterwards frequency of irrigation should be reduced to thrice a month.

Note: The plant species form an intimate association with conifers and should be transplanted around the conifers.

12. *Aconitum heterophyllum* Wallich ex Royle.

Mode of propagation: Vegetatively (Rhizome)

Vegetative propagation

Rhizomes of the species were collected from the natural habitats and were transplanted in the KUBG.

Soil requirements: Sandy loam and porous soil was found to be the most suitable for the sprouting of the rhizomes and establishment of saplings.

Nutrient requirements: A high quantity of organic manure and litter is required for its cultivation at low altitudes.

Time of sowing of rhizome: Rhizomes were sown in the month of October.

Type of bed: Plain beds with raised bunds.

Irrigation practice: The saplings or rhizomes should be irrigated immediately after transplantation. Irrigation should be done thrice a week for a month; afterwards frequency of irrigation should be reduced to twice a month.

Note: The established plants were provided with support so as to prevent it from the lodging.

13. *Jurinea macrocephala* (Royle) C.B. Clarke.

Mode of propagation:Vegetative (Rhizome) and sexual seeds (seeds)

a. Vegetative propagation

Rhizomes and young saplings of the species were collected from the natural habitats and were transplanted in the KUBG.

Soil requirements: Sandy soil was found to be the most suitable for the sprouting of the rhizomes and establishment of saplings.

Nutrient requirements: A high quantity of farmyard manure and/ or vermicompost is required for its cultivation at low altitudes.

Time of sowing of rhizome: Rhizomes were sown in the month of October.

Type of bed: Plain beds with raised bunds.

Irrigation practice: The rhizomes and / or saplingsshould be irrigated immediately after transplantation. Irrigation should be done continuously a week for a month; afterwards irrigation should be reduced to twice a month.

b. Through sexual seeds

Seeds collected from the natural habitats were sown in the KUBG. It was found that both seed germination and percentage seedling survival was higher when sown at 0.5cm depth.

Soil requirements: Sand,soil and manure in the ratio of 1:2:1 was found to be most effective for seed germination and percentage seedling survival.
Nutrient requirements: Litter and manure was found to be effective for seed germination.
Time of collection of seeds: Seeds were collected in the month of October
Type of bed: Plain beds with raised beds.
Irrigation practice: Irrigation should be 2 days a week.

14. *Bergenia ciliata* (Haw.) Sternb.
Mode of propagation: Vegetative means (Rhizome)
Vegetative propagation
Rhizomes and young saplings of the species were collected from the natural habitats and were transplanted in the rocky section of KUBG.
Soil requirements: Rocky soil was found to be the most suitable for the sprouting of the rhizomes and survival of the saplings.
Nutrient requirements: Low manure application is required.
Time of sowing of rhizome: Rhizomes were sown in the month of August, September and October.
Type of bed: Sloppy rocky beds.
Irrigation practice: Should be irrigated immediately after transplantation. Irrigation should be done manually for a month; afterwards irrigation should be reduced.
The present study revealed that on transplantation maximum number of MAPs can be raised by vegetative propagules or by the saplings (Fig.1). Sandy soil was the suitable soil for successful establishment of the studied MAPs transplanted at KUBG (Fig.2). Organic manure was the nutrient requirement in most of the cases; our results are in conformity with that of Nautiyal and Nautiyal, 2004. Most of the transplants thrive well in plain beds with raised bunds; however, some plants grow well in slopy, raised and slopy rocky beds (Fig. 3). The suitable time for transplantation is September- October and April- May.

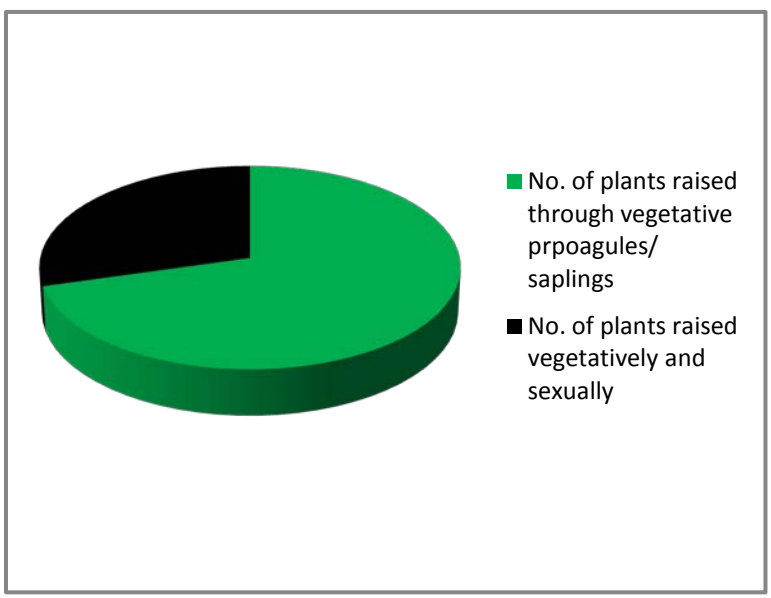

Fig. 1. Proportion of plants raised by means of vegetative and sexual propagules

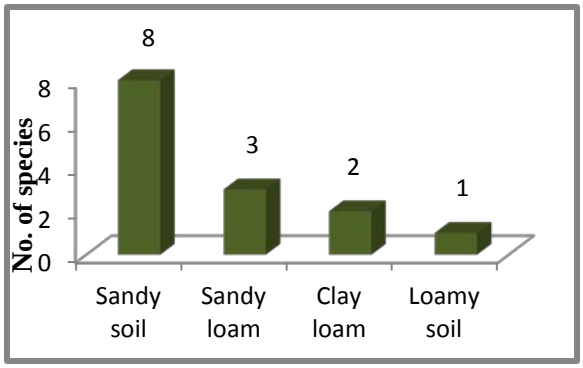

Fig. 2. Requirements of different soils for successful establishment upon transplantation

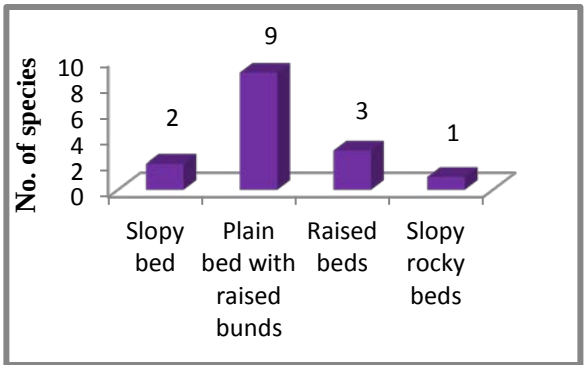

Fig. 3. Different types of beds required by various MAPs for successful establishment upon transplantation

Plate 1. Development of different agro-techniques

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References

Kala, C.P., Dhyani, P. P. and Sajwan, B.S. 2006. Developing the medicinal plants sector in northern India: challenges and opportunities. *Journal of Ethnobiology and Ethnomedicine*. **2**: 32.

Khan, I. .A. and Khanum, A. 2000. Role of Biotechnology in Medicinal and Aromatic Plants. Ukaaz Publications, Hyderabad. India

Kuniyal, C.P., Rawat, Y.S., Oinam, S.S., Kuniyal, J.C. and Vishvakarma, S.C.R. 2005. Kuth (*Saussurea lappa*) cultivation in the cold desert environment of the Lahaul valley, northwestern Himalaya, India: arisingthreats and need to revive socio-economic values. *Biodiversity and Conservation*. **14**:1035-1045.

Lozoya, X. 1994. *Ethnobotany and the Search of New Drugs*. England:John Wiley and Sons.

Nautiyal, M.C., Nautiyal, B.P. and Nautiyal, M.C. 2004. ***Agrotechniques for High Altitude Medicinal and Aromatic Plants.*** Silver Jubilee Publication of HAPPRC by *H. N. Bahuguna Garhwal University*. 202 pp.

Somashekhar, B. S. and Sharma, M 2002. Training Manual on ***Propagation Techniques of Commercially Important Medicinal Plants.*** Prepared for Andhra Pradesh State Forest Department by Foundation for Revitalisation of Local Health Traditions, Bangalore. 133 pp.