The Use of Cafeteria Trials for the Selection of *Desmodium ovalifolium* Genotypes

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THE USE OF CAFETERIA TRIALS FOR THE SELECTION OF *Desmodium ovalifolium* GENOTYPES

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Abstract

For the selection of tropical legumes which contain anti-nutritive components such as tannins, relative acceptability of genotypes to ruminants is of particular importance, since these plant components may influence selective grazing behaviour and subsequent animal productivity. Plant-animal interactions are not predictable from laboratory analyses. Involving grazing animals through the conduction of relative-acceptability (=cafeteria) trials at early stages of the germplasm selection process might therefore provide a convenient tool to adjust and confirm genotype selection based on laboratory quality analyses data. As part of a multi-locational germplasm evaluation project, cafeteria-experiments were conducted at two contrasting environments in Colombia with a core collection of *Desmodium ovalifolium*, a tropical legume species containing tannins. The objective of these experiments was to assess the usefulness of such acceptability trials in the selection of *D. ovalifolium* genotypes. Relative acceptability indices for the 18 accessions confirm genotype selection based on a series of laboratory quality analyses during earlier stages of the project and indicate pronounced genotype-environment interactions. Moreover, animal activity profiles confirm

the influence of plant-environment-animal interactions and thus the usefulness of cafeteria-trials for germplasm selection projects.

Keywords: GxE interactions, tannins, acceptability index, tropical legumes, germplasm evaluation, activity profile

Introduction

The importance of involving grazing animals at early stages of the germplasm selection process had already been stressed by McMeekan (1960) during the 8th International Grassland Congress in Reading, UK. In the last decades, considerable progress was made in the improvement of laboratory techniques to predict forage quality and intake by ruminants (Reid, 1994). Therefore, species and genotype selection of pasture plants is often exclusively based on cutting experiments and laboratory analyses, not taking into account possible forage plant-animal interactions. In the case of tropical legumes that contain anti-nutritive components such as tannins, relative acceptability of genotypes to ruminants is nevertheless of particular importance, since these plant components may influence selective grazing behaviour (plant-animal interactions) and subsequent animal productivity, which are not predictable from laboratory analyses (Launchbaugh, 1996). *Desmodium heterocarpon* subsp. *ovalifolium*, better known under its earlier name *Desmodium ovalifolium*, is such a legume where genotype-environment (GxE) interactions seem to determine forage quality. As part of a multi-locational germplasm evaluation project, a core collection of 18 *Desmodium ovalifolium* accessions was tested for relative acceptability to cattle in a cafeteria-trial (Schultze-Kraft et al., 1989) in two contrasting environments in Colombia. The objective was to assess the usefulness of cafeteria-trials for the selection of genotypes and, in particular, the confirmation of genotype selection based on laboratory data.

Material and Methods

The cafeteria-trial was conducted at La Romelia, Chinchiná, Caldas (Colombian coffee zone, 75°39’58" W, 04°58’20" N, 1360 masl, 2680 mm/a, 20.9 °C, Andisol) and at La Rueda, Florencia, Caquetá (Colombian Amazon basin, 75°25’47" W, 01°26’10" N, 180 masl, 3100 mm/a, 26 °C, Ultisol) during the wet season (November 1996 and July 1997, respectively). The core collection had been sown in early 1995 in a split-plot design with three replicates, where the main plot consisted of a fertiliser treatment (high - low, adjusted to the respective site) and the subplots of the 18 accessions (Schmidt and Schultze-Kraft, 1997). Plot size was 30 m² (6x5 m); between plots were 1-m wide strips planted with *Brachiaria dictyoneura*. A standardisation cut was carried out 6 weeks prior to the experiment; each replicate was fenced off. Following the method of Lascano et al. (1985) a total number of eight heifers (230-250 kg) grazed one replicate per fertiliser treatment for three days in order to allow for adaptation to the new legume. From each plot, leaf samples were taken for laboratory analysis of forage quality (*in-vitro* dry matter digestibility, crude protein, soluble condensed tannins, tannin astringency, acid detergent fibre and neutral detergent fiber). Two heifers were introduced to each block (replicate/fertilizer treatment). During four days, the following animal activities were recorded at five-minute intervals for a total of ten hours (7 a.m. - 5 p.m.): grazing on legume plots (which of the 18 accessions) or grass strips, standing, walking, ruminating, or water intake. Based on the number of observations, animal activity profiles per site and relative acceptability indices for each accession (no. of observations of a given accession being grazed / total no. of grazing observations expected in the respective block, if all accessions were of equal acceptability) were calculated. Accessions with low relative acceptability score indices <1, those with higher acceptability >1. Data were submitted to Analysis of Variance and correlation procedures.

Results and Discussion

The observed relative acceptability indices for each site are presented in Figures 1 and 2. Values are overall means for the respective accession at each site since at neither location there were significant differences between fertiliser treatments. Accessions ranked differently at both sites with CIAT 33058 showing outstanding acceptability. Top ranking accessions were CIAT 33058, 13651, 23762, 350, 13647, 13105, and 13125 at La Romelia, and CIAT 33058, 13305, 23195, and 350 at La Rueda. This indicates not only pronounced GxE interactions ($p < 0.0001$) but also possible genotype x environment x animal interactions. The well-known genotype CIAT 13089 showed at both sites low acceptability indices. Correlation coefficients between single laboratory quality parameters of samples taken prior to the experiment and acceptability indices were low (<0.5) due to a high degree of variation within accession leaf samples. Nevertheless, the top ranking accessions in the cafeteria-trials are identical with those accessions which had been selected in earlier stages of the evaluation project on the basis of a large series of laboratory quality analyses (A. Schmidt, unpubl. data). This confirms the usefulness and resource efficiency of the cafeteria methodology, even for a limited data set as in the present case.

An aspect which demands further investigation is the different animal activity profile at the two sites. Grazing of legume plots was recorded in 39.6 % of all observations at La Romelia in contrast with only 10.9 % at La Rueda. Records on grazing the grass strips were inverse showing a 10 % higher level at La Rueda (39.3 vs. 29.0 %). Animals spent more time ruminating (30.1 vs. 19.7 %) and standing (17.4 vs. 8.2 %) at La Rueda, while at La Romelia there was more active walking around (1.7 vs. 0.4 %) and less times water intake (0.8 vs. 1.2 %). Since legume quality data indicate slightly higher nutritive values for La Rueda, the lower grazing time on legume plots could be attributed to the hot day temperatures at that site during

the experiment. In times of heat stress, ruminants seem to reduce protein intake since this means higher water consumption due to the necessity of increased ammonia-excretion. Heat stress might also explain the different animal activity profiles and the smaller range of acceptability index differences in general. Environmental conditions were more comfortable at the La Romelia site including two days of light rainfall.

It can be concluded that cafeteria-trials are a useful, resource efficient and rapid instrument to assist in the selection of forage germplasm. The integration of the animal into the ultimate decision step – which means also the incorporation of plant-environment-animal interactions – is a convenient tool to adjust and confirm laboratory data and should be regarded as a standard step in germplasm selection projects.

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Figure 1

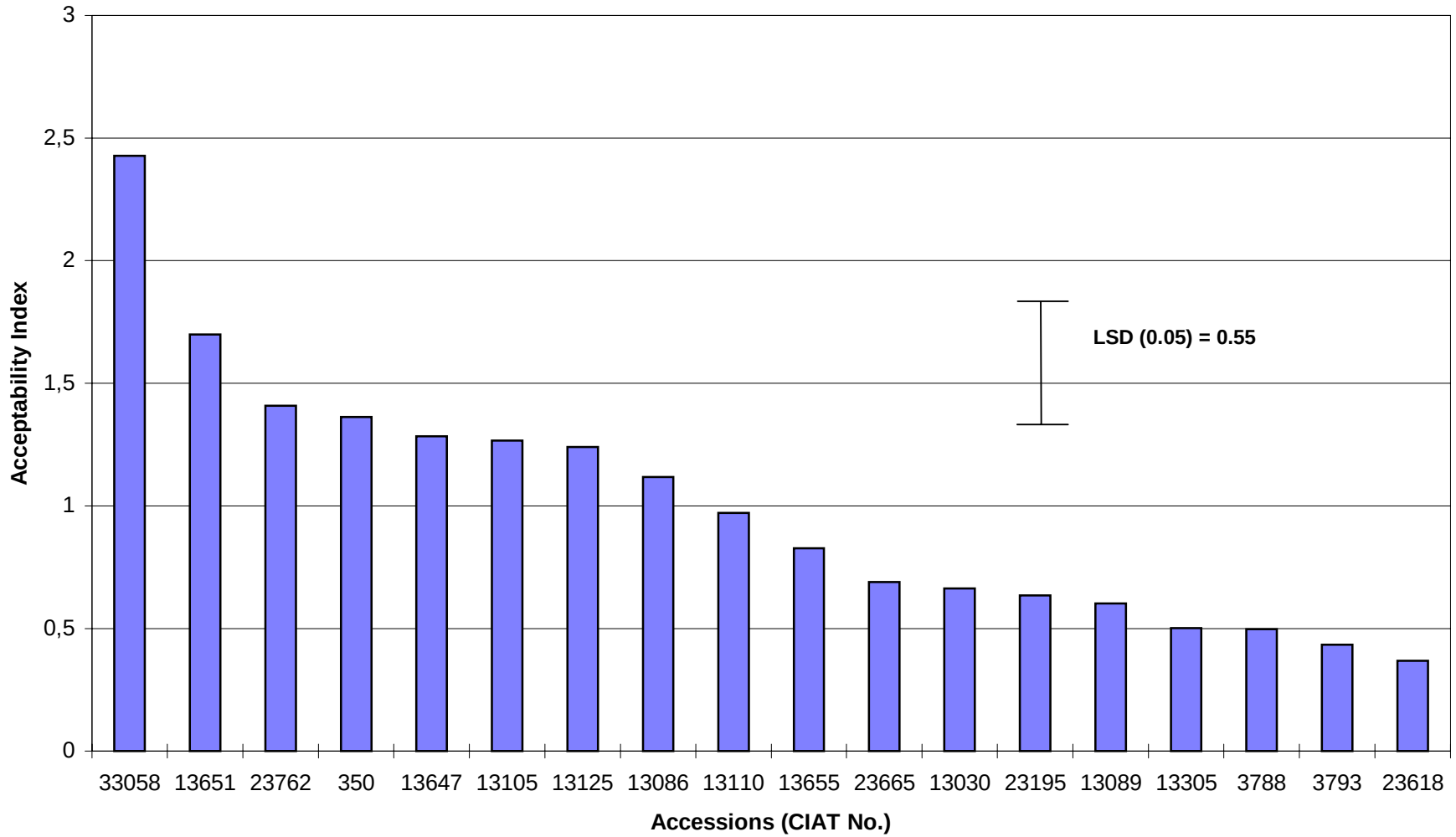
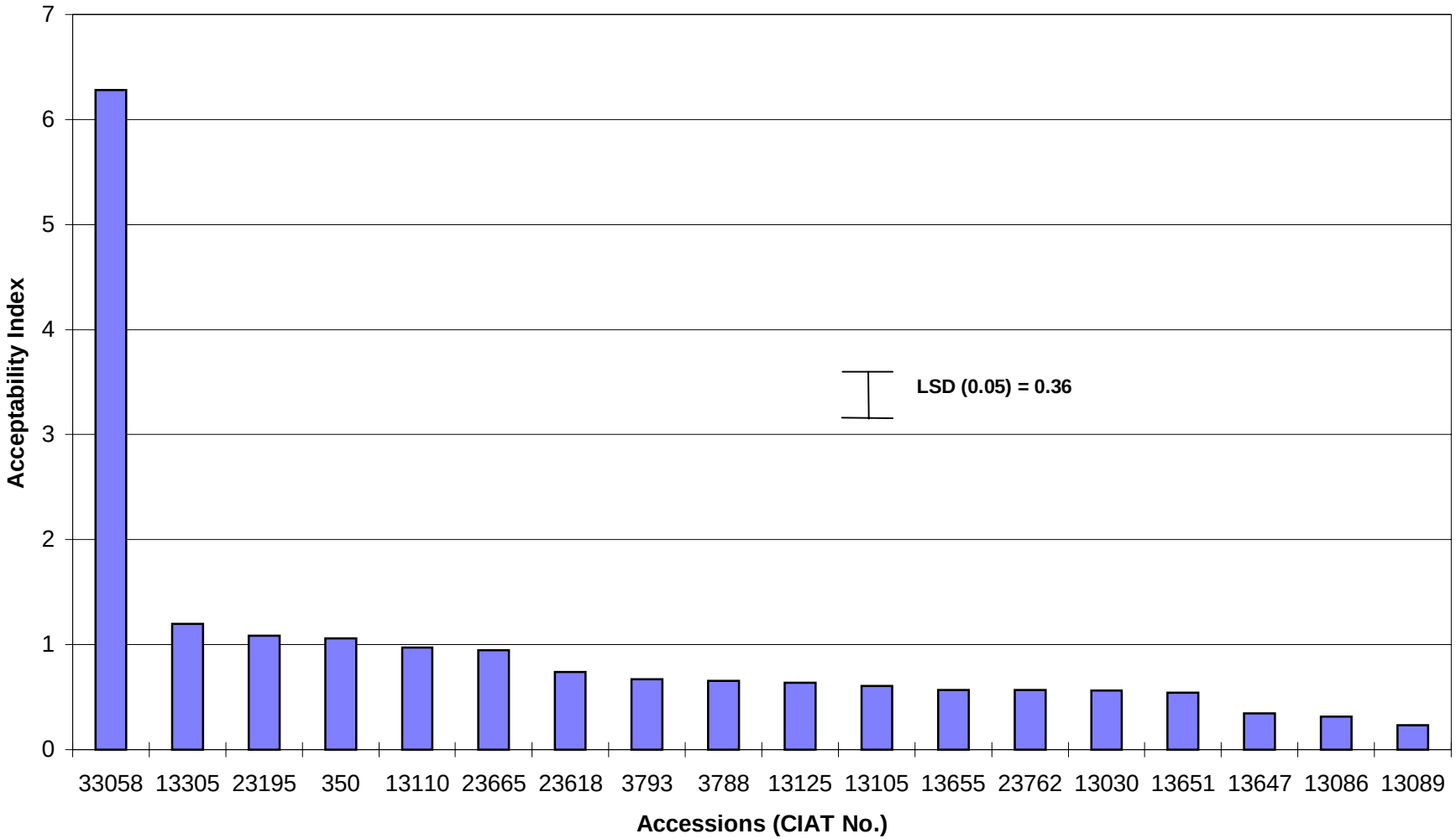

3
2,5
2
1,5
1
0,5
0
Acceptability Index
LSD (0.05) = 0.55
33058
13651
23762
350
13647
13105
13125
13086
13110
13655
23665
13030
23195
13089
13305
3788
3793
23618
Accessions (CIAT No.)

Figure 2


7
6
5
4
3
2
1
0
Acceptability Index
LSD (0.05) = 0.36
33058
13305
23195
350
13110
23665
23618
3793
3788
13125
13105
13655
23762
13030
13651
13647
13086
13089
Accessions (CIAT No.)