# Fodder quality variation in *Grewia laevigata* Vahl. in Himachal Pradesh

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**ABSTRACT :** The present study on fodder quality variation in *Grewia laevigata* Vahl. in Himachal Pradesh revealed that some of the traits *viz.*, leaf fresh weight (g), leaf dry weight (g), leaf dry matter (%), crude protein (%), crude fibre (%), ether extract (%), total ash (%) and nitrogen free extract (%) exhibited variation between the sites. There were also significant differences between trees within the locality in almost all the parameters including the nitrogen free extract and dry matter content in *Grewia laevigata*. In simple correlation combinations, positive and negative significant variations were exhibited. Genotypic correlation coefficients were found greater than phenotypic one for almost all the leaf fodder traits.

**Key words:** *Grewia laevigata*, variation, correlation coefficients and genotypic correlations

## 1. INTRODUCTION

Variation refers to the observable differences in an individual for a particular trait. These differences may be particularly due to genetic effects and partly owned to environmental trappings. The combined reflection of both is the phenotypic effect. The observed value of a trait measured on an individual is the phenotypic value of that individual. The relative magnitude of these components determines the genetic properties of any particular species (Jain, 1982). Therefore, the effective tree improvement programme depends upon the nature and magnitude of existing genetic variability and also the degree of transmission of the traits.

*Grewia laevigata* Vahl (Beuli) of family Tiliaceae is very important fodder species in the Shiwalik hills of Himachal Pradesh. It is a small medium sized tree attaining a height up to 13.5m with clear bole of about 4.5m, and a girth of 0.6 – 0.9m (Troup, 1921). It is well distributed in the areas of natural grasslands, nallahs and wastelands, and on agricultural fields in the Shiwalik hills of Himachal Pradesh. Since the local people are using it as a winter fodder, therefore, it was considered highly imperative to study the leaf fodder nutrient variation, with a view to use this species in future breeding programme and to encourage the farmers to plant this species to enhance the fodder productivity.

## 2. MATERIALS AND METHODS

An eco-geographical survey of the population of *Grewia laevigata* was undertaken during the months of September-October 2005 in the jurisdiction of two districts of Himachal Pradesh *viz.* Solan and Sirmour area to identify the sites where the species occur almost in abundance and a considerable geographically altitude distance at least 100m isolating one site from the other. Since the populations of *Grewia laevigata* under study occur in restricted patches only, therefore, random selection of six mature trees from five localities each of approximately having a girth of 35 – 40 cm was made.

Some of the characteristic features of the experimental sites are described as follows:

| Site | Locality | District | Altitude (m) | Latitude | Longitude | Rainfall (mm) |
|---|---|---|---|---|---|---|
| Site-1 | Rajari | Solan | 1120 | $30^{o}53$ N | $77^{o}04$ N | 1027 |
| Site-2 | Salga | Solan | 910 | $30^{o}57$ N | $76^{o}53$ N | 1554 |
| Site-3 | Tikkari | Solan | 1010 | $31^{o}57$ N | $77^{o}08$ N | 2106 |
| Site-4 | Chawaha | Sirmour | 1220 | $30^{o}36$ N | $77^{o}22$ N | 1740 |
| Site-5 | Dadahu | Sirmour | 1335 | $30^{o}66$ N | $77^{o}26$ N | 1527 |

(Source: Encarta US Geological Survey and Forest Departmant)

### Leaf fodder nutrients traits

Leaf fresh weight (g), leaf dry weight (g), leaf dry matter (%), crude protein (%), crude fibre (%), ether extract (%) and total ash (%), nitrogen free extract (%). The method followed for the analysis of nutritional traits was recommended by AOAC (1995).

### 2.1 Statistical Analysis

Variability and genetic parameters for leaf fodder traits were analyzed by using RBD as described by Panse and Sukhatme (1967) and Chandel (1984). Variability parameters were calculated at phenotypic and genotypic levels by the formula suggested by Burton (1952).

## 3. RESULTS AND DISCUSSION

The analysis of variance showed that there was a wide variation in the content of mineral nutrients and composition of fodder value depending on locality and trees. There were also significant differences between trees within the locality in almost all the parameters including the nitrogen free extract and dry matter content in *Grewia laevigata*. Various workers have reported that there existed a strong variation in leaf composition of trees growing in different localities with different environmental conditions (Ljones and Landfold, 1966; Langille and MacLean, 1976; Nakamura, 1977; Kovas *et al.*, 1985; Kaushal *et al.*, 1986; Khosla *et al.*, 1980; Pal *et al.*, 1983; Jaswal, 1992).

Natural variation occurs as a product of evolution and serves as a raw material which is renewable and utilizable involving basic tools such as selection and manipulation of the variability in the biological population.

### 3.1 Leaf fodder nutrients traits

Analysis of data (Table 1) indicated that crude protein, crude fibre and total ash exhibited higher mean value for $S_4$ (Chawaha) whereas, leaf fresh weight, leaf dry weight and leaf dry matter content for $S_2$ (Salga) and ether extract for $S_5$ (Dadahu). Crude protein and leaf dry matter content indicated maximum mean value for $T_4$ however, crude fibre and nitrogen free extract for $T_5$ and total ash and leaf fresh weight exhibited for $T_1$, ether extract and leaf dry weight for $T_2$ and $T_6$, respectively. The above results showed that leaf fodder nutrients are highly variable between trees and between sites.

These findings lend support to the results obtained by various workers in different species *viz.*, Jaswal (1992) in *Grewia optiva*, Chiang (1982) in *Schima superba*, Helliwall and Harrison (1978) in *Acer pseudoplatanus*, Lohan *et al.* (1983) in *Quercus incana* and Gera *et al.* (2002) in *Dalbergia sissoo*.

### 3.2 Correlation studies

The expression of a character is sum total of the contribution of so many other characters and, therefore, screening/selection should be done on the basis of component's contribution towards that character. The biometrical tool to help this, is correlation which gives the nature and degree of association between various traits. Correlation

Table-1: Tree to tree variation (mean values) in leaf fodder nutrients traits of *Grewia laevigata* at different sites

| Tree No. | Sites | | | | |
|---|---|---|---|---|---|
| | Rajari | Salga | Tikkari | Chawaha | Dadahu |
| | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ |
| | | | 100 leaves fresh weight (g) | | |
| *$T_1$-$T_6$ | 80.34 | 83.40 | 83.00 | 76.90 | 73.34 |
| | | | 100 leaves dry weight (g) | | |
| $T_1$-$T_6$ | 36.63 | 40.13 | 39.10 | 34.24 | 32.82 |
| | | | Dry matter content (%) | | |
| $T_1$-$T_6$ | 45.66 | 48.01 | 47.07 | 44.61 | 44.02 |
| | | | Crude protein content (%) | | |
| $T_1$-$T_6$ | 16.97 | 16.47 | 16.08 | 17.43 | 17.11 |
| | | | Crude fibre content (%) | | |
| $T_1$-$T_6$ | 13.17 | 13.28 | 13.53 | 14.47 | 14.01 |
| | | | Ether extract content (%) | | |
| $T_1$-$T_6$ | 2.814 | 2.796 | 3.007 | 3.106 | 3.124 |
| | | | Total ash content (%) | | |
| $T_1$-$T_6$ | 8.226 | 8.666 | 8.641 | 10.04 | 8.993 |
| | | | Nitrogen free extract content (%) | | |
| $T_1$-$T_6$ | 58.76 | 58.79 | 58.76 | 54.95 | 56.85 |

Where *$T_1$-$T_6$ = Mean values of six trees

Table- 2: Karl Pearson's correlation coefficients for leaf fodder nutrients

| Characters | Leaf fresh weight (g) | Leaf dry weight (g) | Leaf dry matter (%) | Crude Protein (%) | Crude Fibre (%) | Ether extract (%) | Total ash (%) | Nitrogen free extract (%) |
|---|---|---|---|---|---|---|---|---|
| Leaf fresh weight (g) | 1.0000 | | | | | | | |
| Leaf dry weight (g) | 0.6998** | 1.0000 | | | | | | |
| Leaf dry matter (%) | 0.1775 | 0.7558** | 1.0000 | | | | | |
| Crude protein (%) | 0.4001* | 0.4105* | 0.2679 | 1.0000 | | | | |
| Crude fibre (%) | 0.3831* | 0.3885* | 0.2363 | 0.2738 | 1.0000 | | | |
| Ether extract (%) | 0.1473 | 0.0987 | 0.0033 | 0.3181 | 0.1063 | 1.0000 | | |
| Total ash (%) | 0.2243 | 0.2671 | 0.2083 | 0.4223* | 0.3975* | 0.1278 | 1.0000 | |
| Nitrogen free extract (%) | -0.4244* | -0.4238* | 0.2578 | -0.6942** | -0.7104** | -0.3993* | -0.7979** | 1.0000 |

* Significant at 5% level of significance

** Significant at 1% level of significance

Table- 3: Estimation of phenotypic, genotypic and environmental correlation coefficients for leaf fodder nutrients traits

| Characters | | Leaf fresh weight (g) | Leaf dry weight (g) | Leaf dry matter (%) | Crude protein (%) | Crude fibre (%) | Ether extract (%) | Total ash (%) | Nitrogen free extract (%) |
|---|---|---|---|---|---|---|---|---|---|
| Leaf fresh weight (g) | Phenotype | 1.000 | -0.062 | -0.078 | -0.125 | -0.068 | -0.139 | 0.045 | 0.197 |
| | Genotype | 1.000 | 0.216 | 0.986** | 0.423* | 0.984** | -0.219 | 0.397* | 0.761** |
| | Environmental | 1.000 | -0.058 | 0.140 | -0.129 | 0.011 | 0.079 | -0.010 | -0.256 |
| Leaf dry weight (g) | Phenotype | | 1.000 | -0.117 | -0.129 | -0.122 | 0.016 | -0.189 | 0.068 |
| | Genotype | | 1.000 | -0.312 | 0.371* | -0.347 | 0.003 | -0.357* | 0.103 |
| | Environmental | | 1.000 | 0.138 | 0.094 | 0.011 | 0.081 | 0.067 | 0.043 |
| Leaf dry matter (%) | Phenotype | | | 1.000 | 0.231 | 0.088 | 0.368* | -0.002 | -0.412* |
| | Genotype | | | 1.000 | 0.383* | 0.226 | 0.419* | 0.002 | -0.471* |
| | Environmental | | | 1.000 | -0.075 | -0.075 | 0.103 | -0.019 | -0.077 |
| Crude protein (%) | Phenotype | | | | 1.000 | 0.756** | 0.424* | -0.097 | -0.410* |
| | Genotype | | | | 1.000 | 0.926** | 0.601** | -0.158 | -0.562** |
| | Environmental | | | | 1.000 | 0.645** | -0.170 | 0.065 | 0.199 |
| Crude fibre (%) | Phenotype | | | | | 1.000 | 0.258 | -0.003 | -0.268 |
| | Genotype | | | | | 1.000 | 0.498* | -0.001 | -0.488* |
| | Environmental | | | | | 1.000 | -0.185 | -0.009 | 0.213 |
| Ether extract (%) | Phenotype | | | | | | 1.000 | -0.400 | -0.694** |
| | Genotype | | | | | | 1.000 | -0.420 | -0.708** |
| | Environmental | | | | | | 1.000 | -0.235 | -0.314 |
| Total ash (%) | Phenotype | | | | | | | 1.000 | 0.318 |
| | Genotype | | | | | | | 1.000 | 0.347 |
| | Environmental | | | | | | | 1.000 | -0.074 |
| Nitrogen free extract (%) | Phenotype | | | | | | | | 1.000 |
| | Genotype | | | | | | | | 1.000 |
| | Environmental | | | | | | | | 1.000 |

* Significant at 5% level of significance

** Significant at 1% level of significance

studies resolve the complex relations between important traits, which are of immense help in the selection of superior genotypes. So, the knowledge of association of different characters is the first hand information for any important programme.

**Simple correlation coefficients among leaf fodder nutrients traits :** A perusal of Table 2 indicated that out of 36 correlation combinations, two were positive, three negative and highly significant, six were significant and positive, three negative and significant.

Data also revealed that leaf fresh weight had significant positive correlation with leaf dry weight, crude protein and crude fibre, and negative significant correlation with nitrogen free extract. Leaf dry weight showed significant positive correlation with leaf dry matter, crude protein and crude fibre; and negative correlation with nitrogen free extract. Crude protein showed significant positive correlation with total ash and negative correlation with nitrogen free extract. Crude fibre positively correlated with total ash and negatively with nitrogen free extract. Ether extract showed significant but negative correlation with nitrogen free extract. Total ash was significant but negatively correlated with nitrogen free extract. Negative correlation suggests that selection made for nutrients will be contrary to the proximate principle (Table 2).

The present findings are in aacordance with Veerendra and Sharma (1990) in *Santalum album*, Hosalli (1997) in *Leucaena* species, Manga and Sen (1998) in *Prosopis cineraria* and Gera *et al.* (2002) in *Dalbergia sissoo*.

**Phenotypic, genotypic and environmental correlation coefficients among leaf fodder nutrients traits** : When selection is based on two or more characters, the estimation of genotypic correlation between the various traits provides necessary information in a breeding programme. The intensity and direction of association among characters may be measured by genetic coefficients of correlation and phenotypic coefficients of correlation depending on the type of material studied. The knowledge of genotypic interrelationship between characters is also of theoretical interest because a genotypic correlation may drive from genetic linkage, pleiotrophy or from developmentally induced relationship between components that are only indirectly the consequences of gene action.

In the present study, it is clear from the calculations, that the phenotypic correlation coefficients were lower than the corresponding genotypic ones (Table 3). This suggests that it could be either due to the modifying effect of environment or the strong inherent association of characters at genotypic level. It is also evident from Table-3 that out of 36 correlations among leaf fodder traits, one positively significant correlation found at phenotypic, genotypic and environmental level, five showed (two positive + three negative) significant correlations at phenotypic and genotypic level and ten (seven positive + three negative) correlations were significant at only genotypic level.

The above findings derive support from the results of Srivastava (1995) in *Bauhinia variegata*, Mohapatra (1996) in *Acacia catechu*, Manga and Sen (1998) in *Prosopis cineraria*, Chauhan and Verma (1993) in *Acacia catechu*, Anand (2003) in *Bauhinia variegata*, Khosla *et al.* (1982) in *Grewia optiva* and Gera *et al.* (2002) in *Dalbergia sissoo*.

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