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**Research Note**

# Genetic divergence and association analyses in Hedge lucerne (*Desmanthus virgatus* L. Willd)

**Deepthi.I.V.L*, A. Kalamani and N. Manivannan**
Dept. of Forage Crops, Tamil Nadu Agricultural University, Coimbatore-641003
Email: deepthiagri@gmail.com

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**Abstract**
Twenty three mutants along with control of hedge lucerne variety TNDV-1 were evaluated for twelve traits to assess genetic divergence. Mutants were grouped in to eight clusters based on $D^2$ values. Based on the inter cluster distances using $D^2$ values, it can be considered that the genotypes belonging to clusters VII and VIII are more diverse. The minimum inter cluster distance was found in clusters II and III indicating their genetic closeness. Cluster VIII which contain single progeny had high mean values for all the characters except for crude fat content. Path analysis revealed that the number of branches per plant, leaf to stem ratio, dry matter yield per plant was considered as important selection indices for green fodder yield per plant.

**Key words**
*Desmanthus virgatus,* Genetic Divergence, Path analysis

Hedge Lucerne *(Desmanthus virgatus* L. Willd) is a drought tolerant forage legume which is preferred by cattle for its palatable green fodder and adequate amount of crude protein. However, the genetic improvement achieved in terms of its productivity is very low. This necessitates the development of superior varieties with high biomass coupled with high quality. With this in view, the present investigation was programmed to create genetic variability for the improvement of *Desmanthus* with high biomass and high protein through induced mutagenesis. Correlation studies provide useful information about the basis of selection for traits like green fodder yield. Path Coefficient analysis, an effective tool for partitioning the correlation coefficients into direct and indirect effects of yield attributes on yield (Singh and Singh, 2003), would be helpful selection. Therefore, the present investigation was taken up for identification, classification of micro-mutants through multivariate analysis and to understand the nature of association and extent of direct and indirect effects of various yield components on yield in the mutants of hedge lucerne.

Seeds of hedge lucerne (*Desmanthus virgatus* L.Willd),cv. TNDV-1, was used for the gamma-ray treatment. Well filled, uniform sized, handpicked seeds with a moisture content of 10 per cent were chosen for irradiation. A sample of 80 seeds per treatment was packed in butter paper covers and placed in the sample chamber of the gamma cell. The seeds were exposed to the radiation for various durations depending upon the doses desired. The non-irradiated seeds served as control. Gamma irradiation was performed in the Gamma chamber model - 1200 installed at the Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore where Cobalt - 60 is the source of gamma rays. Twenty three promising mutants were isolated from $M_2$ generation of TNDV-1. The investigations were carried out in the new area farm of Department of Forage crops, TNAU, Coimbatore, during *kharif* 2011. The experiment was laid out in randomized block design. Seeds of each treatment were sown in three replications in $M_1$ generation. The mutants recovered were forwarded to $M_2$ generation, 23 promising mutants isolated from this generation and forwarded to $M_3$ generation and used in the present study.

After the exclusion of chlorophyll and morphological macro-mutants, mutated plants in each treatment were observed and were selected on the basis of higher yield. Observations on number of branches per plant, leaf to stem ratio, pod length, pods per cluster, green fodder yield per plant, dry fodder yield per plant, crude protein content, crude fat content, crude fibre content, calcium and phosphorus content were recorded on 10 randomly selected plants from each plot. Multivariate analysis of genetic divergence among mutants was done using Mahalanobis $D^2$ – statistic and grouping of mutants into clusters by Tocher's method (Rao, 1952). Simple correlation coefficients were calculated according to Singh and Chaudhary (1985) and path coefficient analysis was done as per method suggested by Dewey and Lu (1959).

A basic pre-requisite in multivariate analysis and grouping of genotypes is the existence of significant differences among genotypes for multivariate traits. The mutant cultures of TNDV-1 differed significantly in respect of all the traits observed. Twenty three mutant cultures were grouped into eight clusters (Table 1). Among the clusters, cluster I had a maximum of 12 mutants,

remaining clusters had two mutants each except VII and VIII clusters which had one mutant each.

Based on the inter cluster distances using $D^2$ values (Table 2), it can be considered that the parents belonging to clusters VII and VIII are more diverse followed by clusters I and VII and V and VII . The clustering pattern revealed that the mutants obtained from the same treatments were grouped into different clusters. The mutants grouped in these clusters show their diverse nature. The minimum inter cluster distance was found in clusters II and III (352.542) indicating their genetic closeness. Comparison of the cluster means for twelve characters showed that cluster VIII which contains single progeny had high mean values for all the characters except for crude fat content. The present study also revealed that enough genetic diversity existed with respect to the twelve traits among the mutants of TNDV-1. Use of multivariate analysis for identification of parents for hybridization programme has been used earlier in mungbean (Mohapatra *et al.,* 1983;Mishra and Pradhan, 2006).

The simple correlation estimates showed that green fodder yield per plant was significant and positively correlated with number of branches per plant, leaf to stem ratio and dry matter yield per plant. Similar reports were given by Shanthi (1995), Borah and Khan (1999) and Tucak *et al.* (2008). Inter correlation showed that number of branches per plant exerted significant positive correlation with leaf to stem ratio and dry matter yield per plant. Similar findings were reported by Mary and Gopalan (2006). Leaf to stem ratio exerted significant positive correlation with dry matter yield per plant. Similar findings were reported by Mary and Gopalan (2006).

Perusal of the result obtained from path analysis revealed that dry matter yield per plant recorded high positive direct effect on green fodder yield per plant followed by number of branches per plant, plant height, leaf to stem ratio and pods per cluster (Table 5). The residual effect of 0.433 indicates that some more important yield component traits need to be included in the path analysis. Similar reports were given by Shanthi (1995), Borah and Khan (1999) and Kohli and Agarwal (2002). Number of branches per plant recorded positive indirect effect *via* dry matter per plant and leaf to stem ratio. Leaf to stem ratio recorded high positive indirect effect *via* number of branches per plant and dry matter yield per plant. Dry matter yield per plant recorded positive indirect effect *via* branches per plant and leaf to stem ratio. Similar results were given by Chaudhary and Lodhi (1980)

From the foregoing discussion it can be concluded that the mutation created wider genetic divergence in the variety TNDV-1. The correction and path analysis on green fodder yield traits viz., number of branches per plant, leaf to stem ratio, dry matter yield per plant are considered as important selection indices for green fodder yield per plant.

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**Table 1.Clustering pattern of 24 genotypes (23 mutants with control) based on $D^2$ analysis**

| Cluster No. | Number of genotypes per cluster | Genotypes per cluster |
|---|---|---|
| I | 12 | Control,<br>50 Gy-1,2<br>100 GY-1,2,3,<br>350 Gy-1,2,3,4,5,6<br>450 Gy-6 |
| II | 2 | 450 Gy-2,4 |
| III | 2 | 450 Gy-1,<br>500 GY-4 |
| IV | 2 | 450 Gy-5,<br>500 Gy-5 |
| V | 2 | 500 Gy 1,3 |
| VI | 2 | 400 Gy 2,<br>500 Gy-2 |
| VII | 1 | 400 Gy-1 |
| VIII | 1 | 450 Gy-3 |

**Table 2. Inter and Intra Cluster $D^2$ Values**

| Clusters | I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|---|
| I | 748.85 | 1009.95 | 938.88 | 890.94 | 967.66 | 1569.52 | 5375.43 | 1141.05 |
| II | | 166.36 | 352.54 | 708.94 | 1203.53 | 851.97 | 3361.66 | 1027.68 |
| III | | | 178.39 | 951.35 | 1398.21 | 718.25 | 2757.13 | 1514.70 |
| IV | | | | 211.61 | 426.92 | 847.16 | 4365.05 | 504.00 |
| V | | | | | 337.29 | 1297.52 | 5116.32 | 680.04 |
| VI | | | | | | 1150.07 | 2231.61 | 1695.55 |
| VII | | | | | | | 0 | 6156.49 |
| VIII | | | | | | | | 0 |

**Table 3. Cluster mean values for different characters**

| characters / clusters | Number of branches per plant | Leaf to stem ratio(%) | Pod length(cm) | Number of pods per cluster | Plant height (cm) | crude protein content(%) | crude fibre content(%) | crude fat content(%) | calcium content(%) | phosphorus content(%) | Dry matter yield per plant (g/plant) | Green fodder yield per plant (g/plant) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 44.2 | 1.1 | 7.9 | 8.4 | 76.0 | 23.9 | 23.9 | 0.8 | 1.2 | 0.4 | 309.0 | 1539.1 |
| II | 28.1 | 0.9 | 10.3 | 12.3 | 90.5 | 22.4 | 20.2 | 0.5 | 1.2 | 0.3 | 333.3 | 1232.3 |
| III | 34.2 | 1.0 | 9.4 | 9.7 | 92.0 | 21.0 | 23.1 | 0.6 | 1.4 | 0.4 | 210.0 | 956.5 |
| IV | 45.6 | 1.2 | 6.5 | 12.1 | 113.8 | 25.6 | 23.0 | 1.0 | 1.1 | 0.4 | 415.7 | 2167.5 |
| V | 42.4 | 1.2 | 6.8 | 8.9 | 99.7 | 24.3 | 27.7 | 1.5 | 1.0 | 0.4 | 401.5 | 1952.2 |
| VI | 41.6 | 1.1 | 7.7 | 9.8 | 132.4 | 23.7 | 24.6 | 0.9 | 1.2 | 0.4 | 303.7 | 1652.3 |
| VII | 25.1 | 0.7 | 9.0 | 3.0 | 172.3 | 26.6 | 24.9 | 0.8 | 1.2 | 0.4 | 190.7 | 973.7 |
| VIII | 50.2 | 1.4 | 10.6 | 12.7 | 103.8 | 28.4 | 19.7 | 1.2 | 1.3 | 0.4 | 435.3 | 2474.7 |

**Table 4. Simple correlation among green fodder yield per plant and its component characters**

| Characters | Leaf to stem ratio(%) | Pod length(cm) | Number of pods per cluster | Plant height (cm) | Dry matter yield per plant (g/plant) | Green fodder yield per plant (g/plant) |
|---|---|---|---|---|---|---|
| Number of branches per plant | 0.705 ** | -0.142 | -0.025 | -0.368 | 0.666 ** | 0.730 ** |
| Leaf to stem ratio (%) | | 0.118 | 0.290 | -0.287 | 0.679 ** | 0.731 ** |
| Pod length (cm) | | | 0.401 | 0.080 | -0.130 | -0.149 |
| Number of pods per cluster | | | | -0.009 | 0.130 | 0.197 |
| Plant height (cm) | | | | | -0.134 | -0.035 |
| Dry matter yield per plant (g/plant) | | | | | | 0.803 ** |

*, ** are significant at 5 and 1 per cent respectively

**Table 5. Path coefficients of yield components on green fodder yield per plant**

| Characters | Number of branches per plant | Leaf to stem ratio(%) | Pod length(cm) | Number of pods per cluster | Plant height (cm) | Dry matter yield per plant (g/plant) | Green fodder yield per plant (g/plant) |
|---|---|---|---|---|---|---|---|
| Number of branches per plant | 0.387 | 0.167 | 0.017 | -0.004 | -0.095 | 0.260 | 0.730 ** |
| Leaf to stem ratio (%) | 0.272 | 0.237 | 0.004 | 0.035 | -0.074 | 0.266 | 0.731 ** |
| Pod length (cm) | -0.055 | -0.007 | -0.118 | 0.062 | 0.020 | -0.051 | -0.149 |
| Number of Pods per cluster | -0.009 | 0.055 | -0.048 | 0.152 | -0.002 | 0.053 | 0.197 |
| Plant height (cm) | -0.148 | -0.071 | -0.010 | -0.001 | 0.247 | -0.057 | -0.035 |
| Dry matter yield (g/plant) | 0.257 | 0.161 | 0.015 | 0.021 | -0.036 | 0.391 | 0.803 ** |

Residual effect = 0. 433

** are significant at 5 and 1 per cent respectively