Management of *Dalbergia sissoo* in farm conditions using different pruning intensities

S. K. Kafle[1] and P. M. Dixit[2]

Dalbergia sissoo Roxb. (Leguminosae, Papilionoidae) has been extensively planted by farmers in Nepal for its multiple uses and fast growing nature. Farmers start pruning as early as 4 years after planting and leave no branches. Present study attempts to compare the effects of different pruning intensities and locations on the biomass and growth performance of sissoo trees growing on the three six-year old farm plantations at the Terai, Inner Terai and Bhabar. A two year result showed that the growth performance of sissoo trees significantly differed with different intensities of pruning. Based on the results of relative growth and volume increment, 60% pruning intensity is recommended to get maximum fuelwood yield without impairing tree growth.

Keywords : *Dalbergia sissoo*, Terai, growth performance, relative groth rate.

In Nepal, more than seventy five percent of the people still depend on fuelwood for their daily household requirements. Farm plantations and natural forests have been the main sources of fuelwood supply in rural areas. Fuelwood collection by rural people is attributed to be one of the main reasons of forest degradation in the Midhills and in the Terai. In recent years, emphasis has therefore, been given on private plantations for the supplement of forest product requirements.

Sissoo (*Dalbergia sissoo* Roxb.) has been estimated to cover more than 90 percent of private lowland plantations in Nepal (Joshi, 1994; Kafle, 1994). This species has also high potential for afforestation in degraded riversides of the Terai, inner Terai and at lower altitudes of the Midhills (Kafle, 1995).

The species if planted in farms as individual trees or in lines grow at a different manner than when they are in larger block plantations. Trees planted in farms have more side branches and have larger canopies (TU/IDRC, 1993). Farmers therefore, start pruning sissoo generally leaving no branches, as early as 4 years after planting to use the twigs for fuel. Such pruning intensity might provide more fuelwood, but impairs the trees' physiological processes resulting in poor growth performance. Contrary to this, pruning exclusion (no prunning) may also hamper timber quality since side branch production consumes more nutrients. Sissoo being of timber value also, pruning intensity should be such that it does not impair stem growth. The present experiment therefore, attempts to identify correct pruning intensity for the sissoo growing on farm lands so that the sissoo entrepreneurs could use it to get higher yields of timber and fuelwood.

Study areas

Plantation existing at Parbanipur, Hetauda and Karmaiya representing different geographic locations viz. Terai, inner Terai, and Bhabar regions were chosen for the experiment (Table 1)

Table 1 : Study sites and respective planting patterns

Regions	Locations	Planting Pattern	Age of Plantation (yrs)
Terai	Parwanipur	Along field bund	6
Inner Terai	Hetauda	Along field bund	6
Churia Hills	Karmaiya	Along hill slope	6

[1] Chiang Mai University, Faculty of Science, Environmental Risk Assessment Program, Chiang Mai- 50200, Thailand.
[2] TU/IDRC- Farm Forestry Project, Kirtipur, Kathmandu, Nepal.

Methods

Seedlings were raised at the nursery of Institute of Forestry, Hetauda and were distributed to farmers under the technology transfer scheme of the Farm Forestry Project, a project supported by the International Development Research Centre, Canada in collaboration with Tribhuvan University (TU), Nepal. Pitting, planting, and other forestry operations were similar at all the sites. Planting was done in 1984 and initial measurements were taken in 1990 from six year old plantations right after the first pruning. Prior to this, farmers had pruned trees twice. Final measurements were taken two years after the first experimental pruning. Growth increment was derived from deducting initial measurements from the final measurements.

Trees were prunned using sickles and bow saws. At every site four pruning intensities (treatments) were applied and average height and DBH of each pruning intensity of four locations were measured. In each location, ten trees were randomly selected for each treatment (i.e. 40%, 60%, 80% and 100%) corresponding to a total of 40 trees studied at each site. There was no control since this was considered in initial survey where in reality all sissoo trees would be mostly 100% pruned by the local people.

Trees were pruned from the bottom of the crown upwards to the desired percentage of branches to be removed. Differences were assumed to occur between locations and pruning intensities because of variations in soil moisture, temperature, rainfall, and other edaphic, topographic and climatic factors. Height, DBH and biomass yield increment were measured.

Biomass of branches (green weight), relative growth rage (RGR) and stem volume were calculated as shown:

$$RGR = Ln\ H2 - Ln\ H1\ /\ T2 - T1)\ 365$$

where, Ln = natural logarithm; H2 = Final height (cm); H1 = Initial height (cm) and T2 - T1 is the duration in days between two measurements

Stem volume increment was calculated as:

$$V = (\Pi D^2\ H\ 0.6\ /\ 40000$$

where, V= volume of stem (m^3); D = diameter at breast height (cm) and H = tree height (m).

Table 2 : Relative growth rate at different locations under different pruning intensities.

	Relative growth rate by location								
	Inner Terai (Hetauda)			Terai (Parwanipur)			Bhabar (Karmaiya)		
Intensity Pruning %	Avg. Initial ht. (m)	Avg. final ht. (m)	RGR	Avg. Initial ht. (m)	Avg. final ht. (m)	RGR	Avg. Initial ht. (m)	Avg. final ht. (m)	RGR
40	7.2	8.9	0.11	7.3	8.9	1.10	8.0	9.9	0.11
60	8.7	10.7	0.10	7.5	9.2	0.10	8.3	11.2	0.17
80	7.6	8.9	0.08	7.2	9.0	0.11	7.8	8.9	0.07
100	7.4	8.9	0.09	8.0	8.8	0.08	8.1	9.2	0.08

All parameters were calculated in terms of increment. While calculating the volume per hectare, 400 trees in a hectare was assumed (figure 3).

It is assumed that 60 percent of the tree height can be used as timber (i.e. merchantable height in case of sissoo trees), while the rest is used as fuel. Growth data were further analysed statistically (factorial ANOVA) using SPSS computer programming.

Results and discussion

Sixty percent pruning intensity has the highest relative growth rate followed by 40 percent, while 100 percent had the least (Table 2). Among the three sites, Karmaiya (Bhabar zone) had the highest growth rate.

The effects of treatments on height growth was significant, but there were no significant differences in the means of location. However, both treatments and locations on DBH differed significantly. The interaction effect was also found significant in both cases. The highest positive interactions was seen with 60 percent pruning intensity at Karmaiya (Table 3).

Further statistical tests for pair comparison were done considering that they would have little practical value. Instead, trendlines were drawn in order to show the trend of dbh and height increment by locations and treatments from which a clear distinction can be seen (fig 1 and 2). Similar lines were drawn for volume increment and biomass yield. Figure 3 shows that biomass yield increases with increased pruning intensities, whereas average volume increment is highest at 60 percent pruning intensity and decreases afterwards.

Conclusion

Growth performance of sissoo trees significantly differs with different intensities of pruning. Based on our results, 60 percent pruning intensity should be applied in order to get maximum fuelwood yield without impairing stem growth. However, results should be verified in different farm conditions. By observing the trend of biomass yield and volume increment, it can be concluded that prunning exclusion and 100 percent prunning are unsuitable. Location effects were not significant. That is due to similar climatic conditions in these regions. Further studies in different soil, climatic conditions and age of plantations are recommended.

Figure 1. Trends of height increment for two years of growth of 8-year-old sissoo t with different pruning intensities

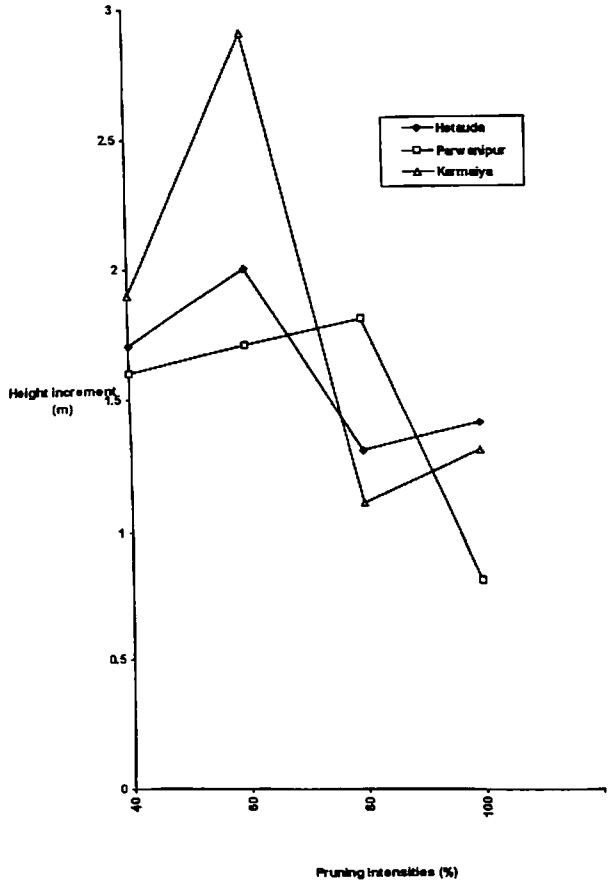


Table 3 : Height and DBH increment in two years with different pruning intensities and at different locations.

Pruning Intensity (%)	Average height and DBH increment by location					
	Inner Terai (Hetauda)		Terai (Parwanipur)		Bhabar (Karmaiya)	
	Height (m)	DBH (cm)	Height (m)	DBH (cm)	Height (m)	DBH (cm)
40	1.7±0.97	1.6±1.1	1.6±0.74	0.9±0.36	1.9±0.67	2.1±0.54
60	2.0±0.48	1.1±0.52	1.7±0.73	4.0±0.77	2.9±0.91	1.8±0.67
80	1.3±0.24	2.1±1.21	1.8±0.63	1.9±1.04	1.1±0.80	1.1±0.44
100	1.4±0.88	1.3±0.82	0.8±0.70	0.9±0.45	1.3±0.92	0.9±0.29

Figure 2. Trends of DBH increment for two years of growth of 8-year-old sissoo trees under different pruning intensities

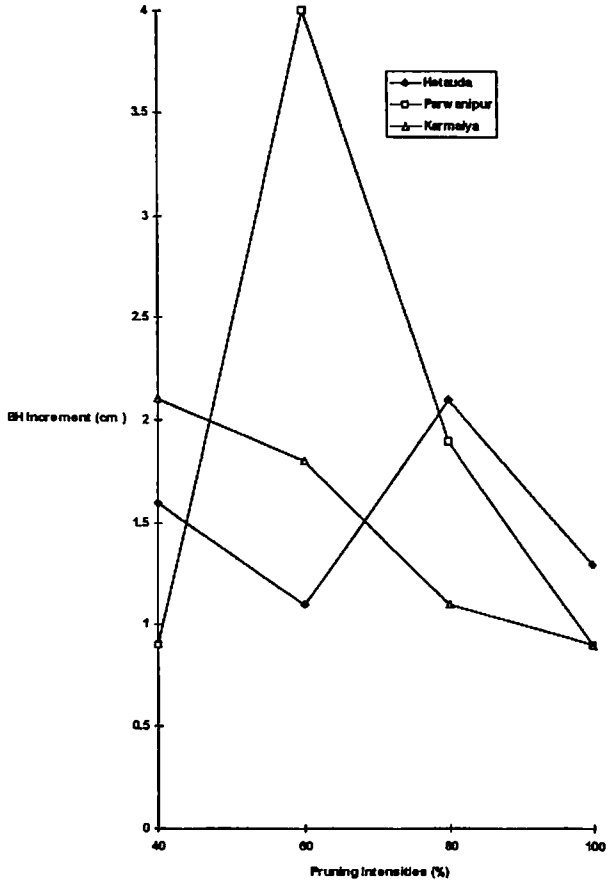
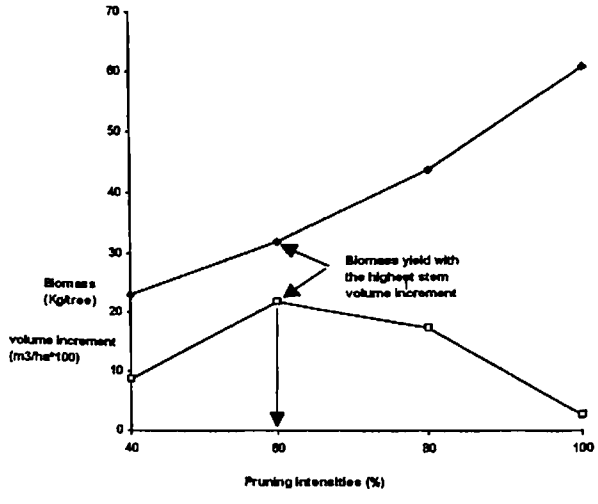


Figure 3. Average stem volume and biomass yield (green weight of branch + foliage) with different pruning intensities



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