# Marker-Assisted Selection for Fibre Concentration in Smooth Bromegrass

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**Introduction** The concentration of neutral detergent fibre is the best single laboratory predictor of voluntary intake potential in forage crops. However, the assay of thousands of plant samples for NDF selection in a breeding program requires a large amount of labour and time, potentially increasing cycle time and reducing the rate of progress. A previous study (Diaby and Casler, 2005) identified 16 random amplified polymorphic DNA (RAPD) markers that were strongly associated with NDF concentration in one or more of four smooth bromegrass (*Bromus inermis* Leyss) populations. The objective of this study was to validate these associations by implementing marker-assisted selection for these 16 RAPD markers.

**Materials and methods** A total of 244 smooth bromegrass clones representing four populations were established as spaced plants in two replicates at Arlington, WI, USA. Leaf tissue samples were harvested eight times over 2 years and analysed for NDF. Each plant was scored for all 16 RAPD markers. Plants were sorted according to presence or absence of each marker and a contrast was performed to test the difference in mean NDF between those clones with the marker vs. those clones without the marker. Marker indices were generated as combinations of marker scores, weighted by the percentage of phenotypic variation explained by each marker. Ties for marker index scores were broken by selection on the basis of pedigree and prior NDF data.

**Results** There were significant marking scoring differences between this study and that of Diaby and Casler (2005), which were scored by different people. This resulted in a distribution of selection effects with an equal number of significant positive and negative effects. As a result, marker indices failed to validate, with low selection differentials and little variation explained (Table 1). Using only those markers with significant positive effects in both studies, new marker indices had large selection differentials, ranging from 36 to 58% of the selection differentials for phenotypic selection (control) and highly significant effects (Table 2).

**Table 1** Marker index validation statistics[#]

| Population | SD | % of control | $R^2$ | P-value |
|---|---|---|---|---|
| Alpha | 2 | 3 | 0 | 0.5096 |
| WB19e | -11 | -20 | 2 | 0.0007 |
| Lincoln | 8 | 13 | 1 | 0.0062 |
| WB88S | 7 | 12 | 1 | 0.0134 |

**Table 2** New marker index statistics[#]

| Population | SD | % of control | $R^2$ | P-value |
|---|---|---|---|---|
| Alpha | 43 | 58 | 23 | <0.0001 |
| WB19e | 31 | 58 | 18 | <0.0001 |
| Lincoln | 22 | 36 | 7 | <0.0001 |
| WB88S | 24 | 42 | 10 | <0.0001 |

[#] SD = selection differential. Control = selection differential for phenotypic selection for NDF concentration.

**Conclusions** Marker selection indices with large and significant selection differentials can be developed from RAPD markers, providing evidence that marker-assisted selection may be used to potentially improve the efficiency of selection for low NDF. The only marker indices that showed potential for use in marker-assisted selection were those based on results of both the current marker-validation study and the previous marker-discovery study of Diaby and Casler (2005). Reproducibility problems between different personnel scoring RAPD marker bands will limit the use of RAPD-based selection indices to the tenure of the person scoring bands, creating a potential need for redevelopment of marker selection indices as program personnel change. Conversion to a more reproducible marker system that is insensitive to personnel would provide a better long-term solution than RAPD markers. These results suggest that one cycle of selection for low NDF should be successful based on these marker selection indices. Polycross populations from selections based on phenotype vs. marker indices will be employed to test this hypothesis.

### References

Diaby, M. and M.D. Casler (2005). RAPD Marker variation among divergent selections for fiber concentration in smooth bromegrass. *Crop Science*, 44,27-35.