Effect of Maturity Stage and Size of Trees on Fodder Proximate Principles in Elm (*Ulmus wallichiana* Planch)

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A B S T R A C T

The current study was conducted during the year-2014-15 on a 22-year old Elm plantation established at Wadura campus of SKUAST-Kashmir. Four diameter classes viz., D_1 (5-10cm), D_2 (10-15cm), D_3 (15-20cm) and D_4 (>20cm) were stratified from the plantation and leaf samples were collected from three trees of each diameter classes during four different sampling periods viz., P_1: April-May, P_2: June-July, P_3: August-September and P_4: October-November. The fodder analysis concluded that there is a decrease in crude protein (CP), NFE (nitrogen free extract) and OM (total organic matters) with the maturity of the leaves whereas, a reverse trend was found for DM (dry matter), CF (crude fibre), EE (ether extract) and total ash. The maximum percentages of these proximate principles were 19.24%, 54.91%, 92.16%, 42.99%, 18.44%, 6.77% and 11.54%, respectively. An increase in DM, CF and EE and a decrease in CP with increase in the size of the trees was observed. The size of the trees did not significantly affect NFE, OM, TC (total carbohydrates) and ash content of the leaves. The interaction of sampling periods and diameter classes produced insignificant variation in fodder proximate principles.

Introduction

The current scenario of animal protein deficiency prevailing in the developing world is caused by lack of forage. Fodder trees have always played a pivotal role in meeting the nutritional requirements of the livestock. These trees are increasingly being recognized as important components of animal feeding, especially as suppliers of protein. The contribution of these trees is all the more significant in difficult environmental conditions, where the available grazing is not sufficient to meet the requirements of animals throughout the year. They are readily accepted by livestock and continue to produce well into the dry season presumably because of their deep-root systems (Paterson *et al.,* 1998). Fodder trees are a cheap source of protein, energy and micronutrients for livestock and have added advantages like wide spread on-farm availability and easy accessibility to farmers.

One of the important fodder tree species of the Himalayan region is *Ulmus wallichiana*, the Himalayan Elm, also known as the Kashmir Elm, a fast growing medium sized tree which grows from Kashmir to Uttarakhand between 900 to 3000 meters amsl. The tree is regularly lopped for leaf fodder in Uttar Pradesh, Himachal Pradesh

and Jammu and Kashmir (Dwivedi, 1999). It yields a strong bark fibre used for cordage, string and sandals. It is used for making the tool handles and agricultural implements. Elms are planted near houses for a sustained yield of leaves which are being dried and kept for winter feeding of livestock. The practice continues in the Himalayan regions of the sub-continent. Elms grow fast and regenerate rapidly by seed, are resistant to pruning and root damage and adapt exceptionally well to unfavorable environmental conditions prevalent in the region. However, little information is available on the nutrient composition and nutritive value of Elm leaves as animal feed in the temperate regions of the country particularly in Kashmir.

Materials and Methods

The experiment was conducted on a 22- year old plantation of Elm located at an altitude of 1510m amsl in the Faculty of Agriculture, SKUAST-K, Wadura, Sopore (J&K) and lies at $34^o3'$N latitude and $74^o5'$E longitude. The trees of the plantation were stratified into four diameter classes i.e., D_1: 5-10cm, D_2: 10-15cm, D_3: 15-20cm and D_4: >20cm. The leaf samples were collected during four different sampling periods viz., P_1: April-May, P_2: June-July, P_3: August-September and P_4: October-November from three trees of each diameter class. The green leaf samples collected from the trees were rinsed in distilled water to remove dust and stored. All the foliages were cut into small pieces so as to facilitate easy handling and uniform sampling for analysis. Samples were dried in the oven at 65^oC for 24 hrs and ground to pass through 1-mm sieve, grinded and stored in polythene bags at room temperature.

The dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and total ash were estimated following the procedure of Association of Official Analytical Chemist (AOAC, 1990). The Nitrogen Free Extract (NFE), Organic Matter (OM) and Total Carbohydrate (TC) were estimated as follows:

Nitrogen free extract

The nitrogen free extract or carbohydrate of the samples was calculated by using following formula:

$$NFE\% = 100 - (\%CP + \%EE + \%CF + \%Ash)$$

Organic Matter (OM)

The organic matter of the samples was calculated by using following formula:

$$OM = CP + EE + CF + NFE$$

Total Carbohydrate (TC)

The total carbohydrate of the samples was calculated by adding the percentage of crude fibre and the percentage of nitrogen free extract.

$$TC = \%CF + \%NFE$$

The data collected was subjected to statistical analysis using general linear model procedure of SPSS Statistic version (17.0). The specified data in percentage was subjected to square root transformation as suggested by Bartlett, 1947.

Results and Discussion

Dry Matter (DM) is the actual amount of feed material after water and volatile acids and bases have been removed. The dry matter content of the Elm leaves increased from 37.29 to 39.93% with increase in the diameter of the trees (Table 1). According to Azim *et al.,* (2011) the intraspecific variation in DM can be attributed to aspect of the tree, time of day, position of leaves in the crown, internal nutrient balance and effects of diseases. These

results are in conformity with the findings of Berhe and Tanga (2013) in *Ficus thonningii*. Among the sampling periods, the highest DM was recorded in P_4 sampling period (42.99%) followed by P_3 (34.86%), P_2 (36.86%) and P_1 (34.98%) (Table 2). This implies that DM increased with advancement of the growing season towards the maturity of the leaves. The variation in DM with season of harvesting has also been reported by Singh and Todaria (2012) in *Quercus semecarpifolia*. Also, Singh *et al.,* (2010) observed significantly higher DM in adult foliage compared to juvenile foliage of *Celtis australis*.

Crude protein (CP) of the foliages is an important requirement for supporting optimum microbial growth in the rumen. CP content of the leaves was significantly lower in the higher diameter classes. The scrutiny of Table 1 revealed that the highest (18.44%) CP content was recorded for the lowest diameter class (D_1). This decrease in CP may be due to comparatively more overall foliage biomass in large sized trees thereby resulting in relatively lesser CP assimilation. Also, the decrease may have resulted due to increase in the nitrogen concentration in the large sized branches of the trees in higher diameter classes, thereby reducing the nitrogen concentration of the leaves.

The decrease in CP values with increase in diameter class has also been found by Berhe and Tanga (2013) in *Ficus thonningii*. According to the classification of Rahim *et al.,* (2011) the CP content in the Elm leaves falls in medium-high category. Sampling periods recorded significant variation in CP values, the highest (19.24%) was found in sampling period P_1 (Table 2). The decrease in CP content with advancement of growing season towards the leaf fall may partly be attributed to re-translocation of leaf nitrogen into branches before leaf fall and partly due to a dilution factor with expansion and maturity of the leaves (Khosla *et al.,* 1992). In earlier

study, Verma and Mishra (1999) reported decrease in nitrogen concentration with the advancement of growing season towards the leaf fall. Our findings are in agreement with this study. Singh *et al.,* (2010) also found higher CP in adult foliage compared to juvenile foliage in *Celtis australis*. Further, Khosla *et al.,* (1980) also reported similar pattern in *Grewia optiva*.

Crude fibre (CF) is the roughage component of feedstuff that affects the production of saliva in the livestock. In the present study, diameter class produced slightly significant effect on CF content of the leaves. A decreasing trend was recorded with decrease in diameter of the trees (Table 1). The highest (16.37%) and lowest (15.51%) CF was obtained in the diameter class D_4 and D_1, respectively. The decrease in CF content in lower diameter class trees has also been reported by Berhe and Tanga (2013) in *Ficus thonningii*. The perusal of the Table 2 showed that CF content of the leaves increased with the maturity of the leave from 13.68% in sampling period P_1 to 18.44% in P_4 period. The results obtained are in line with the findings of Singh *et al.,* (2010) in *Celtis australis*.

Ether extract (EE) represents the fat component of the feedstuff. The current investigation found significant variation in EE among different diameter classes. The diameter class D_4 recorded highest (5.80%) EE percentage and then there was a regular decrease in the order of $D_3 > D_2 > D_1$ (Table 1). The results are in conformity with the findings of Berhe and Tanga (2013) in *Ficus thonningii*. Among sampling periods, there was a significant increase in EE with advancement of the period and it ranged from 4.33 to 6.77% (Table 2). Our findings are in agreement with Verma *et al.,* (1992) and Kamalak *et al.,* (2005). In these studies it was reported that EE increased with increasing maturity.

Table.1 Effect of diameter class on fodder proximate principles of *Ulmus wallichiana*

Parameter	Diameter class				C.D. (0.05)
	D_1 (5-10cm)	D_2 (10-15cm)	D_3 (15-20cm)	D_4 (>20cm)	
DM (%)	37.29	37.89	38.67	39.93	1.82
	18.44	17.12	16.93	16.60	0.14
CP (%)	(4.29)	(4.13)	(4.11)	(4.06)	
	15.51	15.78	16.09	16.37	0.08
CF (%)	(3.93)	(3.97)	(4.00)	(4.04)	
	5.21	5.43	5.51	5.80	0.06
EE (%)	(2.27)	(2.32)	(2.34)	(2.40)	
NFE (%)	51.78	52.47	52.08	51.69	NS
	90.94	90.79	90.61	90.45	NS
OM (%)	(9.54)	(9.53)	(9.52)	(9.51)	
TC (%)	67.29	68.24	68.17	68.06	NS
	9.06	9.21	9.39	9.55	NS
Total ash (%)	(3.00)	(3.02)	(3.05)	(3.07)	

Figures in parentheses are square root transformed values

Table.2 Effect of sampling period on fodder proximate principles of *Ulmus wallichiana*

Parameter	Sampling period				C.D. (0.05)
	P_1 (April-May)	P_2 (June-July)	P_3 (Aug-Sept)	P_4 (Oct-Nov)	
DM (%)	34.98	36.86	38.96	42.99	1.82
	19.24	18.22	16.98	14.65	0.14
CP (%)	(4.39)	(4.27)	(4.12)	(3.82)	
	13.68	15.19	16.43	18.44	0.08
CF (%)	(3.70)	(3.90)	(4.05)	(4.29)	
	4.33	5.24	5.66	6.77	0.06
EE (%)	(2.08)	(2.29)	(2.38)	(2.59)	
NFE (%)	54.91	52.94	51.52	48.66	1.84
	92.16	91.58	90.59	88.46	0.06
OM (%)	(9.60)	(9.57)	(9.52)	(9.41)	
TC (%)	68.59	68.13	67.95	67.09	NS
	7.84	8.42	9.41	11.54	0.18
Total ash (%)	(2.79)	(2.90)	(3.06)	(3.39)	

Figures in parentheses are square root transformed values

Nitrogen free extract (NFE) represents the energy content of feedstuff. NFE differed non-significantly among different diameter classes (Table 1). The relatively higher value of 52.47% was attained in D_2 diameter class. Berhe and Tanga (2013) also reported similar results in *Ficus thonningii*. The appraisal of the Table 2 ascertained that the percentage of NFE decreased with increase in the maturity of the leaves attaining highest value of 54.91% in sampling period P_1. The variation in NFE among different seasons has also been ascertained by Singh and Todaria (2012) in *Quercus semecarpifolia*.

Total organic matters (OM) did not exhibit any significant difference in trees with variable size. However, relatively higher

percentage (90.94%) was achieved in D_1 diameter class (Table 1). It was significantly affected by sampling periods, exhibiting a decreasing trend with maturity of the leaves. The lowest (88.46%) and highest (92.16%) percentages were observed in sampling period P_4 and P_1, respectively (Table 2). Low content of OM in the Elm foliage was a reflection of high ash content corroborating such findings in tree leaves as reported by Beigh and Ganai (2014) and Gemeda and Hassen (2015). Singh and Todaria (2012) have also evaluated seasonal variation in OM in *Quercus semecarpifolia*.

Total carbohydrates (TC) achieved non-significant difference among diameter classes and sampling periods (Tables 1 and 2). However, among sampling periods relatively higher percentage of 68.59% was found in P_1 and thereafter a continuous decrease was observed. In contrast, Singh and Todaria (2012) reported significant variation in TC among different harvesting seasons in *Quercus semecarpifolia*.

Total ash represents the mineral level in a feedstuff. There was no significant association between total ash and size of the trees as shown in the Table 1. However, relatively higher percentage of 9.55% was observed under diameter class D_4. The insignificant low variation in total ash suggests that the percentage is sufficient to meet the dietary requirements of the livestock even in small sized trees. The level of mineral content (ash) assimilated with the maturity of the leaves. The maximum level of 11.54% was attained by sampling period P_4 (Table 2). The findings are comparable with Azim *et al.,* (2011) who observed mean ash values within the same range in *Grewia populifolia*, *Indigofera gerardiana* and *Prosopis cineraria*. The insignificant differences in ash content among different sized trees have also been reported by Berhe and Tanga (2013) in

Ficus thonningii. Furthermore, Singh *et al.,* (2010) observed higher ash percentages in adult as compared to juvenile foliages in *Celtis australis*.

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