



## HIGH YIELDING PROVENANCES OF BHIMAL (*GREWIA OPTIVA*) FOR NORTH-WESTERN HIMALAYAS



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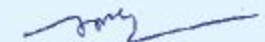
## FOREWORD



Availability of quality planting material is necessary for improving the productivity of trees and crops besides standard package of practices for realizing the maximum genetic potential. Though ample of improvement work has been done in food crops, similar examples in trees are very few. Further, temperate tree species grown in Europe, America and Canada are more successful examples of tree improvement than tropical and sub-tropical species. In the North-Western Himalayas with sub tropical climate, livestock rearing is an integral part of the farming systems, practiced by small and marginal farmers who depend heavily on a variety of multi-purpose tree (MPT) species.

Among all these MPTs, *Grewia optiva* (Bhimal) has established its superiority in respect of quality green fodder for livestock during lean periods, soil binding on terrace risers, fuelwood and fibres used for a variety of purposes which is a source of livelihood under rainfed village economy.

In this brochure some high yielding provenances of Bhimal have been described which were selected after an intensive selection exercise of a decade in respect of growth and productivity parameters. Thereafter, at CSWCRTI, Dehradun was recommended them for North Western Himalayas. Besides enhanced fodder, fuel wood and fibre productivity they are helpful in conservation of natural resources in north-western Himalayas and also embody appropriate ideotypes for adoption in agroforestry systems of the region.



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# HIGH YIELDING PROVENANCES OF BHIMAL (*GREWIA OPTIVA*) FOR NORTH-WESTERN HIMALAYAS

## INTRODUCTION

In north-western Himalayas small and marginal farmers maintain livestock and goats as traditional farming practice of subsistence agriculture. Hill farmers can not afford to allocate their lands for fodder crops like berseem, alfalfa, oats and melilotus at the cost of food crops due to small land holdings and therefore, they depend heavily on multipurpose tree species for quality green fodder throughout the year. In a recent study in Central Himalayas, a population density of 334–418 fodder trees ha<sup>-1</sup> was observed in agricultural fields which are the main source of fodder in winter in north western Himalayas. The scarcity of fodder and fuelwood is our widespread due to rising population in the Himalayan states.

Bhimal (*Grewia optiva*) is the most important multipurpose tree (MPT) species of north-western Himalayas, primarily grown for green leaf fodder. Farmers maintaining bhimal trees on risers of terraced fields is an age old common practice, seen in the hilly north-western Himalayan landscapes of the region even today (Photo 1). Bhimal provides fodder, fibre and fuelwood. It has so far played a key role in the village economy of rainfed agriculture practiced by hill farmers as it provides nutritious fodder during the lean season in winter when no other fodder is available.



Photo 1: Raising of Bhimal on terrace

However, the tree is now being over-exploited (Photo 2). Keeping this in view, high yielding provenances of Bhimal were identified.

## ABOUT THIS TECHNOLOGY

- Bhimal is small to medium sized deciduous tree species distributed in the north-western Himalayas, i.e. in Jammu and Kashmir, Himachal Pradesh, Uttarakhand and Nepal upto an elevation of about 2000 m. Grasses become dry with the onset of winter, grasslands (*Ghasnis*) are located far away from villages and farmers specially farm women have to spend their considerable time during day to collect fodder for their cattle with the looming threat of wild animals like bear and leopard. In vicinity of their villages due to the depleting jungle area.
- The foliage of fodder trees forms an excellent nutritive fodder during the lean season (December to February) in the North-west Himalayas when other fodders are not available. Among the MPTs it has the highest protein content (26%). The shallow root system of this species is highly effective for erosion control particularly on terrace risers.
- In order to assess the genetic potential of this species, seven provenances were collected from different regions of Uttarakhand and Himachal Pradesh and evaluated at CSWCRTI, Selakui Farm Dehradun for 10 years. Out of seven, three provenances, viz; I.C. Bhaintain, I.C. Chamba and I.C. Malas were identified as the most vigorous and productive ones which also embodied ideal ideotypes for agroforestry systems. These high yielding provenances produced 20% more green leaf fodder and 1.8 and 2.0 times more fuelwood and fibre, respectively than the least productive provenances and hence are recommended for planting on farmer's fields for mitigating fodder shortage of the region.



Photo 2: Lopping of Bhimal for fodder



## Selected Provenances

**I.C. Malas:** It produced highest fresh leaf fodder yield of 35.7 q ha<sup>-1</sup> after 10 years of planting which was 20% higher than the least productive provenance. Debarked fuelwood weight of 5.8 q ha<sup>-1</sup> and fibre yield of 2.90 q ha<sup>-1</sup> makes it an ideal MPT. Its crown length was 4.30 m, had more branches (26 nos.) and minimum crown width : bole diameter (59) which is suitable for agroforestry as it casts minimum shade to the agricultural crops grown in its association.

**I.C. Bhaintan:** It produced the fodder yield of 34.9 q ha<sup>-1</sup>, fuelwood 7.1 q ha<sup>-1</sup> (i.e. 80% higher than the least productive provenance) and 3.70 q ha<sup>-1</sup> fibre. Its crown length was 4.11 m, crown spread of 2.75 m and had narrow crown width : bole diameter (58).

**I.C. Chamba:** It produced fodder yield of 32.9 q ha<sup>-1</sup>, fuelwood of 5.6 q ha<sup>-1</sup> and fibre yield of 2.8 q ha<sup>-1</sup>. Its crown length was 3.98 m, crown width 2.78m and crown width : bole diameter (62).

## OTHER USES OF BHIMAL

### Fibres

- Bhimal twigs of 1-2 m length and diameter of 2-3 cm numbering 20-30 are tied in and placed bundles in shallow streams with flowing water, the bundles are pressed with heavy stones so that they may not flow away. The twigs are kept as such for 30-45 days i.e. for retting which softens the wood and it becomes easy to extract the fibres.
- Fibres are used for making ropes for tying animals, *nivar* for cots, small baskets, stakes for keeping earthen pitchers (*Binnas*), mats (*Pands*) and other fancy handicraft items (Photo 3).

### Domestic Fuelwood

- Debarked twigs of bhimal make an excellent source of fuelwood as they catch fire very easily without smoke and burn for a longer period and also make it possible to burn moist twigs of other species (Photo 4).

**Indigenous torch (*Masha*):** Bhimal fibres are used by villagers as light source to move from one hillock to another at night.



Photo 3: Extraction of bhimal fibres by a rural family



Photo 4: Heaps of debarked fuelwood of bhimal for use in rural kitchen

**Farm implements:** Its wood is semi hard which is strong and elastic. Its old twigs are used for making light farm implements like handles of spades, axes, pick axes, *gulel* for bird scaring, wooden oars and other small farm implements like kutla used for weeding. Its branches are also used for making baskets which provide employment to rural poor. Frames of cots and the indigenous apparatus for catching fish are some other uses.

**Indigenous cosmetics:** Hill women have used mucilage found in the bark of bhimal as indigenous hair shampoo since centuries.

## PLANTING TECHNIQUE

### Nursery Raising, Preparation of Pits and their Filling

Fruits (drupe) containing seeds of elite provenances are collected in the months of October-November. Polythene bags (22.5 x 15 cm) are filled up with a mixture of soil : sand : FYM in the ratio of 1:1:1 leaving 2-3 cm free on the top. Sowing ( 3-4



seeds/ bag) is done in the month of February. Polythene bags are kept under some shade of the tree and regularly watered.

Alternatively nursery beds may be prepared. Soil should be dug upto 0.5 m and well rotten FYM should be incorporated at the rate of 2-3 kg m<sup>-2</sup>. To prevent the damage from termites and white ants, Lindane dust at the rate of 75 kg ha<sup>-1</sup> is applied. Stone, pebbles and stumps should be removed.

Usually the size of beds is 10x1 m but may vary depending on the local conditions. It is advisable to raise the level of beds at least 15-20 cm for good drainage. An individual nursery bed can be further divided by path of width 0.5 m.

### Treatment of Seeds

Germination percentage of bhimal seedlings is very low, therefore, Hot water treatment is recommended. It is very easy and convenient to follow. A container is taken with water and heated to the boiling point without seeds. When boiling, container is removed from the heat and allowed to cool for 5 minutes. At this time seeds are dipped in water and stirred thoroughly and allowed to soak overnight as the temperature of hot water comes to room temperature. Seeds are spread on gunny cloth bag and water is allowed to drain off under shade for 1-2 hours before sowing.

### Sowing

Sowing of seeds should be done in lines and regularly watered. During dry season beds may crumble and in rainy season they may erode, therefore, it is always better to support the beds with locally available planks/ bamboos with a lining of bricks and stones.

Healthy seedlings start emerging within 30- 35 days and they pick up their growth very fast reaching 15-20 cm within next 50-60 days. Plants should not face any shortage of moisture. In one year plant height may reach 100-150 cm.

### Preparation of Pits

- Preparations for planting should be done during hot months (summer) May or just before monsoon, digging pits of the size 45 x 45 x 45 cm.
- Remove stones, boulders or any hard pan which may obstruct the growth of young saplings.

- Soil should be kept at one side and pits should remain open for 15-20 days for aeration.
- Mix well rotten 5 kg FYM with soil and fill the pits in a way that soil of upper layer which is rich in humus is added first in the pits followed by lower layers and leave as such for 15-20 days. Termite attack may be caused due to undecomposed FYM which should be avoided by incorporation of chloropyriphos 5 g per pit or 1000 ml of 0.2% chloropyriphos.

### Planting

- One year old healthy saplings (1 m height) should be planted during monsoon season in the pit after removing polythene cover, without disturbing the soil around the roots.
- Scoop 15 cm of soil to form a small cavity and gently place the sapling along with soil in the cavity and level it off with soil keeping the sapling straight.
- Soil should be firmed up and saplings watered adequately so that the roots are in firm contact with soil.
- The cost of planting 33 plants on 100 m running length of risers is given in Table 1.

**Table 1: Establishment cost of planting 33 plants on 100 m riser length**

Activity	Quantity	Rate (₹)	Amount (₹)
Digging of pit (45x45x45 cm)	33 pits	10 / pit	330
Plant cost (₹)	33 plants	5/ plant	165
FYM (cubic feet)	0.3x33= 9.9 cft	6/cubic feet	59
Application of Chloropyriphos (0.2%)	2x33 = 66 ml	200/ litre	15
<b>Total establishment cost</b>			<b>569</b>

### After Care

Bhimal saplings are sensitive to frost and may show mortality ranging from 20-25%.

- Protection from frost can be done by watering plants moderately or by smoking the area during frosty days in January - February and also by thatching the plants with stovers by erecting small tree guards.
- The dead plants should be replaced in the next rainy season by planting healthy and robust plants.



- Normally growth of bhimal plants is very fast during initial 2-3 years after which it steadies.
- Pruning of side shoots which may interfere with agricultural operations is recommended right after first year of planting which can be fed to the cattle. Cut end should be painted with Bourdeaux mixture or Chaubatia paste.
- Generally, damage is caused to young saplings by browsing animals. Therefore, saplings should be well protected from goats and other animals by constructing indigenously made tree guards or live fencing of Rambans/ karonda species.
- Basins (45 cm diameter) should be made in September and kept clean of weeds at least for 3 years. In subsequent years plantation hygiene should be ensured for healthy development of plants.

#### Lopping of Trees

- After five years of planting, 50% lopping can be practiced during December to January. Main shoot should be allowed to grow till 6 - 7 years age after which it can be headed back to induce side shoots.
- Maximum 75% lopping is recommended for sustainable yield of green fodder.

### PRODUCTIVITY AND ECONOMICS

- In hilly areas block plantations of MPTs are not feasible on account of undulating topography. Bhimal plants are planted on terrace risers in the agroforestry systems.
- Average productivity of improved provenances of Bhimal in respect of fodder, fuelwood and bark fibres for a running length of 100m (i.e. 33 plants at a spacing of 3 m) is presented in Table 2 along with revenue generation.

### SCOPE AND AREA OF TECHNOLOGY UTILIZATION

Uttarakhand has 61% of geographical area under forests and only 3% is under agriculture. Efforts have to be made to increase the productivity of the fodder crops and tapping some alternative source of fodder. In hilly regions livestock are mainly maintained on tree loppings. The area under the fodder crops is

**Table 2: Average productivity from improved provenances of Bhimal planted along terrace lengths of 100 m (33 plants at 3 m spacing)**

Item	Rate (₹/q)	Productivity (kg) in provenances with revenue generation			
		I.C. Bhaintan	I.C. Chamba	I.C. Malas	Mean
Green fodder	400	103.62 (414)	97.68 (391)	105.93 (424)	102.41 (410)
Dry fuel wood	500	21.09 (105)	16.63 (83)	17.23 (86)	18.32 (91)
Bark fibers (dry)	1500	10.99 (165)	8.32 (125)	8.61 (129)	9.31 (140)
<b>Total</b>		<b>135.70 (684)</b>	<b>122.63 (599)</b>	<b>131.77 (639)</b>	<b>130.04 (641)</b>

\* Figures in parenthesis shows the revenue generated (₹) per 100 m running length.

too scanty in hills (0.5%). Therefore, high yielding provenances of Bhimal, a multipurpose tree producing fuel, fodder and fiber, has great scope to address such issues in the hill and mountainous agro-ecosystems.

**Potential of Technology :** The proposed technology of high yielding provenances of *Grewia optiva* can increase the fodder productivity of this species to an extent of 20% over the least productive provenances. It has the potential to cover the North Western Himalayan States upto middle elevations in farm forestry.

**Level of Acceptance :** Bhimal tree is an established agroforestry tree species in the North-Western Himalayas. High yielding provenances can add to the resources of hill farmers which will reduce their dependency on forests.