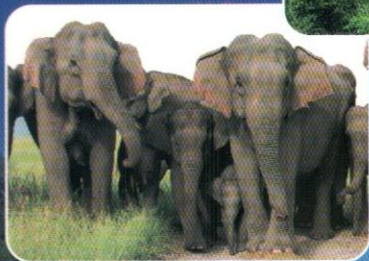
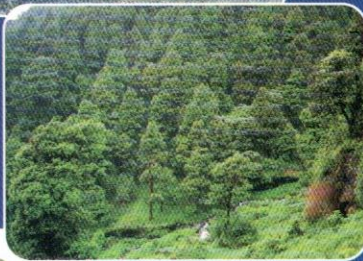
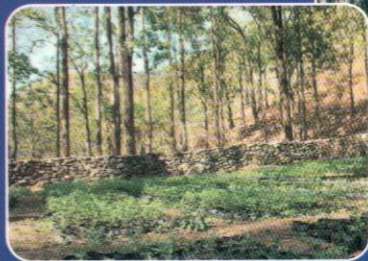
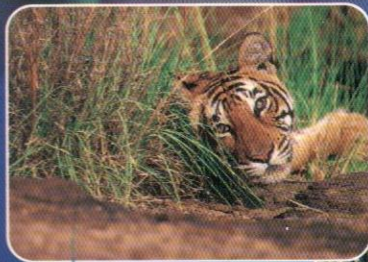


# UTTARAKHAND FORESTRY RESEARCH INSTITUTE, HALDWANI



Annual Report  
2009-10



Govt. of Uttarakhand

Forest Department, Uttarakhand

# Uttarakhand Forestry Research Institute, Haldwani

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2009-10



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Forest Department, Uttarakhand

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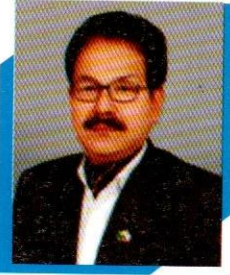
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## Abbreviations

ANR	-	Assisted Natural Regeneration	LIP	-	Linear Increment Plot
APCCF	-	Addl. Principal Chief Conservator of Forests	m	-	metre
CAI	-	Current Annual Increment	MAI	-	Mean Annual Increment
CBJ	-	Clutterbuckganj	NGO	-	Non-Govt Organisation
CCF	-	Chief Conservator of Forests	NWFP	-	Non Wood Forest Produce
CF	-	Conservator of Forests	PAI	-	Periodic Annual Increment
CIP	-	Continuous Inventory Plot	PB	-	Phoolbagh
CMA	-	Clonal Multiplication Area	PCCF	-	Principal Chief Conservator of Forests
CPT	-	Candidate Plus Tree	PIP	-	Poplar Improvement Programme
CSFER	-	Centre for Social Forestry & Eco Rehabilitation, Allahabad	Silva	-	Silviculturist
CSO	-	Clonal Seed Orchard	SP	-	Sample Plot
Comptt	-	Compartment	SPA	-	Seed Production Area
CTA	-	Clonal Testing Area	SS	-	Seed Stand
CTR	-	Corbett Tiger Reserve	SSPA	-	Seedling Seed Production Area
Cum	-	Cubic metre	TERI	-	Tata Energy Research Institute, New Delhi
FRI	-	Forest Research Institute, Dehradun	TIP	-	Tree Improvement Plot
FSI	-	Forest Survey of India, D.Dun	TTZ	-	Triphenyl Tetrazolium Chloride
FTA	-	Forest Training Academy, Haldwani	TTZ Test-	-	Tetrazolium staining test
G	-	Gabua	UCOST-	-	Uttarakhand Council of Science and Technology, Dehradun
Ha	-	Hectare	VMG	-	Vegetative Multiplication Garden
IBA	-	Indole Butyric Acid	WP	-	Working Plan
ICFRE	-	Indian Council of Forestry Research and Education, Dehradun			
K	-	Kerala			



## Message from PCCF, Uttarakhand

**F**orests are renewable resources and the very existence of human being depends on it. Newly created state of Uttarakhand is a part of Indian Himalayan System, therefore, has all the elements of Himalayan geology, ecology and environment. The state has 64.79% geographical area as forest area. Therefore it is but natural that the interface of local people with forests is on regular bases. The biodiversity rich forests of Uttarakhand not only yield fuel, fodder, timber, NTFP, MAP etc, but also are closely linked with the livelihood as well as economic sustainability of the local communities. To meet the ever growing expectations and aspirations of the people of Uttarakhand it is imperative for the forestry sector to keep pace with the modern and day to day advancements which are happening in the research arena in forestry.

I am happy to know that the "Uttarakhand Forest Research Institute" is bringing out the annual report 2009-2010. The report will be of great help in planning the roadmap for forest productivity enhancement, biodiversity maintenance and countering the challenge put forth by climate change.

I congratulate the Chief Conservator of Forests (biodiversity conservation, research and development), Uttarakhand and his staff for bringing out such a beautiful and important report. I wish all the very best.

A handwritten signature in black ink, appearing to read 'RBS Rawat', with a long horizontal stroke extending to the right.

(Dr. R B S Rawat, IFS)  
PCCF, Uttarakhand



## Foreword from APCCF, Forestry Research, Training and Management, Uttarakhand

Scientific forestry research is the *sine qua non* for successful management of forests. Its importance is ever increasing due to the diminishing biodiversity caused by human activity and the resultant need for increasing productivity. Uttarakhand is a great storehouse of biodiversity and its preservation is very important as a resource for future protection and improvement in the fields of agriculture, forestry and animal husbandry.

The principle of sustainable management of forests to meet the needs of ever increasing population has been envisaged in Uttarakhand State Forest Policy, 2001. To meet this objective, increasing the productivity of existing forests and the adoption of new and alternative technologies to reduce the effects of biotic pressure is central to the management of forests.

The need for improvement of natural and artificial regeneration of major species like sal, spruce and fir continues to be a major area of concern. Similarly, serious attempts have to be made to include the much neglected non wood forest produce (NWFP) in productivity enhancement programmes. The work on tree improvement through plant breeding and clonal technology has to be strengthened to cater to the increasing demand for disease resistant and high yielding Eucalyptus and Poplar cultivars.

More number of seed production areas and seed orchards have to be developed to ensure the availability of quality resource base for establishing successful plantations in state forests and panchayat forests.

This report includes some of the significant work done after the formation of the state. I look forward to further fruitful contributions from the team of research organization in future.

(Prakash Bhatnagar, IFS)  
APCCF, Research, Training & Management, Uttarakhand

## 1. Our Vision

Research led scientific conservation of biodiversity and management for sustainably increasing productivity of forests, woodlots, NWFP and other natural resources to enhance livelihoods and socio economic upliftment.

## 2. Our Mission

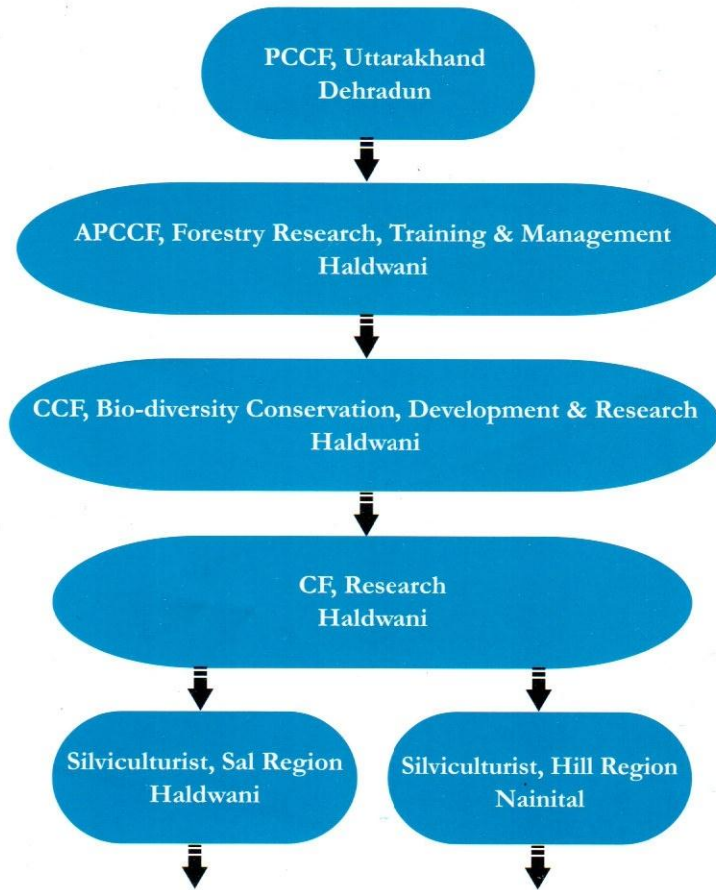
Research activities related to conservation, management and development of various aspects of biodiversity, forestry, agro forestry, natural resources, eco-tourism and livelihood options of forest dependent communities to meet challenges of increasing demands, environmental stability and other concerned issues.

## 3. Our Objectives

- To assess and enhance productivity in natural forests, plantations and agro forestry areas.
- To produce superior planting stock viz. quality seed and other quality planting material.
- To improve management practices based on statistical studies.
  - To conserve and enrich biodiversity for prudent use of natural resources.
  - To promote medicinal and aromatic plants, fodder, fuel wood, bamboo and other NWFPs for enhancement of livelihood opportunities of local and fringe population.



#### 4. Our Organization



##### Ranges

Research Range, Haldwani  
 Research Range, Ranipur  
 Seed Range, Haldwani  
 Statistical Range, Haldwani

##### Unit

Research Unit, Lalkuan

##### Ranges

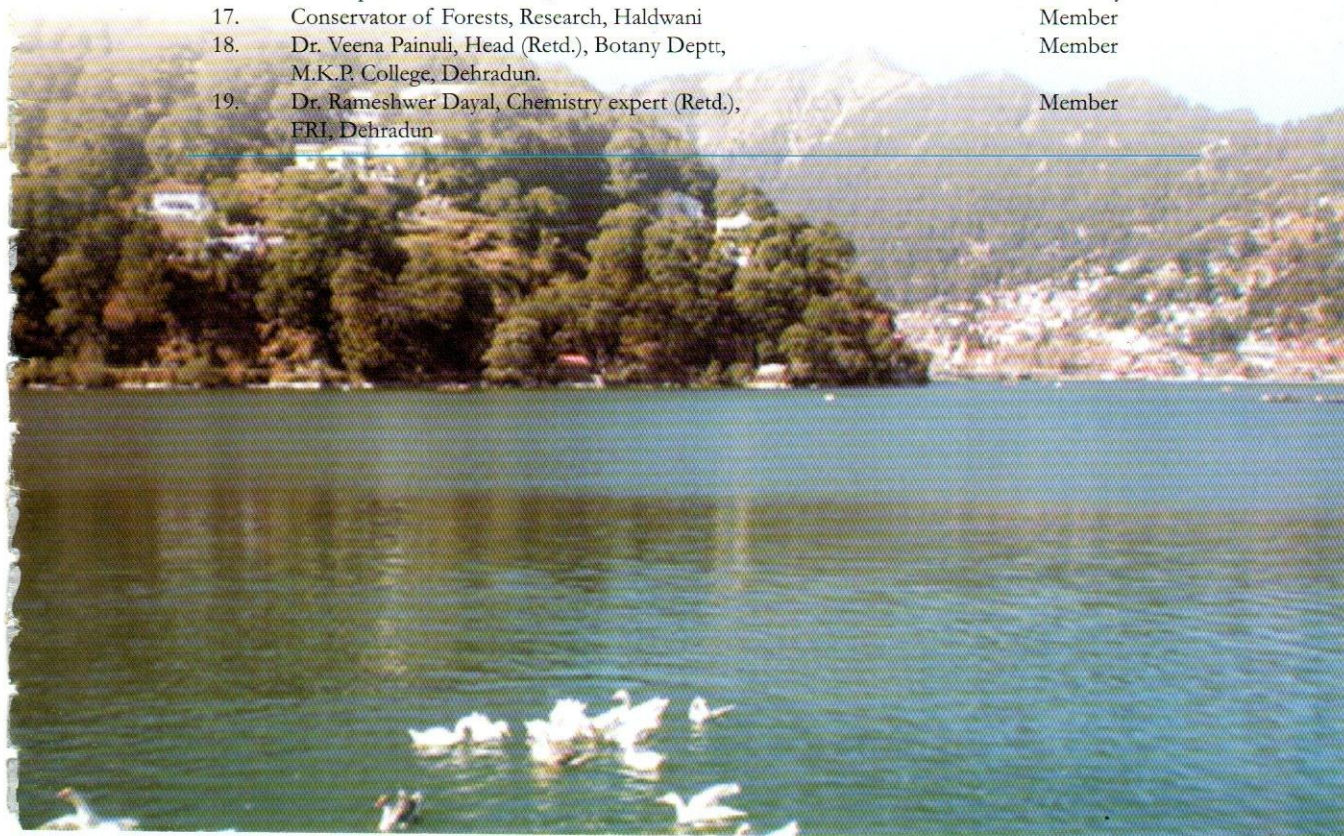
Research Range, Kalika  
 Research Range, Gaja  
 Research Range, Lohaghat  
 Research Range, Gopeshwar  
 Research Range, Kalsi  
 Seed Range, Ranikhet  
 Seed Range, Gauchar  
 Seed Range, Chamba  
 Seed Range, Kalsi  
 Statistical Range, Kalika

##### Unit

Himalayan Botanical Garden,  
 Sadiatal (Nainital)

#### 4.1 Research Advisory Group (RAG)

Sl. no.	Name and designation	Post
1.	Principal Chief Conservator of Forests, Dehradun	Chairman
2.	Additional Principal Chief Conservator of Forests, Forestry Research, Management and Training, Haldwani	Vice-Chairman
3.	Principal Chief Conservator of Forests, Wildlife or a member nominated by him.	Member
4.	Additional Principal Chief Conservator of Forests, Van Panchayat or a member nominated by him.	Member
5.	Director, FRI, Dehradun	Member
6.	Director, G.B. Pant Institute of Himalayan Environment and Development, Koshi, Almora	Member
7.	Director, Vivekanand Parvatiya Krishi Sansthan, Koshi, Almora.	Member
8.	Director, Herbal Research and Development Institute, Gopeshwer, Chamoli.	Member
9.	Director, U.C.O.S.T., Dehradun	Member
10.	M.D., Uttarakhand Forest Development Corporation or a member nominated by him.	Member
11.	Chief Conservator of Forests, Working Plan, Uttarakhand.	Member
12.	Vice chancellor, G.B. Pant Agriculture University, Pantnagar or a member nominated by him.	Member
13.	Director, Wildlife Institute of India, Dehradun or a member nominated by him.	Member
14.	Dr. B.S.Burfal, Chairman, Bio-diversity Board, Uttarakhand	Member
15.	Dr. J.S.Mehta, Forest Officer(Retd.), Haldwani	Member
16.	Chief Conservator of Forests, Bio-diversity Conservation, Development and Research, Haldwani.	Member Secretary
17.	Conservator of Forests, Research, Haldwani	Member
18.	Dr. Veena Painuli, Head (Retd.), Botany Deptt, M.K.P. College, Dehradun.	Member
19.	Dr. Rameshwer Dayal, Chemistry expert (Retd.), FRI, Dehradun	Member





## 5. Brief History

Research is the backbone of any sphere of life sciences. It forms the basis for future growth. Forestry consists of principles and practices utilized in the management and development of forests aimed at society's well-being. The planning of forestry should ideally combine the scientific knowledge, information and technology as well as the local knowledge of the site and utilization (i.e. all phases from research to utilization of the end product) to achieve the highest possible social, environmental and economic benefits. Forestry research has the capacity for generating improved technologies necessary for driving development through enhanced forest productivity. Given the central role of forestry in the state, forestry research is likely to play a more determinative role in future. Forestry research is particularly expected to generate improved technologies geared to cope with the socio-economic challenges of the twenty first century.

### 5.1 Chronology of events

- Forestry research in India was initiated on a formal basis in 1906 with the establishment of Forest Research Institute (FRI) in Dehradun.
- In Uttar Pradesh, forestry research started in a formal way with the appointment of the State Silviculturist, Research and Development in 1918.
- Silviculture Division, Hill Region, U.P. was established with head quarters at Nainital in 1961. Again in 1964, Silviculture Division for Vindhyan Region was created with head quarters at Kanpur.
- First State Research laboratory was established at Kanpur in 1970 (Renamed as State Forestry Research Institute in 1993).
- After the formation of Uttarakhand, Silviculture Division, Sal region was created in 2000 with head quarters at Haldwani. Silviculture Division, Hill Region continues at Nainital. Both the divisions are under the administrative control of Conservator of Forests, Research Circle, Haldwani.
- Research Advisory Group (RAG) was constituted for providing direction to research activities in 2004. It was again reconstituted in 2010 under the chairmanship of PCCF, Uttarakhand.
- In 2009, a new post of Additional Principal Chief Conservator of Forests, Research, Training and Management, Haldwani was created and a post of Chief Conservator of Forests, Bio diversity Conservation, Development and Research, Haldwani was segregated as a new post from that of Chief Conservator of Forests/ Director, Training/ Uttarakhand Forestry Training Academy, Haldwani.



## 6. Significant Achievements in Past

### 6.1 Sal Region

#### 6.1.1 Tree Improvement of Eucalyptus through Clonal Technology

Phoolbagh and Gabua series of Eucalyptus clones were developed during 1997 and 1999 respectively in the hi-tech nurseries of Shyampur, Lalkuan and Haldwani and released for plantations. These clones are not being used at present because of gall formation.

Comparative evaluation of exotic Eucalyptus clones with locally developed clones was taken up in 1995. 5 clones from Bhadrachalam (at Bannakheda, Tarai West Forest Div. in 2.4 ha), 8 clones from TERI (at Pipal Padao-26, Tarai Central Division in 3.6 ha) and 15 local clones (at Phoolbag, Tarai Central Division in 0.36 ha) were selected and planted at 4m x 1.5 m spacing for this trial. Volume was calculated using the volume equation,  $V = 0.02894 - 0.89284D + 8.72416D^2$  developed by FSI, Dehradun. Current Annual Increment (CAI) and Mean Annual Increment (MAI) were calculated assuming 100% survival. From this trial, the following 11 clones were selected.

**Table-1: Results of better performing Eucalyptus clones (Sal Region)**

Name of clone	MAI (m <sup>3</sup> /ha)
<b>Bhadrachalam clones</b>	
AP147	11.1
AP 10	14.5
AP 3	12.0
AP 5	10.9
<b>TERI clones</b>	
348	11.7
107	11.9
360	10.2
<b>Phool Bag clones</b>	
PB 5	35.8
PB 6	27.7
PB 9	35.4
PB11	37.4

3 CTAs, 3CMAs, 4 SSPAs and 2 CSOs were established till 2007-08 and are being monitored.

**Table-2: List of CTAs, CMAs, SSPAs and CSOs (Sal Region)**

Name	year	No. of clones	Area (ha)
<b>CTAs</b>			
Tanda-20	2003	22	5.0
Dhimri-57	2005	20	10.0
Tanda- 76	2006	22	6.6
<b>CMAs</b>			
Lalkuan nursery	2006, 2007, 2009	16	0.8
Haldwani nursery		6	0.3
Shyampur nursery		4	0.2
<b>SSPAs</b>			
Gangapur Patia	2001	6	3.0
Tanda- 20	2002	12	1.5
Tanda- 20	2003	6	2.0
Dhimri- 57 A	2007	1	0.4
<b>CSOs</b>			
Tanda- 20	2003	11	4.0
Talli Haldwani	2004	6	4.0

### 6.1.2 Development of Local Clones of Poplar

Flowering in G-3 and G-48 clones was observed in 1982 for the first time in the Tarai Region of Uttarakhand. Since then efforts have been made to evolve new local clones through hybridization. Various series of L-clones were developed through open pollination and controlled pollination from 1982 to 1992 followed by vegetative propagation. Development of new clones through hybridization was again initiated in 2005 and evaluation trial of the resultant 87 clones is in progress. Along with this, in collaboration with ICFRE, multi locational trials of 65 clones supplied by ICFRE in 1998-99 named as PIP series have also been taken up at Tanda, Phoolbag (Tarai Central Forest Division) and Shyampur (Haridwar Forest Division).

#### Clones developed in the period 1982-89 (20 clones) :

L-12/82, L-13/82, L-29/82, L-30/82, L-34/82, L-49/82/, L-52/82, L-51/84, L-62/84, L-71/84, L-75/84, L-165/84, L-181/84, L-188/84, L-200/84, L-247/84, L-290/84, L-293/84, EL-74, EL-89

#### Clones Under Trial (spacing 5m x 3m) at Dhimri 55B since 1997

18 clones (excluding L-51/84 and EL-74 from the above mentioned clones) + 60 clones (L-179/85, L-40/88, L-35/88, L-124/86, L-246/90, L-277/90, L-18/92, L-113/89, L-136/89, L-59/88, L-287/90, L-2/92, L-371/91, L-17/92, L-16/92, L-158/87, L-47/91, L-143/91, L-19/82, L-151/91, L-48/89, L-47/88, L-154/86, L-54/86, L-44/88, L-141/85, L-131/85, L-154/84, L-185/85, L-2/87, L-188/85, L-113/86, L-57/88, L-134/86, L-13/86, L-156/89, L-183/89, L-454/91, L-258/98, L-164/88, L-545/91, L-232/89, L-29/92, L-86/88, L-243/96, L-95/88, L-25/92, L-333/91, L-205/89, L-80/88, L-52/88, L-92/88, L-20/87, L-24/88, L-7/85, L-70/86, L-38/85, L-106/86, L-20/88, L-14/92) + 2 clones as control (D-121 and G-48)

Table-3: Volume of locally developed Poplar clones (Sal Region)

Most promising clones	MAI (m <sup>3</sup> /ha) in 12 yrs rotation	Av. Dia. (cm)	Av. Ht (m)
L-20/87	12.3825	19.576	26.940
L-165/84	12.088	19.275	27.127
L-29/82	10.013	19.475	22.035
L-62/84	9.798	17.600	26.405
L-205/89	9.547	18.350	23.672

#### PIP series Trials (spacing 5mx3m), 2000 and 2001

65 clones were tried and results of 5 best clones after 8 yrs are as follows

Table-4: Volume of PIP series Poplar clones (Sal Region)

Clones	MAI (m <sup>3</sup> /ha) in 08 yrs rotation	Av. Dia. (cm)	Av. Ht (m)
PIP102	10.622	24.06	24.928
PIP203	9.813	23.96	23.230
PIP209	9.431	23.16	23.898
PIP219	7.256	21.18	22.012
PIP108	7.165	21.40	21.292

### 6.1.3 Genetic improvement of Teak (*Tectona grandis*)

To meet the increasing demand of quality seeds, "Plus Trees" are identified and marked at different localities. Three Clonal Seed Orchards (CSOs) have been established for collection of quality seeds.

**Table-5:** Teak CSOs (Sal Region)

Location	No of Clones	Area	Year of establishment
Tanda-20	10	4 ha	2000
Gangapur Patia	10	6 ha	2001
Shyampur-10	10	3 ha	2001

### 6.1.4 Genetic improvement of Shisham (*Dalbergia sissoo*) through clonal multiplication

Method of propagation of Shisham through root suckers has been standardized. Progeny trails were carried out in 1998 at Gangapur Patia to select the most promising progeny and propagate it further. Later CSOs, SSPAs and CTA were established as given in Table-6.

**Table-6:** CSOs, SSPAs and CTA of Shisham (Sal Region)

Location	Area (ha)	Formation year	Remarks
<b>CSOs</b>			
Gangapur Patia	1.0	2000	-
Tanda-20	2.0	2000	-
<b>SSPAs</b>			
Gangapur Patia	1.7	1999	-
Gangapur Patia	5.0	1999	CSFER funded
Gangapur Patia	1.5	2000	-
<b>CTA</b>			
Gangapur Patia	1.0	2000	-

## 6.2 Hill Region

### 6.2.1 Vegetative Propagation of Thuner (*Taxus baccata*)

*Thuner*, in recent years, has become important for high-valued 'Taxol' extracted from its leaves and bark, used in the preparation of drugs. To facilitate large scale plantations, nursery technique for the vegetative propagation of *Thuner* has been developed and standardised. Cuttings obtained from 2 year old branches of a tree in the month of Sept.-Oct. and Feb.-March when treated with 10,000 ppm IBA resulted in 70% success in rooting in 7 months. So far, 5.87 lakh plants have been raised till 2009- 10 by this technique and supplied to various forest divisions.



(Thuner Seedling)

### 6.2.2 Propagation of Tejpat

Mass propagation of *Tejpat* through seeds had been carried out at Bhujiyaghat nursery, near Ranibagh (Haldwani). Seeds are collected during March-April from the selected trees and sown in irrigated nursery beds. Seeds start germinating in 15 days after sowing. Seedlings are transplanted in root trainers one month after germination. 70% germination and 60% plant survival have been achieved. Plants are regularly being supplied to forest divisions, various agencies and individuals.



(Tejpat nursery at Bhujiyaghat)



### 6.2.3 Propagation of Shrubs and Climbers

In a forest ecosystem, shrubs and climbers play a vital role by enriching biodiversity, protecting soil from erosion, improving soil moisture, reclaiming and rehabilitating refractory sites, providing food, shelter and breeding place to birds and other wildlife. Apart from this, many shrub species have immense medicinal and fodder value and thus enhance livelihood options for the forest fringe communities. Hence, to promote their conservation and utilization, nursery techniques for propagation of shrubs such as Tushiyari (*Debregeasia salicifolia*), Matoi (*Desmodium tiliacifolium*), Dhaula (*Woodfordia fruticosa*), Hinsalu (*Rubus ellipticus*), Ghingarau (*Pyracantha crenulata*), Timru (*Zanthoxylum armatum*), Kilmora (*Berberis aristata*), Guiyan (*Viburnum cotinifolium*), Luhish (*Ramnus purpurea*), Wild jasmine (*Jasminum humile*) and climbers such as Kunjo (*Rosa moschata*), *Smilax aspera*, Giloi (*Tinospora cordifolia*) and Gomphal/ Jangli Sharifa (*Holboellia latifolia*) have been tried and developed.



(Shrub multiplication)

### 6.2.4 Propagation of Kaphal (*Myrica esculenta*)

Kaphal, a moderate sized tree generally growing in association with banj and burans, is of great significance to wildlife as well as man because of its edible fruits. Its propagation in nursery through seeds was not giving satisfactory results until right time for seed collection (first-second week of May, when the fruit turns black). Appropriate seed treatment, germination and pricking techniques were experimented with, which gave more than 90 % germination success and 70% overall plant success. It was found that the pulp of the fruit should not be removed from the seed during pre-sowing treatment as it has myric acid which helps in breaking down the hard coat of seed.



(Kaphal seedlings)

### 6.2.5 Establishment of Thuner (*Taxus baccata*) Preservation Plots

Preservation plots of *thuner* have been established at Ginni bend Munsyari- 7 ha, Harkot Van Panchayat, Munsyari- 10 ha, Vinayak (Nainital)- 2 ha, Jageshwar- 50 ha, Kanasar- 10 ha and Ghimtoli Van Panchayat - 10 ha to conserve and protect existing natural stands of *thuner*. Protection measures are taken up and regeneration status is studied in these stands to assess the effect of protection.

### 6.2.6 Soil and Water Conservation Measures

Pine needles locally called '*pirul*' is a serious fire hazard due to their high inflammability. It has been innovatively used in soil and water conservation measures through *pirul* check dams and mulching. For check dams, coir or jute is woven into nets of 10cm x 10cm grids and rolled over pine needles and tied securely to form logs. Each running metre



(Pirul check dam)

of such logs would carry 30- 35 kg of pine needles. These logs are made in various sizes according to the size of the gully to be plugged. These *pirul* logs are placed across eroded streams or gullies and secured tightly. Large number of gullies and *nallabs* have been treated with *pirul* check dams in Gaja, Lohaghat, Himalayan Botanic Garden and Gopeshwar ranges. Land slips have also been treated with *pirul* mulching followed by geo-cover and grass planting in Jangaliya gaon, Khurpatal and Lohaghat.

### 6.2.7 Lantana eradication

Lantana has been recognised as a major weed affecting the forests of Uttarakhand. To improve the productivity and to enhance the biodiversity of these forests, lantana eradication task had been taken up in selected areas. The methodology for lantana eradication adopted is Dr. C.R.Babu's 'Cut Rootstock method' developed by CEMDE (Centre for Environmental Management of Degraded Ecosystems), Delhi University, Delhi. Following table gives the list of the areas where lantana eradication work had been carried out successfully in recent past.

**Table-7:** Areas of lantana eradication (Hill Region)

Research Range	Location	Year	Area (ha)
Kalsi	Fathepur block (Dehradun Division)	2007-08	170.00
Lohaghat	Rameshwar-Baitori motor road (Champawat Division)	2007-08	80.00
	Matela Van Panchayat, Ghat to Pithoragarh motor road (Champawat Division)	2008-09	10.00
Gaja	Both sides of Jeolikot to Ranibag motor road	2007-08	40.00
	Observatory bend to no.-1 bend (Near Jeolikot) (Nainital Division)	2007-08	40.00
	Bhowali Sanatorium to Bhumiyaadhar (Nainital Division)	2007-08	20.00
	Jangaliyagaon Van Panchayat (Nainital Division)	2008-09	20.00
	Both sides of Khurpatal-Mangoli motor road (Nainital Division)	2007-08	24.00
Gopeshwar	Tangsa Civil area (Kedarnath Division)	2006-07	23.00
	Trisula compartment 1 (Kedarnath Division)	2006-07	17.00
Kalika	Village Panchayat Chapad (Near Papli) (Almora Division)	2006-07	21.00
<b>Total</b>			<b>465.00</b>

The impact of lantana eradication in these areas is under observation.

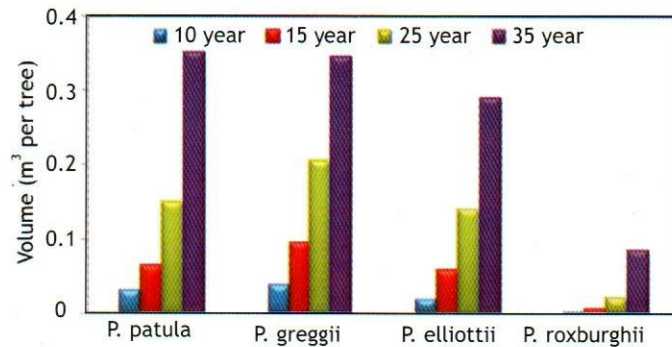
### 6.2.8 Performance of Exotic Pine in Ranikhet region

50 species of exotic (tropical) pines were planted in Uttarakhand in the period of 1970-75 to study their suitability for this region. After analyzing the results of various experimental plots of Gaja, Kalika and Gopeshwar, three species of exotic pines were found most promising viz. *Pinus patula* of Kenyan origin, *P. greggii* of Mexican origin and *P. elliotii* of U.S. origin. Their comparison with native *P. roxburghii* (chir pine) was carried out to analyse the survival, growth and suitability of three exotic pines and to find out the most productive pine species for short rotation forestry purposes. The data obtained was analyzed in 2007 for mean tree volume of these four species.

On the basis of 35 years of growth it can be concluded that *P. patula* and *P. greggii* are suitable for Himalayan region and other regions with similar climatic conditions for management as short rotation crop, to meet the ever increasing demand of small timber in the form of pole crop, especially in degraded Civil and Soyam forests and Panchayat forests.

**Table- 8:** Mean tree volume ( $m^3$ ) of different exotic pines and chir pine

Age (yrs)	<i>P. patula</i>	<i>P. greggii</i>	<i>P. elliottii</i>	<i>P. roxburghii</i>
10	0.03	0.038	0.02	0.002
15	0.06	0.095	0.06	0.006
25	0.15	0.205	0.14	0.022
35	0.35	0.345	0.29	0.085



**Figure 1.** Comparative mean tree Volume ( $m^3$ )

Short rotation management of these three exotic pines would reduce the ever increasing demand of pole crop. Chir pine may be managed for long rotation period to meet the other timber and resin demand.



## 7. Ongoing projects and achievements during the year

### 7.1 Sal Region

#### 7.1.1 Field trial of different Eucalyptus clones

Field trial of 2 clones of AP (Andhra Pradesh) series at 4m x 1.5m spacing was taken up at Bannakhera, Tarai West Forest Division in 1999.

In 2003, field trial of 9 clones of K (Kerala) series and 13 clones of G series (locally developed Gabua clones) was taken up at Tanda-20, Tarai Central Forest Division at 4m x 3m spacing.

In 2005, 2 clones of AP series, 7 clones of K series, 6 clones of G series, 2 clones of P (Pipalpadaw) series and 1 clone of PB and RT series (of Orissa origin) each were put under field trial at 4m x 1.5 m spacing in Dhimari-57 (Tarai Central Forest Division).

In 2006, 3 clones of G series, 5 clones of P series, 9 clones of GL (Gabua Lalkuan) series and 1 clone of AP series were tried at 4m x 1.5m in Tanda-76, Tarai Central Forest Division.

In 2007, 5 clones of G series, 5 clones of P series and 1 clone each of AP and GL series were put under trial at 4m x 1.5m in Dhimari-57, Tarai Central Forest Division. Data analysis is under progress.

#### 7.1.2 Development of New Clones of Poplar

The breeding work done in Poplar at Lalkuan nursery since 1982 has been strengthened and multi-locational trials and field trial areas have been established at different locations. Presently, controlled hybridization work is under progress at Lalkuan nursery. In the year 2005 hybridization work was started again to produce new clones. The process resulted in selection of 14 superior phenotypes. Similarly in 2006 and 2007, hybridization resulted in selection of 33 and 40 superior phenotypes respectively. These 87 phenotypes have been put under further evaluation and testing. On the basis of these trials, phenologically superior clones will be selected.



(Development of new poplar clones at Lalkuan)

#### 7.1.3 Development of germination technique of Haldu (*Adina cordifolia*)

The seeds of *Adina cordifolia* are very small and light in weight (about 11,000 seeds weigh 1 g). Though seeds are produced in large numbers, the proportion of seeds which germinate and seedlings that survive and establish themselves is relatively very small. The results of direct sowing of this species have not been satisfactory (Troup, 1921), thus it was tried to develop a suitable technique for propagation of this species through seeds.

Seeds were sown in germination trays containing pure sterilized sand. These trays were placed in a poly tunnel house in order to keep off rain and direct sunlight. Watering was done as a fine spray as and when required. Germination recorded by this method was 55-60%. Two month old vigorous seedlings (4 leaf stage) were pricked out carefully and transplanted in 300 c.c. root trainers containing soil, sand and farmyard manure in a ratio of 1:1:2.



(Haldu seedlings)

**Table-9:** Results of germination trial of Haldu

Parameter	Traditional technique	New technique
Germination %	40	60
Plant %	24	55.2

#### 7.1.4 Standardisation of propagation technique of Sandan (*Ougeinia oojeinensis*)

*Sandan* has a problem of poor natural regeneration in wild. Thus it was tried to develop a suitable technique for propagation of this species through root suckers. Superior trees of Sandan, approximately 25- 30 years old, were identified as Candidate Plus Trees (C.P.T.) in Ramnagar Forest Division. Root suckers were taken out from the selected C.P.T. in the months of February and March and planted in different media at Lalkuan nursery. The success obtained was 50 to 60 % and results suggest that propagation through root suckers in open beds with a mixture of soil and sand (ratio 1:1) covered with a layer of fine sand as potting medium is an effective method for propagation of *Sandan*.

#### 7.1.5 Establishment of seedling seed production area of Neem (*Azadirachta indica*)

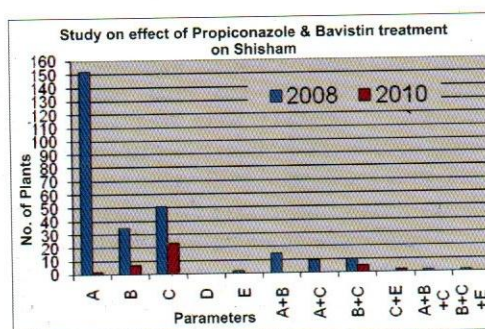
Neem is a species revered by Hindus and its bark, leaves and fruits have multiple medicinal uses. Due to its great economic and ecological importance, a seedling seed production area (SSPA) was established at Barhani Comptt 43 (Tarai West Forest Division) in 2009 in 1 ha at 3m x 3m spacing (1100 plants) to ensure sustainable supply of good quality seeds.

#### 7.1.6 Suitability studies in Kala Shisham (*Dalbergia latifolia*)

In the recent years, large scale mortality is reported in *Dalbergia sissoo*. Therefore, as an alternative species, in 2007, *Dalbergia latifolia* has been introduced at 5m x 5m spacing (400 plants/ ha) at three locations (Bailparaw Comptt. 46, Tarai West Forest Division in an area of 10 ha, Tanda- 76, Tarai Central Forest Division in 2 ha and Nallowala Comptt. 8 Haridwar Forest Division in 12 ha). The wood of *Dalbergia latifolia* is more valuable than that of *Dalbergia sissoo*. Growth and suitability of this species for this region would be evaluated for taking up large scale plantations.

#### 7.1.7 Study on Shisham mortality in collaboration with F.R.I. Dehradun

Treatment of area showing high degree of Shisham mortality had been done as per the recommendations of Forest Pathology Division, F.R.I., Dehradun in Oct. 2008. 0.5 ha area was taken up in Pipalparaw- 80, Tarai Central Forest Division and on the basis of infection level and symptoms, 464 trees were grouped into 5 categories. Soil drenching with 0.5% solution of propiconazole and 0.05% solution of bavistin was done. 15 litre of the solution was filled in a moat of 45cm depth made around each stem and it was repeated after every 20 days, for three times, during the first year.



**Figure-2:** A- Band Formation, B- Splitting of bark, C- Oozing of sap, D- yellowing of leaves, E- New leaves at base.

The treatment is found to be more effective at band formation stage (98%) followed by splitting of bark (80%) and oozing of sap (50%) stages. Negligible effect was observed at other stages viz. yellowing of leaves and formation of new leaves at base.

#### 7.1.8 Study of Forest Hydrology System in Sal Forests

Hydrological study in a Sal forested watershed is under progress since 2005 in Musabangar, Ramnagar Forest Division in collaboration with National Institute of Hydrology, Roorkee, to study the effect of light intensity on soil moisture and natural regeneration under various canopy densities and to study the erosion pattern and its impact on natural regeneration in the watershed. Effect of three soil/fire treatments was studied with three canopy densities.

Results obtained indicate highest regeneration under canopy density  $\leq$  0.3 and that soil moisture alone is not responsible for good regeneration of Sal. Controlled fire showed overall better regeneration.

#### 7.1.9 Effect of Bio fertilisers on growth of plants

Field trial of mycorrhiza in various forest species was carried out in 2009 with the objective to see its effect on growth and biomass production. Preliminary observations indicate that mycorrhizal application is very effective in growth of Reetha (*Sapindus mukorossii*) and Khair (*Acacia catechu*) while application of photosynthetic bacteria (PSB) is effective in growth of Pula (*Kydia calycina*), Gutel (*Trevis nudiflora*) and Kachnar (*Bauhinia variegata*). Azotobacter considerably improves growth of Siris (*Albizzia lebecke*), Harar (*Terminalia chebula*) and Amla (*Embelica officinalis*). This indicates that though most of forest species have mycorrhizae, not all benefit equally from symbiosis.

#### 7.1.10 Growth study of two exotic Bamboo species-Dendrocalamus membranaceous and Thyrsostachys siamensis

Study was initiated in 2007 on suitability, growth performance and mode of propagation of these species in Tarai and Bhabhar zones of Uttarakhand. Average no. of culms per clump in *Dendrocalamus membranaceous* is 3.1 with an average height of 1.7 m and in *Thyrsostachys siamensis* average no. of culms per clump is 7.2 with an average height of 3.5 m after two years of establishment in field. *D. membranaceous* is found suitable for Bhabhar areas and *T. siamensis* for Tarai areas.

#### 7.1.11 Development of Silvi-medicinal plant model

Experiment was initiated in 2008 with an objective of evaluating economically important medicinal plants species as intercrop under clonal plantations of eucalyptus utilizing the space available between two rows of plantations. 8 species viz. Sarp Gandha (*Rauwolfia serpentina*), Satavar (*Asparagus racemosus*), Mandukparni (*Centella asiatica*), Pipli (*Piper longum*), Prishnaparni (*Uraria picta*), Salparni (*Desmodium gangeticum*), Vanhaldi (*Curcuma aromatica*) and Ghritkumari (*Aloe vera*). This experiment has been redesigned and progress is being monitored.

## 7.2 Hill Region

### 7.2.1 Trial on Hill Poplar

Since 1986, several species and varieties of Poplar suitable for hills have been crossed to obtain hybrid progenies having superior growth and disease resistance characteristics. Female clones (D-121, G-48, *Populus robusta*) and male clones (*Populus nigra* and *Populus yunnanensis*) were selected and seeds produced through hybridization up to 1990 in Gaza nursery, near Jeolikote. Selection was done in seedlings obtained from seeds. Finally 5 clones viz. J1, J2, J14, J15, and J18 have been selected after screening at different stages and field trial has been laid down in January, 2008. The experiment is under observation.



(Field trial of selected clones in Gaja)

### 7.2.2 Propagation of Burans (*Rhododendron arboretum*)

*Burans*, the State tree of Uttarakhand, has great significance in the local economy as squashes and *chutneys* made out of its flowers are popular among the local population. It also forms an important part of the forest ecosystem by supporting nectar feeding birds and insects. Though it has immense value, it is not used in plantations as it is an extremely difficult species to propagate. Hence there is a need to develop suitable nursery techniques for multiplication of this species. Efforts are on since 2007 to propagate *Burans* through seed, cuttings and air layering. Till now good germination of seeds has been noticed but seedlings survival is only 10-12 percent. A survival percent of 8-8.5 percent through cuttings and 25% through air layering has been achieved. Efforts are going on to improve and standardize the technique.



(Burans cuttings and seed germination at Kalika nursery)

### 7.2.3 Propagation of Chilgoza (*Pinus gerardiana*) through seeds

Chilgoza is a pine tree bearing edible seeds. Its natural stands are found in high altitude and cold desert areas between 2000 to 3500m of Himachal Pradesh and J&K and are good source of revenue for locals. Though it is not found in Uttarakhand, if introduced in proper localities, it may prove to be a useful species. Experiments have been initiated in 2009 to propagate chilgoza through seeds obtained from Kinnaur Forest Division, HP. Best result obtained after 1 year of project initiation is 76% overall survival in the nursery. Plants will be introduced in selected areas in future.



(Chilgoza seedlings at Kalika nursery)

### 7.2.4 Polypit Technique Trial

Availability of quality planting material is essential for raising a successful plantation. Nursery plants should not only be healthy but should also be able to put forth good growth in short time to cut down nursery costs. To study the effect of low cost polypit technique on the survival, growth and development of nursery plants, this trial was initiated in 2009. Nursery plants of 24 species were raised in 1m deep pit covered with UV stabilised polythene sheet at night and uncovered in morning. Raised CO<sub>2</sub> level in trapped air during night while plants respire, higher photosynthetic activity in the early hours of morning, increased temperature inside the pit during night and protection from frost are some of the advantages perceived from this arrangement. Till now, Utis (*Alnus nepalensis*) showed growth enhancement of 264% while 3 species viz. Padam (*Prunus cerasoides*), Genthi (*Boehmeria rugulosa*) and *Ficus foveolata* showed growth enhancement of 76 to 100%, 4 species viz. Banj (*Quercus leucotrichophora*), Tejpat (*Cinnamomum tamala*), *Hovenia dulcis* and Darim (*Punica granatum*) showed 51 to 75 % enhancement, 4 species viz. Timla (*Ficus roxburghii*), Bamboo (*Dendrocalamus strictus*), Silver Oak (*Grevillea robusta*) and *Chukrasia velutina* showed 26- 50 % enhancement, 6 species viz. Tushiyari (*Debregeasia longifolia*), Ringal (*Arundinaria falcata*), Jamun (*Syzygium cumunii*), Cheura (*Diploknema butyracea*), *Olea europaea*, Putli (*Acer oblongum*) showed 1- 25 % enhancement. Further analysis is being carried out.



(Effect of Polypit treatment on Dadim)



(Effect of Polypit treatment on Genthi)

### 7.2.5 Effect of Pollarding on Tejpat (*Cinnamomum tamala*)

With an objective to improve the yield of leaves while enhancing ease of leaf collection, pollarding experiments was initiated in *tejpat* in 2006. 8 to 10 year old trees were pollarded at 1, 2 and 3 feet height. Yearly estimation of biomass shows pollarding at 1 foot height gave better performance in attaining bushy growth.



(Pollarding of Tejpat)

### 7.2.6 Study on the impact of ban on green felling of chir (*Pinus roxburghii*)

Chir Pine is one of the most important trees of Uttarakhand and has been major source of income with timber and resin, in addition to various other products and the ecological services it provides. Chir was earlier being managed under the shelter wood system until the Supreme Court came out with a complete ban on green felling above an altitude of 1000m above mean sea level. This study was initiated in 2005 to compare the adverse and beneficial aspects of ban on green felling of chir with respect to physical, biological and socio-economic environment. Data on regeneration survey, plant biodiversity, basal area, canopy density, ground litter, wild and domestic animal presence,



soil characteristics etc. has been collected from 8 forest divisions (Nainital, Almora, Civil Soyam Almora, Bageshwar, Champawat, Pithoragarh, Badrinath, Tons) in areas felled around 1980 and the areas due for felling around the same time, but not felled due to the ban. Data analysis is in progress.

### 7.2.7 Promotion of agave for fibre extraction

Since the ban on green felling in the hilly region of Uttarakhand has been imposed, promotion of Non Timber Forest Produce for the upliftment of local economy has become an important mandate of Forest Department.

Fibre is one such field which has huge potential for Uttarakhand. High fibre yielding variety of agave viz. Blue Sisal has been planted at Bhujiyaghat in 2009 to develop demonstration plot, to study its suitability for fibre extraction and to evaluate the economic options for promotion of livelihood. Growth and survival of plants have been found satisfactory till now and further study is continuing.



(Agave plantation at Bhujiyaghat)

### 7.2.8 Conservation and Propagation of Ginkgo biloba

*Ginkgo biloba*, also known as living fossil tree due to its origin dating back to pre-Jurassic era, is a tree of great importance in the field of medicine as well as ornamental planting. In 2008, Ginkgo from different areas, namely, Ranikhet, Nainital, Dehradun, Mussoorie and Palampur (HP) was selected, cuttings collected and planted at Kalika nursery, Ranikhet. All the individual trees of Nainital have been fenced to protect from damage by private collectors. A demonstration plot will be developed.



(Hedge garden of *Ginkgo biloba* at Kalika)

### 7.2.9 Conservation and Propagation of Trachycarpus takil

*Trachycarpus takil*, a palm tree, is endemic to Uttarakhand and is an important member of the biodiversity heritage of the state. Only one stand has been found till now near Ginniband, Munsiyari and it has been demarcated as a preservation plot in year 2008. Takil population was found to be of 85 trees after total enumeration. Propagation through seed will be carried out after collection of seeds.



(Takil tree at Ginniband, Munsiyari)

### 7.2.10 Enhancement of biodiversity in Chir Pine forests by development of lower canopy of shrubs and small trees

Large areas of Uttarakhand Himalayas are covered with Chir forests. Majority of such forest lack ground flora and have blank floor due to anthropogenic factors. To develop lower canopy by under planting of small and medium size trees and shrubs in chir pine forest and thus to enhance biodiversity and to study its effect on incidence of fire, a trial has been taken up. Different tree and shrub species like Padam (*Prunus cerasoides*), Hinsalu (*Rubus ellipticus*), Tushiyari (*Debregeasia velutina*), Angu (*Fraxinus micrantha*), Ghingaru (*Pyracantha crenulata*), Kafal (*Myrica esculanta*), wild Chameli (*Jasminum humile*), Banj (*Quercus leucotrichophora*), Kilmora (*Berberis aristata*) etc. have been planted in Chir Forest in Ranikhet on trial basis in year 2009.

### 7.2.11 Study of impact of Lantana eradication in Jangalia Gaon

To ecologically restore Lantana-infested site by plantation of fodder species and to develop fodder plots and thus enhance fodder availability for villagers, lantana had been eradicated in 2009 in Jangaliya Gaon Van Panchayat in 7 ha and the area is being restored with fodder trees, shrubs and grasses on experimental basis. The methodology adopted for lantana eradication is Dr. C.R. Babu's 'Cut Rootstock method' developed by CEMDE (Centre for Environmental Management of Degraded Ecosystems), Delhi University.

### 7.2.12 Study of Causal factor of Twist in Chir Pine

Large areas of chir forest under Almora Forest Division have twisted chir. The twist in chir leads to loss in revenue due to reduction in timber volume and value. An effort has been initiated to find out the causal factors for twist in Chir Pine with the long term objective of replacing twisted chir with ordinary chir. Soil samples from areas of twisted and ordinary chir pine have been analysed. Seeds have been collected from twisted (Katpuriya) and normal chir pine stands (Soni) and plants raised from them have been planted in selected areas.





## 8. Nurseries and Production of Quality Planting Material

### 8.1 Sal Region

Modern nurseries have been established with infrastructure like mist chambers, shade houses/ hardening chambers etc at Shyampur, Lalkuan and Haldwani for various propagation research activities and large scale production of planting material.

#### 8.1.1 Planting stock of Sal Region

Table-10: Species wise plant stock information of Sal Region

Name of Range	Nursery	Area of nursery (ha)	Species wise stock information as on 31.03.2010	
			Species	No. of Plants
1	2	3	4	5
Research Unit Lalkuan	Lalkuan	12.03	Eucalyptus	39380
			Kala shisham	19750
			Haldu	10000
			Aonla	2000
			Others	3644
			<b>Total</b>	<b>74774</b>
Research Range Haldwani	Haldwani	01.00	Eucalyptus	8286
			Kala shisham	20000
			Neem	5000
			Jamun	4000
			Cane	4000
			Others	9115
			<b>Total</b>	<b>50401</b>
			Research Range Ranipur	Shyampur
Bamboo	1560			
Others	30			
Lalpani	0.50	Jamun		6050
		Chirchita		350
		Toon		300
		<b>Total</b>		<b>17420</b>
		Seed Range Haldwani		Haldwani
Ber	1000			
Harad	998			
Others	1938			
<b>Total</b>	<b>7576</b>			
Munshi	—		Haldu	11000
			Phaldu	8540
			Indrajau	4870
			Others	600
			<b>Total</b>	<b>25010</b>
			<b>Grand Total</b>	<b>175181</b>

## 8.2 Hill Region

This division has 13 nurseries out of which 10 are equipped with mist chambers. The notable achievements in these nurseries have been the large scale vegetative propagation of *Thuner*, propagation and development of hedge garden of *Ginkgo* and development of nursery techniques for *Kaphal*, besides other numerous activities. Currently, research work on propagation of *Burans* is ongoing. Bhujiyaghat nursery in Gaja range has been earmarked for large scale propagation of *Tejpat*. High altitude medicinal plants are raised in the nurseries of Devban and Munsiyari.

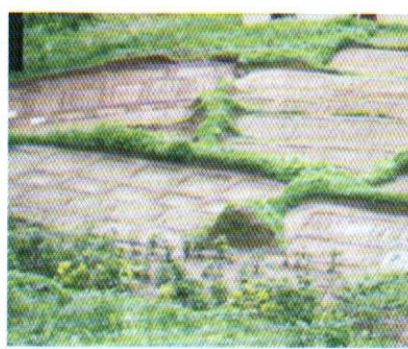
**Table-11:** Species wise plant stock information of Hill Region

Name of Range	Name of Nursery	Area of nursery (ha)	Species wise stock information as on 31.03.2010		
			Species	No. of Plants	
Research range, Gaja	Gaja	1.4	<i>Cinnamomum tamala</i>	8074	
			<i>Dendrocalamus strictus</i>	16500	
			<i>Eucalyptus grandis</i>	4820	
			<i>Thysanolaena maxima</i>	13000	
			Others	44999	
				<b>Total</b>	<b>87393</b>
	Bhujiyaghat	2.5	<i>Cinnamomum tamala</i>	93000	
			<i>Thysanolaena maxima</i>	15000	
			<i>Diploknema butyracea</i>	950	
			Others	4685	
			<b>Total</b>	<b>113635</b>	
	Khurpatal	0.2	<i>Juglans regia</i>	3200	
			<i>Microstylis wallichii</i>	1200	
			<i>Heteropogon contortas</i>	5000	
			Others	10226	
<b>Total</b>			<b>19626</b>		
Research range Lohaghat	Lohaghat	2.1	<i>Arundinaria falcata</i>	7000	
			<i>Carum carvi</i>	1700	
			<i>Valeriana wallichii</i>	3000	
			Others	35282	
			<b>Total</b>	<b>46982</b>	
	Munsiyari	2	<i>Arundinaria falcata</i>	10645	
			<i>Allium consanguineum</i>	15080	
			<i>Carum carvi</i>	16000	
			<i>Taxus baccata</i>	20000	
			Others	32270	
			<b>Total</b>	<b>93995</b>	
Research range Gopeshwar	Tangsa	3	<i>Arundinaria falconeri</i>	17000	
			<i>Juglans regia</i>	3000	
			<i>Diploknema butyracea</i>	20500	
			Others	565	
			<b>Total</b>	<b>41065</b>	
	Mandal	3	<i>Arundinaria falconeri</i>	16600	
			<i>Juglans regia</i>	2500	
			<i>Thysanolaena maxima</i>	8000	
			Others	2000	
			<b>Total</b>	<b>29100</b>	

Name of Range	Name of Nursery	Area of nursery (ha)	Species wise stock information as on 31.03.2010	
			Species	No. of Plants
Research range Kalika, Ranikhet	Kalika	1.5	<i>Taxus baccata</i> <i>Fraxinus micrantha</i> <i>Pinus roxburghii</i> <i>Prunus cerasoides</i> Others <b>Total</b>	13210 2616 2660 1233 10070 <b>29789</b>
	Dwarso	2	<i>Taxus baccata</i> <i>Cinnamomum tamala</i> <i>Cedrus deodara</i> <i>Quercus leucotrichophora</i> Others <b>Total</b>	26300 1200 2011 1965 13005 <b>44481</b>
Research range Kalsi	Kalsi	0.2	<i>Cinnamomum tamala</i> <i>Centella asiatica</i> <i>Dendrocalamus hamiltonii</i> <i>Panicum maximum</i> Others <b>Total</b>	62000 20300 10000 12300 16177 <b>120777</b>
	Devban	3	<i>Arundinaria falcata</i> <i>Aconitum heterophyllum</i> <i>Picrorhiza kurroa</i> Others <b>Total</b>	229000 1738 1500 5436 <b>237674</b>
	Chamba	0.3	<i>Artemisia nilagirica</i> <i>Dodonaea viscosa</i> <i>Cymbopogon martinii</i> <i>Cymbopogon flexuosus</i> Others <b>Total</b>	2200 2000 500 500 1310 <b>6510</b>
Himalayan Botanical Garden, Nainital	Sadiatal	0.7	<i>Cinnamomum tamala</i> <i>Microstylis wallichii</i> <i>Witbania somnifera</i> <i>Zanthoxylum alatum</i> Others <b>Total</b>	1999 2000 1040 2400 33464 <b>40903</b>
<b>Total</b>				<b>914231</b>



(Kalika Nursery)



(Devban Nursery)

### 8.3 Bamboo Rhizome Banks

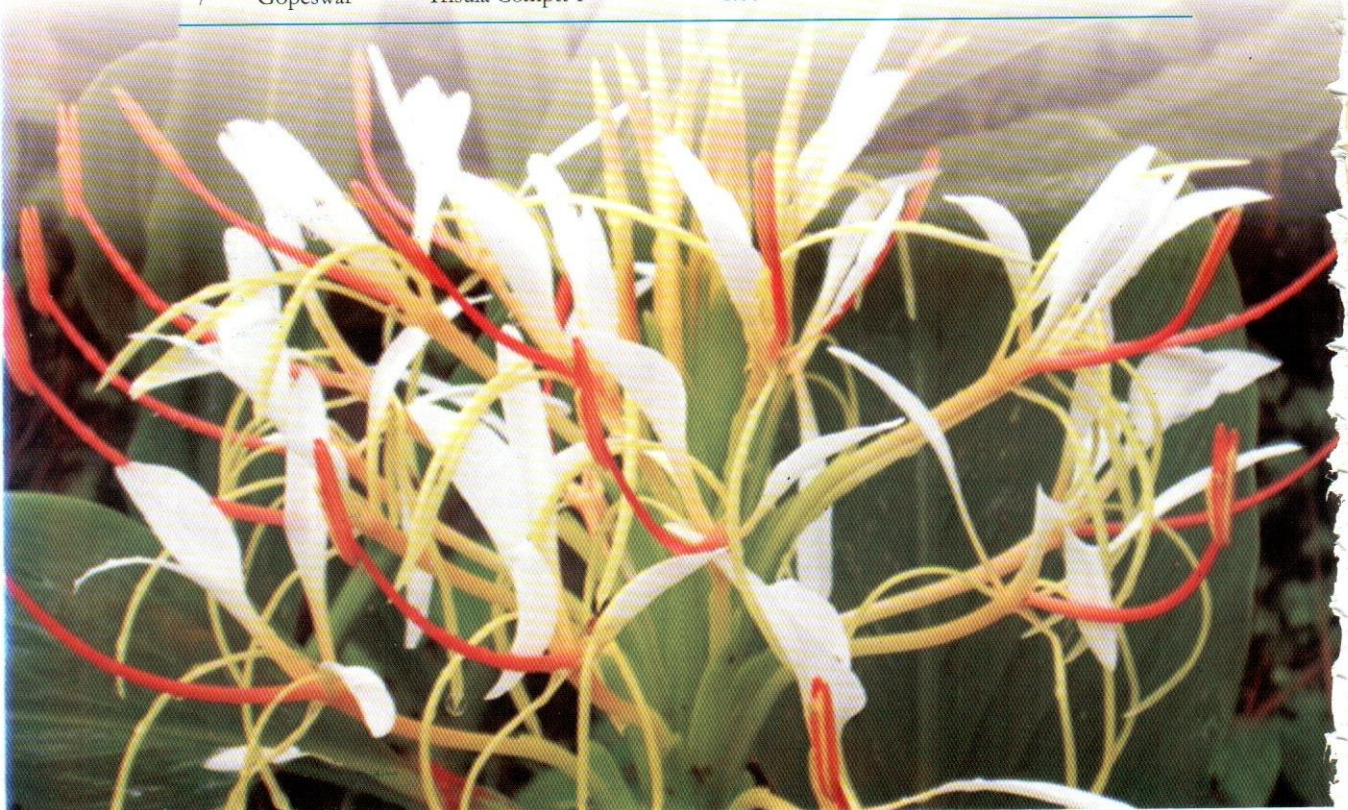
For supply of quality planting material of Bamboo rhizome banks of different Bamboo species have been established.

**Table-12 :** List of Rhizome Banks in Silva Sal

Sl.No.	Name of Range	Location	Area(ha)	Name of species
1	Haldwani	Tanda Plot no 76	5.00	Thyrsostachys siamensis
2	Haldwani	Tanda Plot no 1	10.00	"
3	Haldwani	Tanda Plot no 1	10.00	Dendrocalamus. membranaceus
4	Haldwani	Bail Parawo Plot no 46	3.00	"
5	Haldwani	Tanda Plot no 20	3.40	"
6	Haldwani	Dhimari Plot no 57	2.80	"
7	Haldwani	Bail Parawo Plot no 3B	4.00	"
8	Ranipur	Jakhan Plot no 2	10.00	Dendrocalamus asper, Dendrocalamus membranaceus

**Table-13:** List of Rhizome Banks in Silva Hill

Sl.No.	Name of Range	Location	Area(ha)	Name of species
1	Kalsi	Binhar Comptt 3	10.00	Dendrocalamus strictus
2	Kalsi	Kalsi Comptt 13	5.00	Dendrocalamus hamiltonii and Bambusa nutans
3	Kalsi	Devban Comptt 6	5.00	Thamnocalamus spathiflorus
4	Gaja	Nalaina Comptt 24	0.60	Dendrocalamus strictus
5	Gaja	Nalaina Comptt 24	1.00	"
6	Gaja	Mangoli Comptt 1	3.00	Thysanolaena maxima
7	Gopeswar	Trisula Comptt 1	1.00	"



## 9. Seed Production

Seed is a very significant input not only in plantation forestry but also in regeneration of natural forests. The productivity of forests per unit area can be improved by using good quality seeds. Seed quality has a critical effect on the quality of trees produced as well as on the economics of growing them.

Seeds are collected on the basis of maturity period from seed plots, seed stands and seed production areas depending upon the availability. After collection seeds are cleaned, dried and safely stored until use in the nurseries. The cleaned and dried seeds are packed in moisture proof bags and labelled. Seeds are tested before supplying to determine their germination ability. Germination percentage is tested in nursery beds and seed germinator. At the time of supply seeds are supplied with a certificate mentioning the area of collection, date of collection and germination percent.

### 9.1 Sal Region

#### 9.1.1 Production of quality seeds

**Table-14:** List of CSOs (Sal Region)

Sl. No.	Name of Division	Range	Block And Comptt	Species	Area (ha)	Year of Formation	Seed Trees
1	Tarai central Forest Division	Tanda	Gangapur Patiya	Shisham	1.0	2000	175
2	"	Tanda	Tanda 20	Teak	4.0	2000	180
3	"	Tanda	Gangapur Patiya	Teak	6.00	2001	200
4	"	Tanda	Tanda 20	Shisham	2.00	2003	150
5	"	Tanda	Tanda 20	Eucalyptus	4.00	2003	350
6	"	Haldwani	Talli Haldwani Block	Eucalyptus	4.00	2004	50
7	Haridwar Forest Division	Shyampur	Shyampur 10	Teak	7.00	2000	849
8	"	Shyampur	Shyampur 10	Teak	3.00	2001	401

**Table-15:** List of SPAs (Sal Region)

Sl. No.	Name of Division	Range	Block And Comptt	Species	Area (ha)	Year of Formation	Seed Trees
1	Tarai East Forest Division	Dauli	Imlighat 22a	Khair	10	2000	674
2	Tarai East Forest Division	Dauli	Kot khara 16	Semal	10	2003	500
3	Dehradun Forest Division	Rishikesh	Lalpani 2	Eucalyptus	1	2002	118
4	Haldwani Forest Division	Sarda	Sarda tapu 37	Shisham	10	2000	548
5	Tarai Central Forest Division	Tanda	Tanda 23	Eucalyptus	5	1996	276
6	Haridwar Forest Division	Chirapur	Nalowala 3	Eucalyptus	5.4	1996	473
7	Tarai Central Forest Division	Tanda	Tanda 60	Teak	10	2000	523
8	Dehradun Forest Division	Rishikesh	Bibiwala 3b	Teak	10	1998	600
9	Tarai Central Forest Division	Tanda	Tanda	Teak	5	2005-06	250



Table-16: List of SSPAs (Sal Region)

Sl. No.	Name of Division	Range	Block And Comptt	Species	Area (ha)	Year of Formation	Seed Trees
1	Tarai central Forest Division	Tanda	Gangapur Patiya	Shisham	1.7	1999	300
2	"	Tanda	Gangapur Patiya	Shisham	5.0	1999	410
3	"	Tanda	Gangapur Patiya	Shisham	1.5	2000	125
4	"	Haldwani	Talli Haldwani Block	Khair	3.00	2000	150
5	"	Tanda	Gangapur Patiya	Eucalyptus	3.00	2001	1400
6	"	Tanda	Tanda 20	Eucalyptus	1.50	2002	450
7	"	Tanda	Tanda 20	Eucalyptus	2.00	2003	250
8	"	Tanda	Lalkuon Nursery	Harad, Bahara, Anwala	0.50	2004	50
9	"	Tanda	Dhimari 57A	Eucalyptus grandis	0.4	2007	150
10	Tarai West Forest Division	Bailparawo	Bailparawo 46	Kala Shisham	10	2007	3400
11	Tarai central Forest Division	Haldwani	Tanda 76	Kala Shisham	2.0	2007	350
12	"	Barahani	Barahani 43	Neem	3.0	2009	3000
13	Haridwar Forest Division	Shyampur	Shyampur 10	Khair	7.00	2000	400
14	"	Shyampur	Shyampur 10	Anwala	2.0	2009	250

Table-17: List of Seed stands (Sal Region)

Sl. No.	Name of Division (s)	Range	Block and Comptt.	Species	Establish year	No of trees
1	Tarai East Forest Division	Kilpura	East and West Kilpura	Bahera	2008-09	90
2	Tarai East Forest Division and Tarai Central Forest Division	Kilpura and Tanda	Kilpura and Tanda	Jheengan	2008-09 2009-10	151
3	Tarai East Forest Division and Tarai Central Forest Division, Haldwani Forest Division	Doli, Goula, Pipalparaw and Sharda	Emlighat, Shahdora, Goula-5,	Kala siris	2005-06 2008-09 2009-10	901
4	Tarai East Forest Division, Haldwani and Tarai Central Forest Division, Haldwani	Kilpura, Pipalparaw, Tanda	Kilpura, Pipalparaw and Tanda	Kharpat	2005-06 2006-07 2009-10	110
5	Tarai East Forest Division, Haldwani and Tarai Central Forest Division, Haldwani	Kilpura, Pipalparaw, Gadgadiya	Kilpura, Pipalparaw	Safed siris	2008-09 2009-10	390
6	Tarai Central Forest Division, Haldwani, Ramnagar Forest Division, Ramnagar	Haldwani and Kaladhungi	Haldwani-Lalkuan motor road and Kaladhungi	Haldu	2005-06 2008-09	205
7	Tarai Central Forest Division, Haldwani Tarai East Forest Division, Haldwani, Ramnagar Forest Division, Ramnagar	Haldwani, Kilpura, Fatehpur	Haldwani, Kilpura and Chousala	Amaltas	2006-07 2009-10	180
8	Ramnagar Forest Division, Ramnagar	Kaladhungi	Nihal	Dhauri	2008-09	105

Sl. No.	Name of Division (s)	Range	Block and Comptt.	Species	Establish year	No of trees
9	Ramnagar Forest Division, Ramnagar Tarai Central Forest Division, Haldwani	Kaladhungi, Pipalparaw	Kaladhungi, Pipalparaw	Phaldu	2005-06 2009-10	7
10	Tarai Central Forest Division, Haldwani	Haldwani and Tanda	Talli Haldwani and Tanda-20	Bijasal	2005-06 2006-07	10
11	Tarai Central Forest Division, Haldwani	Haldwani and Tanda	Talli Haldwani and Tanda-20	Kadam	2005-06	5
12	Tarai Central Forest Division, Haldwani Tarai East Forest Division, Haldwani	Rudrapur and Khatima	Lalkuan- Kicha road and Nanakmatta road	Kachnar	2006-07	10
13	Tarai Central Forest Division, Haldwani	Gadgadiya, Pipalparaw and Tanda	Gadgadiya, Pipalparaw and Tanda	Semal	2009-10	200
14	Tarai Central Forest Division, Haldwani Tarai East Forest Division, Haldwani	Rudrapur	Nagala	Gulmohar	2005-06	10
15	Haldwani Forest Division, Haldwani	Danda	Gouniyaro-5	Tejpat	2005-06	49
16	Tarai Central Forest Division, Haldwani	Rudrapur	Nagala	Dhak	2005-06	5
17	Tarai East Forest Division, Haldwani	Kilpura	Haldwani-Kicha road and Kilpura	Bourang	2005-06	100
18	Tarai East Forest Division, Haldwani	Kilpura	Kilpura	Marodhfali	2006-07	50
19	Tarai East Forest Division, Haldwani	Dolli	Santipuri road	Dadim	2005-06	6
20	Haldwani Forest Division, Haldwani	Danda	Gouniyaro	Reetha	2006-07	3
21	Tarai East Forest Division, Haldwani	Kilpura	Kilpura	Rohini	2009-10	3
22	Tarai Central Forest Division, Haldwani	Tanda	Tanda	Neem	2005-06	5
23	Tarai Central Forest Division, Haldwani	Rudrapur	Nagala	Bijasal	2005-06	20
24	Tarai East Forest Division, Haldwani	Kilpura	Kilpura	Tun	2009-10	110
25	Tarai Central Forest Division, Haldwani	Tanda	Tanda	Madrasi babool	2005-06	2
26	Ramnagar Forest Division, Ramnagar	Fatehpur	Fatehpur-1	Mahua	2009-10	60
27	Tarai Central Forest Division, Haldwani	Tanda	Tanda	Lesora	2006-07	5
28	Tarai East Forest Division, Haldwani	Kilpura	East Kilpura Plot No. 45	Arru	2007-08	120
29	Tarai Central Forest Division, Haldwani	Tanda	Tanda	Pula	2006-07	25
<b>Total</b>						<b>2,937</b>

## 9.1.2 Collection of seed

Table-19: Details of seed collection (Sal Region)

Sl. No.	Species	Quantity collected in 2009-10(kg)
1	<i>Terminalia bellerica</i>	163.700
2	<i>Terminalia chebula</i>	355.000
3	<i>Acacia catechu</i>	1505.000
4	<i>Bombax ceiba</i>	312.000
5	<i>Dalbergia sissoo</i>	732.000
6	<i>Holoptelia integrifolia</i>	1275.000
7	<i>Albizzia lebeck</i>	602.700
8	<i>Tectona grandis</i>	5274.000
9	<i>Trevisa nudiflora</i>	2135.750
10	<i>Kydia calycina</i>	107.500
11	<i>Sapindus mukorosii</i>	219.000
12	<i>Lannea coromandelica</i>	235.000
13	<i>Garuga pinnata</i>	150.000
14	<i>Zizyphus mauritiana</i>	234.000
15	<i>Pongamia pinmta</i>	174.000
16	<i>Cassia fistula</i>	430.790
17	<i>Ailanthis excelsa</i>	247.000
18	<i>Terminalia tomentosa</i>	451.500
19	<i>Toona ciliata</i>	415.000
<b>Total</b>		<b>15018.940</b>

## 9.2 Hill Region

## 9.2.1 Production of quality seeds

There are 265 seed plots, seed production areas, seedling seed production areas, etc. for collection of quality seeds. The seeds are processed and tested before supply. The seeds are certified and packed and follow up action is also taken to see the performance of the seeds at different nurseries. Instructions on pre sowing treatment and sowing techniques are also given to the nursery staff. This Division collects seeds mainly of the hill species, the major species includes Oak, Deodar, Chir, Walnut, Harad, Baheda, Amla, Chamkharik, Cheura, Tejpat, Utis and many others including medicinal plants. Seed Centres have been established at Ranikhet and Gauchar for seed processing, storage, testing, certification, packaging and information dissemination to the buyers.

Table 20: Division and species wise list of seed plots (hill region)

Species Name	Division Name												Total				
		Almora	Almora C/S	Badrinath	Bageswar	Chakrata	Champawat	I.V.R.I	Kedarnath	Kedarnath w/ sanctuary	Nainital	NDBR		Pithoragarh	Tons	Upper Yamuna	Uttarakashi
<i>Abies pindrow</i>	SP	-	-	-	-	3	-	-	2	-	2	-	-	-	-	-	7
<i>Acacia spp.</i>	SP	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
<i>Acer oblongum</i>	SS	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Acer pictum</i>	SP	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
<i>Aesculus indica</i>	SP	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	SSPA	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1

Species Name	Division Name	Almora	Almora C/S	Badrinath	Bageswar	Chakrata	Champawat	I.V.R.I	Kedarnath	Kedarnath w/ sanctuary	Nainital	NDBR	Pithoragarh	Tons	Upper Yamuna	Uttarakashi	Total
<i>Quercus dilatata</i>	SP	3	-	-	-	-	-	4	-	-	-	-	-	-	-	-	7
<i>Quercus incana</i>	SP	2	-	-	-	-	1	-	-	-	1	-	-	-	-	-	4
	SSPA	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Quercus leucotrichophora</i>	SS	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2
<i>Quercus semicarpifolia</i>	SP	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
<i>Quercus serrata</i>	SP	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	SSPA	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Rhododendron arboreum</i>	SS	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Robinia pseudocacia</i>	SP	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2
<i>Santalum album</i>	SP	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Sapindus mukorossi</i>	SSPA	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Taxodium mucronatum</i>	SP	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Taxus baccata</i>	SS	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2
	VMG	12	-	-	-	-	-	-	-	2	-	-	2	-	-	-	16
<i>Terminalia belerica</i>	SSPA	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Toona ciliata</i>	SSPA	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Zanthoxylum alatum</i>	SSPA	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<b>Total</b>		<b>97</b>	<b>1</b>	<b>11</b>	<b>1</b>	<b>19</b>	<b>21</b>	<b>4</b>	<b>14</b>	<b>2</b>	<b>58</b>	<b>1</b>	<b>12</b>	<b>7</b>	<b>3</b>	<b>14</b>	<b>265</b>

Table-21: Details of seed collection (Hill Region)

Sl. No.	Name of Species	Quantity collected in 2009-10(kg)
1.	<i>Terminalia belerica</i>	95.00
2.	<i>Quercus leucotrichophora</i>	125.00
3.	<i>Bauhinia purpurea</i>	12.00
4.	<i>Pyrus pashia</i>	47.4
5.	<i>Terminalia chebula</i>	80.00
6.	<i>Grewia optiva</i>	12.00
7.	<i>Aesculus indica</i>	185.00
8.	<i>Acer oblongum</i>	18.00
9.	<i>Sapindus mukorossi</i>	54.00
10.	<i>Albizgia sp.</i>	5.00
11.	<i>Cupressus torulosa</i>	23.00
12.	<i>Juglans regia</i>	200.00
13.	<i>Fraxinus micrantha</i>	37.00
14.	<i>Emblicia officinalis</i>	20.00
15.	<i>Alnus nepalensis</i>	1.0
16.	<i>Callistemon viminalis</i>	1.0
	<b>Total</b>	<b>915.40</b>



## 10. Statistical record and analysis

One of the important objectives of forestry research, especially for sustainable production forestry is to cater to the increasing demand of timber, fuel, fodder and other minor forest produce. Different research activities are undertaken to achieve this objective. Large number of sample and experimental plots are being maintained in the state for growth and yield analysis as well as performance trials of various indigenous and exotic species. Measurement of various Sample Plots, Linear Increment Plots (L.I.P), Tree Increment Plots (T.I.P), and Continuous Inventory Plots (C.I.P) is done at regular intervals. The oldest sample plot was established in 1911. Measurements of these plots are done periodically and data recorded. Analysis of growth data is under progress.

**Table-22:** Details of statistical plots (Sal Region)

Description of Sample Plot	Total no. of Sample Plots in Sal Region	No of plots in which data was recorded during the year	Total no. of Sample Plots in Hill Region	No of plots in which data was recorded during the year
Sample plots	245	119	342	121
Preservation plots	13	-	8	-
Linear increment plots (L.I.P)	30	14	3	-
Tree increment plots (T.I.P)	7	5	51	9
Continuous inventory plots (C.I.P)	2	-	-	-
Experimental plots	64	50	905	85
Conservation plots	-	-	1	-
<b>TOTAL</b>	<b>361</b>	<b>188</b>	<b>1310</b>	<b>215</b>

### 10.1 Sal Region

Division and species wise list of sample plots, TIPs and LIPs for Sal region is given below

**Table-23a:** Distribution of Statistical Plots in various forest divisions: Species-wise (Sal Region)

Forest Division	Type of Plots	<i>Acacia catechu</i>	<i>Pinus roxburghii</i>	<i>Adina cordifolia</i>	<i>Ailanthus excelsa</i>	<i>Bombax ceiba</i>	<i>Brousonetia papyrifera</i>	<i>Toona ciliata</i>	<i>Dalbergia sissoo</i>	<i>Holoptelia integrifolia</i>	Misc. species	<i>Pterocarpus acerifolium</i>	<i>Melia azadirach</i>	Poplar	<i>Tectona grandis</i>
Tarai Central	S.P.	11	-	1	4	-	-	4	8	2	24	-	2	13	20
Division	T.I.P.	-	-	-	2	1	-	-	-	-	-	-	-	-	-
Haldwani	S.P.	-	-	-	-	-	-	-	-	1	-	-	-	-	12
Division	T.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	L.I.P.	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Ramnagar	S.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Division	L.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Forest Division	Type of Plots	<i>Acacia catechu</i>	<i>Pinus roxburghii</i>	<i>Adina cordifolia</i>	<i>Ailanthus excelsa</i>	<i>Bombax ceiba</i>	<i>Brousonetia papyrifera</i>	<i>Toona ciliata</i>	<i>Dalbergia sissoo</i>	<i>Holoptelia integrifolia</i>	Misc. species	<i>Pterocarpus acerifolium</i>	<i>Melia azadirach</i>	Poplar	<i>Tectona grandis</i>
Tarai East Division	S.P.	-	-	-	-	-	-	-	-	-	4	-	-	3	-
Tarai West Division	S.P.	2	-	-	-	1	1	1	1	-	-	-	-	-	4
Dehradun Division	S.P.	-	1	-	-	-	-	-	-	-	-	-	-	-	2
Kalagarh /C.T.R.	T.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	L.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rajaji National Park	C.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Haridwar Division	T.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S.P.	-	-	-	11	-	-	-	-	-	-	-	-	-	3
Total	T.I.P.	-	-	-	2	1	-	5	9	3	28	-	2	16	54
	S.P.	13	1	1	15	1	1	5	9	3	28	-	2	16	54
	L.I.P.	1	-	-	-	-	-	-	-	-	-	-	-	-	-
	C.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table-23b: Distribution of Statistical Plots In various Divisions: Species-wise (Sal Region)

Forest Division	Type of Plots	<i>Diospyros embryopteris</i>	<i>Ougeinia oojeinensis</i>	<i>Shorea robusta</i>	<i>Syzygium cumini</i>	<i>Trewia nudiflora</i>	<i>Terminalia tomentosa</i>	<i>Anogeissus latifolia</i>	<i>Eucalyptus hybrid</i>	<i>Eucalyptus clonal</i>	<i>Dalbergia sissoo clonal</i>	<i>Kydia calycina</i>	<i>Albizia procera</i>	<i>Moringa olifera</i>	Total
1	2	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Tarai Central Division	S.P.	-	-	-	-	1	-	-	2	18	8	-	1	1	120
Haldwani Division	T.I.P.	-	-	2	-	-	-	-	-	-	-	-	-	-	5
	S.P.	-	-	5	1	-	-	-	-	-	-	-	-	-	19
	T.I.P.	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Ramnagar Division	L.I.P.	-	-	10	-	-	-	-	-	-	-	-	-	-	11
	S.P.	-	-	11	-	2	-	-	-	-	-	-	-	-	26
Tarai East Division	L.I.P.	-	-	16	-	-	-	-	-	-	-	-	-	-	16
Tarai West Division	S.P.	-	-	2	-	-	-	-	-	3	-	-	-	-	12
	S.P.	-	-	-	-	-	4	1	-	-	-	1	-	-	16

Forest Division	Type of Plots	<i>Diospyros embryopteris</i>	<i>Ougeinia oojenensis</i>	<i>Shorea robusta</i>	<i>Syzygium cumini</i>	<i>Trevesia nudiflora</i>	<i>Terminalia tomentosa</i>	<i>Anogeissus latifolia</i>	<i>Eucalyptus hybrid</i>	<i>Eucalyptus clonal</i>	<i>Dalbergia sissoo clonal</i>	<i>Kydia calycina</i>	<i>Albizia procera</i>	<i>Moringa olifera</i>	Total
Dehradun	S.P.	-	-	10	-	-	2	-	-	-	-	-	-	-	15
Division	T.I.P.	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Kalagarh /	S.P.	-	-	9	-	-	-	-	-	-	-	-	-	-	9
C.T.R.	L.I.P.	-	-	4	-	-	-	-	-	-	-	-	-	-	4
	C.I.P.	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Rajaji National	S.P.	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Park	T.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Haridwar	S.P.	-	-	-	-	1	-	-	2	10	-	-	-	-	27
Division	T.I.P.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	S.P.	2	-	37	1	4	6	1	4	31	8	1	1	1	245
	T.I.P.	1	-	3	-	-	-	-	-	-	-	-	-	-	7
	L.I.P.	-	-	30	-	-	-	-	-	-	-	-	-	-	31
	C.I.P.	-	-	2	-	-	-	-	-	-	-	-	-	-	2

## 10.2 Hill Region

Division and species wise list of sample plots, TIPs and LIPs for hill region is given below.

**Table-24:** Division and species wise list of statistical plots (Hill region)

Sl. No.	Species Name	Plots	Divisions											Total		
			Almora	Badrinath	Bageshwar	Civil soyam Almora	Chakrata	Champawat	Dehradun east	Kedarnath	Nainital	Pithoragarh	Tons		Upper Yamuna	Uttarakashi
1	<i>Acacia mearnsii</i>	SP	-	-	-	-	-	1	-	-	-	-	-	-	-	1
2	<i>Acacia spp.</i>	TIP	1	-	-	-	-	-	-	-	-	-	-	-	-	1
3	<i>Juglans regia</i>	SP	-	-	-	-	-	1	-	-	-	-	-	-	-	1
4	<i>Fraxinus micrantha</i>	SP	-	-	-	-	1	-	-	-	1	-	-	-	-	2
		TIP	1	-	-	-	-	-	-	-	1	-	-	-	-	2
5	<i>Quercus leucotrichophora</i>	SP	16	-	-	1	7	4	-	-	11	1	-	-	-	40
		TIP	2	-	-	-	-	-	-	-	-	1	-	-	-	3
6	<i>Rhododendron arboreum</i>	SP	-	-	-	-	-	1	-	-	-	-	-	-	-	1
7	<i>Carpinus viminea</i>	SP	-	-	-	-	-	-	-	-	1	-	-	-	-	1
		TIP	-	-	-	-	-	-	-	-	1	-	-	-	-	1
8	<i>Pinus roxburghii</i>	SP	38	1	6	-	6	8	-	-	2	5	4	2	2	74
		TIP	-	-	4	-	1	-	1	-	-	-	2	1	-	9
		LIP	-	2	-	-	-	-	-	-	-	-	-	-	-	2
9	<i>Cupressus torulosa</i>	TIP	1	-	-	-	-	-	-	-	-	-	-	-	-	1



## 11. Laboratories

### 11.1 Soil Testing Laboratory

A Soil testing lab has been established at Haldwani with following objectives

- To evaluate soil fertility status.
- To predict the probable crop response to applied nutrients.
- To classify soils into different fertility groups.
- To identify the type and degree of soil related problem like salinity, alkalinity and acidity etc.



(Soil Testing Lab)

Presently pH-meter, Auto-titrator, Spectrophotometer, Flame Photometer, Macro and Micro Kjeldhal Distillation Unit, Digestion Unit, etc. are available in the lab for analysis of soil.

**Table-25:** Soil Samples Tested

Sl. No.	Name of the Division	No. of soil samples tested in 2009-10
1	Silva Hill, Nainital (Champawat, Badrinath, Tons Division)	5
2	Tarai Central Division	115
3	Tarai East Division	9
4	C.C.F. Working Plan Divisions	19
<b>TOTAL</b>		<b>148</b>

### 11.2 Tissue Culture Laboratory

This lab has been established for the purpose of mass multiplication of difficult-to-propagate species in very high demand. Equipment like autoclave, refrigerator, laminar air flow, oven, pH-meter, weighing balance, hot plate, etc. is available in the lab. Culture room is equipped with culture racks, photoperiodic timer, humidity controller, air conditioner etc.

### 11.3 Seed Testing Laboratory

Seed weight, purity percentage, humidity, germination percentage and viability tests are conducted on the collected seeds. Germination percentage is calculated in three different potting media, viz. sand, soil and vermiculite. T.T.Z test is conducted to know viability of seeds.



(Seed Testing)

Table-26: Seed samples tested

Sl. No.	Species	No. of samples tested
1	Shisham ( <i>Dalbergia sissoo</i> ), Asna/ Sain ( <i>Terminalia tomentosa</i> ), Borang ( <i>Hymenodictyon exelsum</i> ), Pula ( <i>Kydia calycina</i> ), Safed Siris ( <i>Albizzia procera</i> ), Semal ( <i>Bombax ceiba</i> ), Kachnar ( <i>Bauhinia variegata</i> ), Chironji ( <i>Buchanania latifolia</i> ), Chandan ( <i>Santalum album</i> ), Bel ( <i>Aegle marmelos</i> ), Faldu ( <i>Mitragyna parviflora</i> ), Jhingan ( <i>Lannea grandis</i> ), Amaltas ( <i>Cassia fistula</i> ), Kharpat ( <i>Garuga pinnata</i> ), Kala Siris ( <i>Albizzia lebbek</i> ), Kadamb ( <i>Anthocephalus cadamba</i> ), Bahera ( <i>Terminalia belerica</i> ), Harar ( <i>Terminalia chebula</i> ), Arru ( <i>Ailanthus excelsa</i> ), Bent ( <i>Calamus tenuis</i> )	1 each
2	Haldu ( <i>Adina cordifolia</i> ), Kanju ( <i>Holoptelea integrifolia</i> ), Dhauri ( <i>Lagerstroemia parviflora</i> ), Toon ( <i>Toona ciliata</i> ), Gutel ( <i>Trewia nudiflora</i> ), Ritha ( <i>Sapindus mukorossi</i> )	2 each
3	Khair ( <i>Acacia catechu</i> ), Teak ( <i>Tectona grandis</i> )	3 each
Total of all species		38



## 12. Services and facilities

### 12.1 Library

A well equipped library has been established at Haldwani. About 1400 books related to forestry, viz. Genetics and Tree improvement, Silviculture, Soil Science, Seed Biology, Wild life, Agriculture, Environment, Ecology, MAPs, Gardening, Encyclopaedia etc. are available in this library.

Another library at Kalika has 3787 books on different aspects of research and other forestry subjects.

### 12.2 Seed Supply

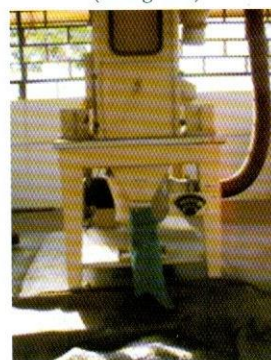
High quality seeds are collected from seed production areas, seed plots, plus trees and seed stands located at various locations in the state; then graded, treated and stored properly and finally supplied to different territorial divisions and agencies according to their demand. In the year 2009-10, 16865 kg seeds of 39 species by Silva Sal and 780 kg seeds of 16 species by Silva Hill were supplied to various divisions and institutions.



(Seed grader)

### 12.3 Soil Testing

Soil testing laboratory was established at Haldwani in 2006 for soil testing purposes. This is the first departmental soil testing lab which is highly useful for plantation and nursery activities. It is useful for villagers and farmers as well. Presently pH, Organic Carbon, Nitrogen %, Phosphorus %, Potassium %, Bulk density and porosity is being analyzed from the soil samples.



(Seed treatment plant)

### 12.4 Information centre

Information cum supply centre has been established at Haldwani and Lalkuan under Silva Sal. These centres serve as a demonstration centre for research activities and are utilized to disseminate information as well as planting materials.

Information cum supply centres have also been established at Botanical Garden, Sadiataal and at research nursery, Kalika under Silva Hill.

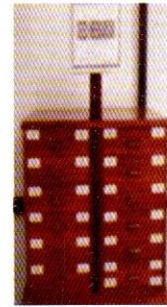
### 12.5 Supply of Quality Planting Material

High quality planting materials of important tree, shrub and bamboo species have been produced in different nurseries and supplied to the territorial divisions according to their demand. A total number of 157026 plants including clonal Eucalyptus were supplied by Silva Sal and 42929 plants comprising of species like *Thuner*, *Tejpat*, Bamboo etc. were supplied by Silva Hill in 2009-10.

## 12.6 Herbarium

### 12.6.1 Seed Herbarium

Cupboards for storing authentic seed have been set up having a collection of about 70 species. It is proposed to raise this seed collection to almost all the species found in this region. The seed herbarium specimens can be referred to for identification and purity analysis of seeds.



(Seed Herbarium)

### 12.6.2 Digital Herbarium



(Plant Herbarium)

Preparation of a digital herbarium is under progress with digital information and image retrieval system in addition to the standard herbarium facilities at Himalayan Botanic Gardens, Sadiatal. It is a continuous and long process and the collections were started with a humble beginning of 1200 specimens. Another aspect is the imaging of plants in their live state for easier identification. The field staff of the department are being trained in herbarium collection, preparation and preservation.



## 13. Publication and Publicity

As part of extension activity, several publications in the form of leaflets, information booklets, posters etc. are being regularly published. Besides number of papers based on research findings have been published in scientific journals.

### 13.1 Booklets/ Manuals/Brochures

- Seed Manual has been published, which gives detailed information regarding seeds
- Effect of Debudding on Branching in Bambusa bamboos.
- Folder on 'Phenograms and Phenological Cycle' of important species.
- Brochure on Germination technique of *Adina cordifolia*

### 13.2 Research/ Conference papers

- 1 Early flowering in rooted cuttings of Tejpatta (*Cinnamomum tamala*). S.K. Verma and C.S. Joshi. 2005. *Indian Forester* 131: 1637-1637.
- 2 A note on fruiting on *Taxus baccata* in hedge garden. S. K. Verma and C.S. Joshi 2006. *Indian forester* 132: 887-888.
- 3 Growth study of *Taxus baccata* in vegetative multiplication garden. C.S. Joshi and S. K. Verma. 2007. *Indian forester* 133:1139-1140.
- 4 Propagation of *Taxus baccata* through seeds. N.K. Sharma and C.S. Joshi. 2008. *Indian forester* 134:981-982
- 5 Growth performance of three exotic pine species in relation to indigenous species in Uttarakhand Himalaya, India. Neeraj Sharma, Manoj Chandran and Jitendra Bhatt 2009. *Indian Forester* 135: 1556-1564
- 6 Propagation of Tejpat (*Cinnamomum tamala* Nees and Eberm.) through seeds: A new Approach. Jitendra Bhatt, Neeraj Sharma and C.S. Tewari. 2007. *Indian Forester* 133:1572-1574.
- 7 Conference paper on "A study on propagation technology of *Adina cordifolia* through seeds in different potting media " (IUFRO,2010) presented by Prachi Gangwar, 2009.
- 8 Conference Paper on "Effect of canopy manipulations and soil working on the regeneration of Sal (*Shorea robusta*) ( National Forestry Conference,2009, FRI) presented by Prachi Gangwar
- 9 Conference paper on "Developing rhizome banks of economically important species of Bamboo-*D. membranaceous* and *T. siamensis* for social and economic development of Kumaon region" presented by Prachi Gangwar, 2009.



## 14. Training Programme

The research wing regularly gives training to the field staff on different techniques and package of practices related to forestry activities. The research staff also visit the problematic areas in the field and after thorough study of the problems suggest remedial measures. Constant advice on establishment of modern nursery techniques is also provided. Some of the training programmes conducted during the year are:

- Construction of Pine needle check dams and Lantana eradication techniques.
- Clonal technique of propagation of Eucalyptus and Poplar for Departmental Staff and farmers.
- Demonstration and extension of seed processing and storage techniques to departmental personnel and others.
- Production of vermicompost from organic wastes.
- Conservation of medicinal plants to forest guard trainees.







## 15. Education and Recreation

### 15.1 Himalayan Botanic Garden, Sadiatal (Nainital)

In 2004, Himalayan Botanic Garden was established in Sadiatal (Nainital) with the objective of conservation, research and display of Himalayan flora, nature education,



(Geodesic Dome)

ecotourism and promotion of marketing of forest produce in an area of 85 ha on Nainital-Kaladungi motor road. *In-situ* and *ex-situ* conservation and propagation



(Aquatic Garden)

work of economically and ecologically important species of Uttarakhand is in progress. The Botanic Garden also serves as a storehouse of natural biodiversity with several species of fauna including birds, butterflies, reptiles and flora including lichens, moss, ferns etc. Currently, it features fern house, orchidarium, arboretum, medicinal plant demonstration plots, aquatic garden, butterfly park, nature trails, geodesic domes, forest produce sales counter, library, digital herbarium, auditorium, canteen, bamboo hut, watch tower, Sadiatal falls etc.

**A total of 100012 visitors visited the Himalayan Botanic Garden in 2009-10**

### 15.2 Munsyari Herbal Garden

Munsyari Herbal Garden is being developed in 70 ha since 2007 for conservation,



(Fernarium)

cultivation, processing, storage and marketing of medicinal plants; and to promote ecotourism and livelihood of local communities. It is also a centre of research, training,



(Canopy Walkway)

education and information. Currently, fernarium and orchidarium, gazebos, watch tower, aquatic garden, nature trails, medicinal plant demonstration area, canopy walkway

etc. are the main attractions.

### 15.3 Mini Herbal Gardens

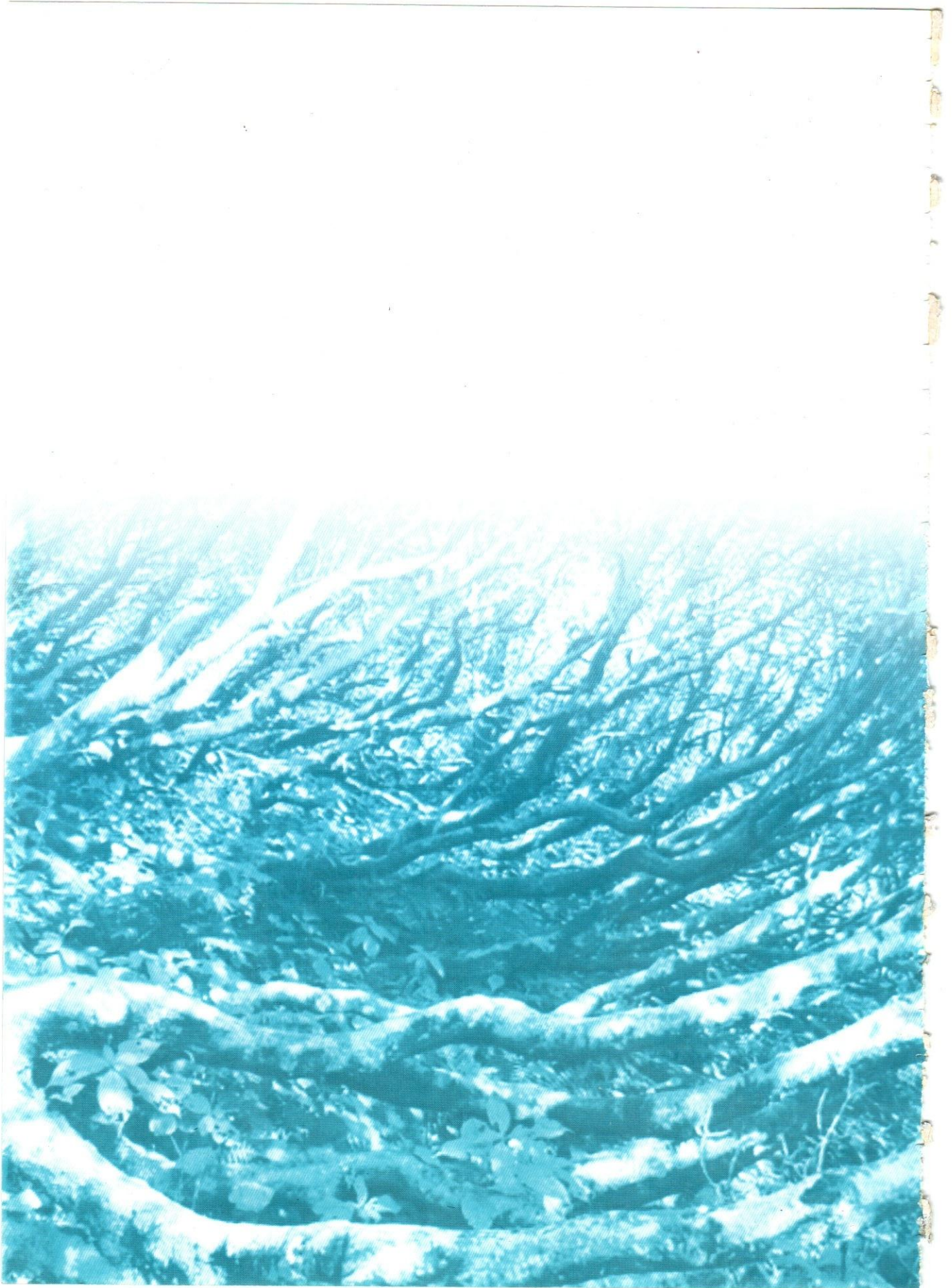
Mini Herbal gardens have been established at Haldwani, Gaja, Kalsi and Devban nurseries.

### 15.4 Bambusetums

Bambusetums with different species of bamboo have been established at Lalkuan, Shyampur and Bhujjighat nurseries in addition to a large bambusetum at Tanda in 2.5 ha.



(Bambusetum at Lalkuan)



## 16. Financial Statement

### 16.1 Budget and Expenditure (2009-10)

Budget for the Research Institute is allotted by State Govt. mainly under Research and Technology development, Twelfth Finance Commission and Herbal Garden schemes.

**Table-27:** Budget detail (Sal Region)

Sl. No.	Name of scheme	Budget head	Sanctioned amount (Rs.)	Expenditure (Rs.)
1.	2406-Research and Technology dev. scheme	24-Major con.	97,00,000	93,94,132
		25-Minor con.	5,00,000	4,99,999
		29-Maintenance	11,50,000	10,94,122
2.	2406- Twelfth finance commission	24- Major con.	11,50,000	11,50,000
		42- Other expenditure	4,50,000	4,50,000
3.	Rozgar parak	24- Major con.	2,00,000	2,00,000
		29-Maintenance	2,93,000	2,47,437
4.	Fire	24- Major con.	17,000	17,000
5.	Non Plan	29-Maintenance	2,00,000	2,00,000
<b>Total:</b>			<b>1,36,60,000</b>	<b>1,32,52,690</b>

**Table-28:** Budget detail (Hill Region)

Sl. No.	Name of scheme	Budget head	Sanctioned amount (Rs.)	Expenditure (Rs.)
1-	2406-Research and Technology dev. scheme	24-Major con.	1,00,00,000	1,00,00,000
		25-Minor con.	5,00,000	5,00,000
		29-Maintenance	11,50,000	11,50,000
2-	2406- Twelfth finance commission	24- Major con.	11,50,000	11,50,000
		42- Other expenditure	9,50,000	8,95,298
3-	Rozgar parakh	24- Major con.	3,68,000	3,68,000
		29-Maintenance	2,69,000	2,69,000
4-	Fire	24- Major con.	34,000	34,000
5-	Non Plan	29-Maintenance	2,00,000	2,00,000
6-	Eco Tourism	24-Major con.	18,00,000	18,00,000
		25-Minor con.	9,00,000	9,00,000
		29-Maintenance	618000	6,18,000
		42- Other expn.	2,00,000	2,00,000
7-	Herbal Garden	24- Major.con	17,79,000	17,79,000
		25- Minor con.	7,00,000	7,00,000
		29- other expn.	2,33,000	2,33,000
<b>Total:</b>			<b>2,08,51,000</b>	<b>2,07,96,298</b>

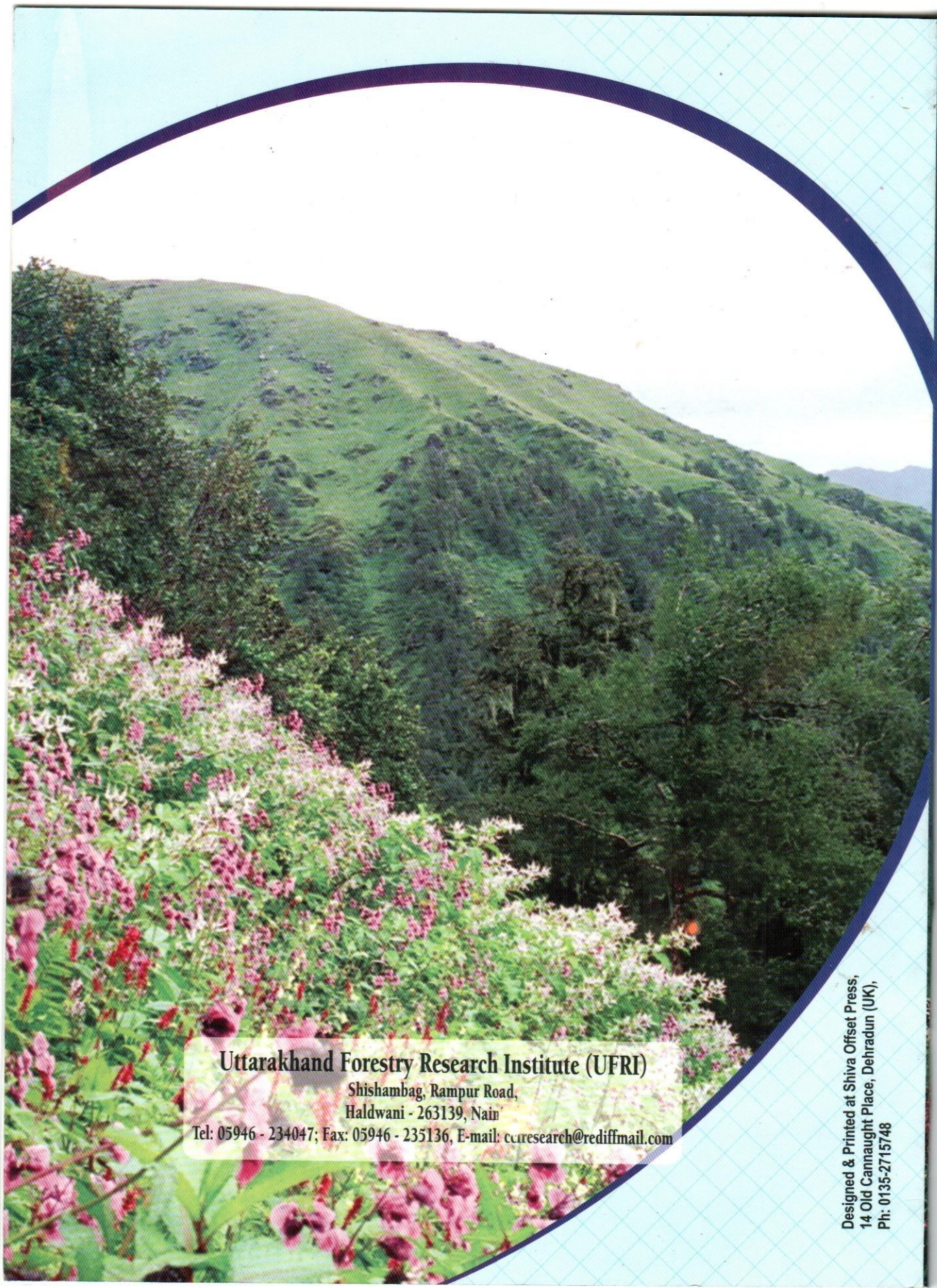
## 16.2 Revenue

Revenue is not the target of research divisions but they earn revenue through supply of plants and seed, and ecotourism activities at Himalayan Botanical garden and Sadiatal waterfall.

**Table-29:** Revenue earned in 2009-10

Name of division	Revenue earned (Rs)
Silva Sal	1031526
Silva Hill	991560





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