Protecting French Guiana grasslands against weed development

Feed supplies for livestock in French Guiana are dependent on grasslands in which weed development can lead to the destruction of forage species. Classical weed control is poorly sustainable. A study of the factors responsible for infestation has shown that it is not the environment that is responsible for the problem, but farmer practices, which affect the forage structure. An explanatory model of pasture invasion dynamics is currently being tested. The degree to which research results have been taken into account by farmers has still to be investigated in the field.

Introduction

In French Guiana, all year round direct grazing is the main feeding system practised by livestockowners. Natural savannah vegetation is very poor. Grasslands have then been improved with the introduction of more productive exotic species like *Digitaria swazilandensis* or *Brachiaria* spp.; the soils on these former savannah or forest areas are poor and acid (pH: +/- 4). Rainfall is high (>2 500 mm/year) with a dry season extending on 2-3 month. The mean daily temperatures ranges 25 to 30°C with high relative humidity 80-95%. Water deficits are observed between September and November.

These grassland agro-ecosystems are quite fragile and easily invaded by weeds; a situation ecologists in pastoral areas refer to as "degradation" (Daget and Poissonet, 1971). The development of the major sub-ligneous weeds (*Mimosa pudica* and *Spermacoce verticillata*) reduces the frequency of forage species and subsequently animal productivity. According to their phenology and the local climate, these weeds multiply, flower, seed and germinate all year round, and weed control becomes rapidly complex, costly and largely unsustainable. The objective was to find operational sequence (grass management practice) able to protect grassland against invasion without increase of the input.

Approaches and methods for identifying grassland degradation factors
Based on the results of ecological and agronomic studies, we were able to study the interaction between population dynamics and agricultural practices. We opted for a systemic and synchronic approach to assess the universality of the degradation factors. The categories of recorded determinants were:

1. The environment: the soil (pH, aluminium toxicity, water supply constraints, C, fertility?) and infestations of weeds in grasslands;

2. Practices: grassland setting up, maintenance (fertilisation, roller chopping, chemical weeding) and management of pasture exploitation (stocking density, allotment and grazing practices in particular);

3. Grass characterisation: The frequency and the contributions of species. Floristic parameters were recorded at the end of the rainy season, when weed expression reaches a peak. Factorial data were collected during three years on annual average of 61 parcels in 85 agro-ecological stations.

In the final year, we characterised the forage structure, which reflects grass growth (Duru et al., 2001) and interspecific competition (Magda and Jarry, 2000). Cover density and thickness were measured according to contact point methods and bio volume. The data were processed per category of factors in a classical PCA, the overall factorial categories were then submitted to a Hill and Smith’s analysis (1976) which is able to handle continuous with data's without having to transform the continuous data into classes. The data were processed with ADE-4 software (http://biomserv.univ-lyon1.fr/ADE-4F.html).

Results

The "weight" of the practices

There were no significant links between environmental factors (quality of soil, weeds outside sources) and weed frequency in the grassland. Practices appeared to be linked to the weed frequency in the grasslands. The closely linked variables were the "choice of forage species" (the best species being Brachiaria humidicola), "pasture management" (the under grazing is very detrimental, heavily grazed pastures > 900 kg LW ha\(^{-1}\) year\(^{-1}\) appeared better than lightly grazed ones), and "P2O5 applications", but this is not all the practices that were directly linked to the weed frequency. Practices affected above all the structure of the forage canopy. The shape of the forage structures in our analysis was linked to practices and to grassland condition. Dense, thick structures were linked to grasslands that were barely or not degraded, the opposite was also true.

Interpretation, Discussion, and Prospects
The role of the forage structure

Grassland degradation factors were identified and an explanatory diagram of weed development dynamics in pastures was drawn up. These weeds can only be removed through herbicides use. To prevent pasture invasion (without using chemical weed killers), mature weed plant development has to be alleviated. By virtue of their density and thickness, forage structures can provide shade that helps to impair weed seedlings juvenile development. Our analyses of forage structure shows that, depending on the forage species and pasture management methods, forage structures can protect grasslands (or not). The effect of shade on seedling survival is currently being studied through trials on a model weed (Mimosa pudica) at INRA Toulouse, by the Orphée team (M. Duru, D. Magda and team). If this agroecological model is validated, we will be able to move up to the parcel scale (Girard and Hubert, 1999).

The relevance of our results will depend on their adaptability to practices compatible with local livestock farm management. Functional analyses (Moulin et al., 2001) have to be undertaken to check this compatibility through the processing of data concerning the parcels, allotments, stocking rates, rotations, and farmers’ plans.

References


In: Grassland Science in Europe, Vol. 7