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Above Ground Biomass Production of *Grewia optiva* Pollarded at Different Heights under Agroforestry Systems in Mid-hills of Himachal Pradesh, India

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ABSTRACT

The present study was conducted in experimental farm of Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni - Solan (HP) to investigate the biomass production (leaf and branch wood) of 6 year old *Grewia optiva*, planted at 8 m (plant to plant) and 2 m (row to row), pollarded at different heights (1.5 m, 3.0 m and 4.5 m). Experiment was laid out in replicated factorial RBD with three replications and 18 treatment combinations with three pollarding heights (P_1- 1.5 m, P_2 –3.0 m and P_3 – 4.5 m) and two directions from tree row (S_1 – north aspect of tree row and S_2 – south aspect). Pollarding heights significantly influenced the leaf and branch wood biomass of *Grewia optiva* and was maximum at P_2 followed by P_3, however P_2 and P_3 were at par. The crown spread was found better in north direction than in the south direction. This shows that P_2 is relatively better height for pollarding to form more sprouts and their growth. The N, P and K content in leaf and branch wood were influenced significantly due to pollarding height. Maximum leaf and branch wood nutrient content were recorded at P_3 and minimum at P_1.

Keywords:
Agroforestry, biomass, pollarding heights, interaction.

INTRODUCTION

The dwindling forest resources and degradation of land has in fact not only led to shortage of basic needs e.g. fuel, fodder, timber and other miscellaneous products in rural sectors and various raw materials in forest based industries, but many mishaps as well. Our country faces a shortage of 15 million tons of fuel wood, 12.5 million cu.m of timber, which is likely to further aggravate, as we shall require around 225 million cu.m of fuel wood and 46.76 million cu.m of timber by 2000 A.D. (DCPPAI, 1983). To overcome this situation, increasing productivity of existing forest stands, restocking low density areas, wastelands under social forestry and integration of trees in agricultural fields seems to be very visible options. The integration of trees on farm lands with agricultural crops, coined as agroforestry, needs a special preference as this would enable the people to be self sufficient for their basic needs and thereby help directly and indirectly in conserving and improving the public forest land. Agroforestry land use are biologically more complex and diverse than other farming practices prevalent throughout the world. Such system though hold promising potential to address the various basic issue of the farming communities, yet they have not been given due scientific attention. In fact vary little information is available on the tree-crop combinations and various interaction involved there in as well as different tree management practice which is properly applied shall help to minimize the negative effect of trees on accompanying crops.

Keeping in view the widening fodder and fuelwood demand, the present study was carried out on to estimate above ground biomass production of *Grewia optiva* pollarded at different heights in mid-hills of Himachal Pradesh.

MATERIALS AND METHODS

The present study was conducted on experimental farm of Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni - Solan (HP). The experimental site falls in the mid hill zone of H.P. at an elevation of 1250 m above mean sea level. The climate of the area is transitional between sub humid sub-tropical to sub temperate. The annual temperature ranges from 3^0 C to 31^0C, the area receives on an average annual rain fall of 1200-1300 mm most of which is concentrated in the monsoon period mid June- August) winter shower are usually mild. The soil of the experimental site was gravelly loam in texture and have granular in structure. Experiment was laid out in factorial RBD with three replications and comprising 18 treatment combination with three pollarding heights (P_1- 1.5 m, P_2 –3.0 m and P_3 – 4.5 m) of *Grewia optiva* and two direction from tree row (S_1 – north aspect of tree row and S_2 – south aspect of tree row). The pollarding was done in 6 year old *Grewia optiva* planted 8 X 2 m.

The collar diameter (at 15 cm above ground level) and diameter at breast height (DBH at 1.37 cm above ground level) was measured in centimeters. The height of the trees was measured in meters from ground level to the top of the main shoot with the help of altimeter. The crown spread was measured in meters from the tree trunk in north and south direction with the help of graduated wooden rod. The branches were lopped (from pollarded trees) completely in the month of October. The leaves were separated from the branches and fresh weight was taken in the field. The branches and leaf samples were dried at 85^0C to estimate dry biomass. The branch wood and leaf samples of trees were randomly collected from each treatment and replication. All the samples were washed in series with tap water then with 0.1 N HCL followed by distilled water. The washed samples were allowed to dry in air subsequently in oven at 65+/- 5^0C till constant weight. The dried samples were then grinded in willy mill and analyzed for N, P and K. The cost of lopping of fodder trees was worked out on the basis of number of trees, requirement of labor, mechanical power required per hectare. The leaf and branch wood production were converted into gross returns in rupees per hectare based on prevailing local market price. The net returns were calculated by deducting the total cost from gross return. The data obtained from the present investigation were subjected to statistical analysis and analysed by the procedure attained by Gomez and Gomez (1984).

RESULT AND DISCUSSION

Analysis of the data in Table 1 reveals that leaf biomass enhanced with the increase in pollarding height, yet the difference between P_2 and P_3 remained statistically non- significant. There was a gain of 67.66 % from P_1 to P_2 and P_3 to P_2. The data for branch wood biomass given in Table 1 shows that P_2 recorded the maximum biomass followed by P_3 and P_1. It is increased by 32.41 percent from P_1 to P_2 and declined by 11.93 percent with increase in pollarding height from P_2 to P_3.

The overall results shows that leaf and branch biomass were influenced significantly due to pollarding height and were found to be recorded maximum at P_2 followed by P_3, however P_2 and P_3 were at par Table 1. This shows that P_2 is relatively better height for pollarding to form more sprouts and their growth. Kumar (1996) recorded maximum branch wood biomass from *Morus alba* at 1.5 m cutting height. Keerthisena (1995), Yadav (1997) reported the similar findings.

The data in Table 2 revealed that nitrogen, phosphorous and potassium in both leaf and branch wood was influenced significantly due to different pollarding heights. The nitrogen content in leaf had significant improvement with increasing pollarding height, however nitrogen content in branch wood improved significantly from P_1 to P_2 but remained similar thereafter. Whereas phosphorous content in leaf as well as branch wood improved statistically with increase in pollarding height. Yet the difference between P_1 and P_2 in branch wood was statistically non – significant. The potassium content in leaf as well as branch wood followed an identical pattern to that of phosphorus content. The N, P and K content in leaf and branch wood were influenced significantly due to pollarding height. Maximum leaf and branch wood nutrient content were recorded at P_3 and minimum at P_1. Karim *et al.* (1991) reported that increase in nitrogen yield per tree with increase in cutting height and intervals. The percent of composition of nutrient in the present study was in accordance with the values reported by Verma and Mishra (1989), Singh (1982), Joshi and Talapatra (1960) and Lal (1996).

Table 1: Effect of pollarding height on leaf and branch wood biomass production of *Grewia optiiva*

Pollarding height	Leaf biomass (kg/tree)	Branch wood biomass (kg/tree)	Total biomass (kg/tree)
P_1 (1.5m)	3.37	13.42	16.78
P_2 (3.0m)	5.73	17.77	23.50
P_3 (4.5m)	5.65	15.65	21.30
SE (diff.)	0.56	1.78	2.06
$CD_{0.05}$	1.25	3.96	5.03

Table 2: Effect of pollarding height on N,P and K content on leaf an branch wood of *Grewia optiva*

Pollarding height	Nitrogen (%)		Phosphorous (%)		Potassium (%)	
	Leaf	Branch	Leaf	Branch	Leaf	Branch
P_1 (1.5m)	2.76	1.2	0.16	0.08	2.25	1.19
P_2 (3.0m)	2.83	1.23	0.18	0.08	2.43	1.21
P_3 (4.5m)	2.9	1.23	0.19	0.09	2.63	1.25
SE(diff.)	0.01	0.013	0.002	0.002	0.012	0.012
$CD_{0.05}$	0.023	0.023	0.004	0.004	0.03	0.03

The data on effect of pollarding height on crown spread of *Grewia optiva* is given in Table 3. The result shows that the in north direction the crown spread was maximum in P_1 (1.53 m) and minimum in P_3 (1.41 m). It is increased in the range by 637.5 percent (P_1). Whereas, in south direction the crown spread was maximum in P_2 (2.00 m) increased by 180.18 percent and minimum in both P_1 and P_3 (1.86 m). The crown spread was found better in north direction than in the south direction

Economic evaluation of agroforestry system

Economics of the above ground biomass production (Leaf and branch wood) of *Grewia optiva* pollarded at different heights presented in Table 4. It revealed that the net return from *Grewia optiva* (leaf + branch wood) were found to be Rs. 3088.8 per hectare and the gross return Rs. 4438.80 per hectare. Whereas the cost of lopping were found to be Rs.1350.00. The net returns from the fodder tree *Grewia optiva* of six year age pollarded at different height in Agroforestry systems at mid hills of Himachal Pradesh was found to be commercially viable. These results are in consonance with the findings of Kumar (1996) who reported that the net returns and gross returns from soybean system gives higher value than wheat system.

Table 3: Effect of pollarding height on crown spread of *Grewia optiva*

Pollarding height	Av crown spread in December after complete lopping(m)		Av crown spread in October (m)		% increase in crown spread	
	North	South	North	South	North	South
P_1 (1.5m)	0.24	0.57	1.53	1.86	637.50	326.32
P_2 (3.0m)	0.32	1.11	1.51	2.00	471.88	180.18
P_3 (4.5m)	0.37	1.31	1.41	1.86	381.08	141.98

Table 4: Economics of fodder production of *Grewia optiva* pollarded at different heights in agroforestry systems

Fodder tree	Income (Rs./ha)		Gross return (Rs./ha)	Cost of lopping (Rs./ha)	Net return (Rs./ha)
	Leaf	Branch wood			
Grewia optiva	541.20	3897.60	4438.80	1350.00	3088.80

CONCLUSION

Leaf and branch wood biomass of fodder tree *Grewia optiva* pollarded at different heights in agroforestry systems at mid hills of Himachal Pradesh were influenced significantly due to pollarding height and was recorded maximum at P_2 followed by P_3, however P_2 and P_3 were at par. The crown spread was found better in north direction than in the south direction. This shows that P_2 is relatively better height for pollarding to form more sprouts and their growth. The N, P and K content in leaf and branch wood were influenced significantly due to pollarding height. Maximum leaf and branch wood nutrient content were recorded at P_3 and minimum at P_1. The net returns from the fodder tree *Grewia optiva* of six year age pollarded at different height in Agroforestry systems at mid hills of Himachal Pradesh was found to be commercially viable.

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