Genetic and Multilocation Evaluation of High Yielding Provenances of Bhimal (*Grewia optiva*) on Farmers' Fields in North Western Himalayas

Harsh Mehta
Indian Institute of Soil and Water Conservation, India

M. Ayoub Dar
Indian Institute of Soil and Water Conservation, India

Debashis Mandal
Indian Institute of Soil and Water Conservation, India

Rajesh Kaushal
Indian Institute of Soil and Water Conservation, India

A. C. Rathore
Indian Institute of Soil and Water Conservation, India

See next page for additional authors

The XXIII International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.

Proceedings Editors: M. M. Roy, D. R. Malaviya, V. K. Yadav, Tejveer Singh, R. P. Sah, D. Vijay, and A. Radhakrishna

Published by Range Management Society of India

Presenter Information

Harsh Mehta, M. Ayoub Dar, Debashis Mandal, Rajesh Kaushal, A. C. Rathore, O. P. Chaturvedi, and P. K. Mishra

Paper ID: 509
Theme 4. Biodiversity, conservation and genetic improvement of range and forage species
Sub-theme 4.1. Plant genetic resources and crop improvement

Genetic and multilocation evaluation of high yielding provenances of Bhimal (*Grewia optiva*) on farmers' fields in north western Himalayas

Harsh Mehta*, M. Ayoub Dar, D. Mandal, Rajesh Kaushal, A. C. Rathore, O. P. Chaturvedi, P. K. Mishra
ICAR- IISWC- Dehradun, Dehradun, India
*Corresponding author e-mail : harshmehta41ddn@gmail.com

Keywords: Fodder productivity, Fuelwood, Growth parameters, Locations specific technology, Provenances

Introduction

Agroforestry is the inclusion of woody perennial within farming systems, has been practiced as a traditional land use and livelihood option since time immemorial (FSI 2013). It is being practiced on agricultural lands for fuel wood and fodder (Khybri *et al.,* 1992), as well as medicinal and fruit trees (Bijalwan, 2011; Rathore *et al.,* 2014) enabling food security (Narain 1998), non timber forest products, timber and shelter etc. A number of different (185) agroforestry systems are popular among farmers in different agro-climatic regions (Solanki, 2006). *Grewia optiva* Drummond (Bhimal) is an important agroforestry tree species primarily grown for green fodder in the north west Himalayas (Khybri *et al.,* 1992; Dhyani, 2009). It is distributed throughout the sub-Himalayan tract upto an altitude of 1800m. Therefore, the present study was envisaged to monitor the performance of three best provenances of Bhimal (Mehta *et al.,* 2011) on farmers' fields at four locations comprising middle hill elevations and valley zones and their effect on field crops.

Materials and Methods

The study was carried out at four different sites on farmers' fields at Almas, Ranigaon, Selakui and Sabhawala villages with elevation ranging from 479-1728 m asl (Table 1) in Tehri Garhwal and Dehradun districts of Central Himalayas. The experimental area is spread over 0.33ha at each site. Data on growth and productivity parameters of bhimal plants were recorded on eight years old plants of bhimal, planted on the terrace risers. Shade effects of bhimal plants on the under storey of field crops were minimized by adopting 75% lopping of bhimal plants by the farmers at each site after three years of planting. The climate is typical monsoon, with 80% of annual rainfall (1700 mm) occurring during warm July-September period and monthly minimum and maximum temperatures varying in the range of 7-24°C and 19-34°C, respectively.

Table 1 Geographic location of experimental sites.

	Village:**Almas** Block: Thituud Tehsil: Dhanolti District:T Garhwal	Village:**Ranigaon** Block:Kalsi Tehsil:Chakrata District:Dehradun	Village:**Selakui** Block: Sahaspur Tehsil:Vikasnagar District:Dehradun	Village:**Sabhawala** Block: Sahaspur Tehsil:Vikasnagar District:Dehradun
Altitude (m)	1615-1728	1331-1339	520	479-490
Latitude (N)	300 28/ 217//	300 37/ 407//	300 21/ 157//	300 22/ 006//
Longitude (E)	780 11/ 499//	770 52/ 271//	770 52/ 25//	770 48/ 39//

Results and Discussion

Performance of Bhimal at different sites

Growth parameters: After first year of planting in 2007, marked differences of locations were reflected in respect of growth parameters of Bhimal at different sites which could be directly attributed to genotype x location interactions. Bhimal plants showed faster growth in valley locations in respect of plant height and other growth parameters in comparison to middle elevations. After seven years of planting, an average plant height at middle elevations ranged from 354.0 to 391.4 cm for Almas and Ranigaon respectively, while it was 555.0 to 559.0 cm for Selaqui and Sabhawala respectively, at valley locations. Plant growth in respect of collar diameter at middle higher elevations ranged from 5.6 cm to 6.6 cm respectively while it was 10.3 to 11.2cm at valley locations for Selakui and Sabhawala

respectively. The mean annual increments (MAI) in plant height and collar diameter at different locations, registered higher values at valley locations than at middle higher elevations of Almas and Ranigaon.

Productivity parameters: The average fresh fodder productivity was 1.278 to 1.714 Kg plant^{-1} , at Ranigaon and Almas in 2014, while it was 4.126 and 4.527 Kg plant^{-1} , respectively at Selaqui and Sabawala . Similarly the average fuelwood productivity was 1.700 to 2.689 Kg plant^{-1} , at Ranigaon and Almas in 2014, while it was 4.014 and 5.072 Kg plant^{-1} , respectively at Selaqui and Sabawala. In Sabhawala (valley), IC Bhaintan recorded the highest dry fuel yield of 5.639 Kg per plant, followed by IC Malas at 5.156 Kg per plant. On the contrary, at middle elevations of Almas and Ranigaon IC Chamba recorded the highest dry fuel yield at 3.100 and 1.900 Kg per plant respectively followed by IC Malas at 2.67 and 1.700 Kg per plant, respectively. The highest fresh fodder productivity was recorded for IC Bhaintan at 4.826 and 4.441 Kg plant $^{-1}$ at Sabhawala and Selakui, respectively.

Performance of field crops: Yield levels of wheat variety HD 2923 were 22.8 (<4m from tree line) to 28.1q ha^{-1} (>4m) at Selakui, while the yield levels were 21.9 and 24.4 qha $^{-1}$, respectively at Sabhawala.Yield levels at middle elevation of Ranigaon were low at 12.6 and 14.8 qha^{-1} under hilly rainfed conditions (Table 2).

Table 2. Productivity levels of wheat HD2923 (q ha^{-1}) during 2013-14 *Rabi* and *Kharif* 2013 at different sites

Location	***Rabi* 2013-14, (q ha^{-1})**				***Kharif* 2013, (q ha^{-1})**		
	Farmers' field crop	**Local**	**Wheat (HD2923)**		**Farmers' field crop**		
			Near tree line (0-4m)	**Away from tree line (>4m)**		**Near tree line (0-4m)**	**Away from treeline (>4m)**
Almas	Wheat	9.4	13.7	15.5	Capsicum	77.0	80.0
Ranigaon	Wheat	8.2	12.6	14.8	Ginger	78.0	87.3
Sabhawala	Wheat	18.2	21.9	24.4	Paddy	26.1	37.4
Selakui	Wheat	20.0	22.8	28.1	Maize	9.94	22.8

During *Kharif* the productivity of capsicum under trees ranged between 77 to 80 q ha $^{-1}$ near tree line (<4m) and away from tree line (>4m), in 2013. Average yield of ginger at Ranigaon was 78.0 to 87.0 while maize productivity ranged between 9.94 to 22.8 qha^{-1} at Selakui. The productivity of Kasturi basmati was 26.8 and 37.4 qha^{-1} at 4 m and away from 4 m, respectively from tree line. Similar reductions in final yield of crops under trees have been reported by Khybri *et al*. 1992, Bijalwan *et al.,* 2011.

Soil Analysis: Indicated that the gravel content was the highest at Ranigaon and Almas locations (middle elevations), while at Doon valley locations very little gravels were observed. These edaphic factors alongwith cold climatic conditions accounted for lesser growth of bhimal plants at middle elevations.

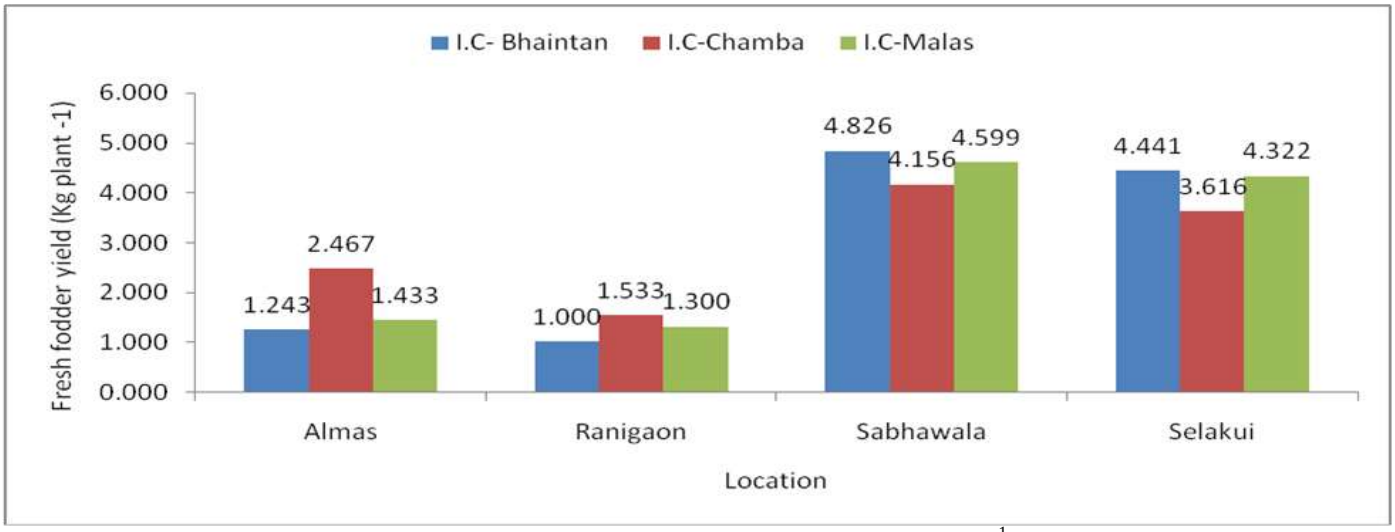

Fig 1. Fresh fodder productivity of ***Grewia optiva*** provenances at different locations (Kg plant $^{-1}$) in 2014 after eight years of planting**.**

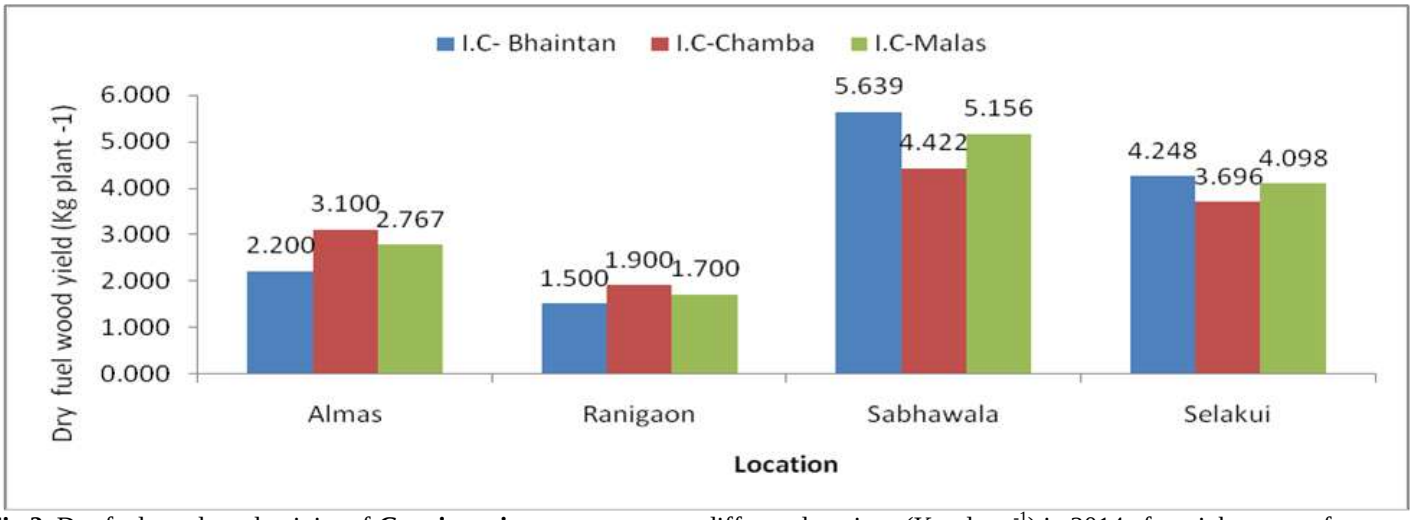

Fig 2. Dry fuelwood productivity of ***Grewia optiva*** provenances at different locations (Kg plant $^{-1}$) in 2014 after eight years of planting.

Conclusion

Significant differences for growth and productivity parameters of *Grewia optiva* were recorded at valley and middle higher elevations of North Western Himalayas. The highest fresh fodder productivity was recorded at Sabhawala (valley) for provenance I.C.Bhaintan (4.826 Kg plant $^{-1}$), which was 2.21 times higher in comparison to middle elevations. I.C. Chamba recorded the highest fresh fodder yield of 2.467 Kg plant $^{-1}$ at higher elevations in 2014 which is 84% higher than the remaining two provenances. Thus, location specific technologies for fodder production of *Grewia optiva* have been identified, which can be recommended under different elevations of North Western Himalayas.

References

Bijalwan, A., 2011. Productivity assessment of agricultural crops in existing agrihorti-silvicultural system of mid hills of Central Western Himalaya, India. *African Journal of Agricultural Research*. 6 (10), pp. 2139-2145.

Dhyani, S.K., 2009. Agroforestry Past, Present and Future, pp 1-11. In : Agroforestry : Natural Resource Sustainability, Livelihood & Climate Moderation. (eds.)

FSI 2013. Forest Survey of India, India State of Forest Report, Ministry of Environment & Forests, Government of India, Dehradun-248 195

Khybri. M .L., R.K. Gupta, S. Ram and H.P.S. Tomar. 1992. Crop yields of rice and wheat grown in rotation as intercrops with three species in the outer hills of Western Himalaya. *Agroforestry Systems*, 17:193-204.

Mehta. H., P. C. Tyagi and K.S. Dadhwal. 2011. High yielding provenances of Bhimal *Grewia optiva* J.R. Drumm. Ex Burret) for fodder and fuelwood production in North Western Himalaya. *Indian Journal of Agric. Sciences*, 81(8)717-722.

Narain Pratap, R. K. Singh, N.S. Sindhwal and P. Joshie. 1998. Agroforestry for soil and water conservation in the western Himalayan Valley Region of India. *Agroforestry Systems*, 39:191-203.

Rathore A. C., H. Lal, N. K. Sharma, Harsh Mehta, J. Jayaprakash, O. P. Chaturvedi 2014. Livelihood security through Litchi (*Litchi chinensis* L.)-based agri-horticultural models for resource-poor communities of Indian Sub-Himalaya. *Current Science*, 106 (11) : 1481-1484.

Solanki. K.R. 2006. Agroforestry-opportunities and challenges . In : Production TEChnology and Management of Agroforestry Models (eds Chauhan S.K., S.S. Gills., H. N. Khajuria. and R. Chauhan). Agrotech Publishing Academy, Udaipur pp14-15

Acknowledgement

The authors gratefully acknowledge to Dr. P.K. Mishra, Director, ICAR-IISWC, Dehradun for constant support and encouragement. The authors are also grateful to Dr. P.C.Tyagi, Ex. Pr. Scientist & Head for initiating the studies. Help rendered by Shri Daya Ram, Technical Officer for these studies is thankfully acknowledged.