

Trees as browse and to support animal production

by M. Baumer

INTRODUCTION

Ligneous plants, which may be trees, small trees, shrubs or undershrubs, are an important component of the fodder resources for livestock and wildlife. The fodder value of their leaves and fruits is often superior to herbaceous plants, particularly in the case of legumes. In arid and semi-arid zones, they provide the largest part of the protein supply during the driest months; for example, it is estimated that, in the Sahel, up to 80% of the protein ration is provided by plants of the *Capparaceae* family during the three driest months of the year.

HISTORY

In the past, trees were commonly used as browse and the cutting of leaves or branches for animal feed is recorded as long ago as Roman times. Sometimes ligneous plants were used for different purposes but their importance as browse plants was only recognised later. For example, *Gliricidia maculata* and *G. sepium* were introduced at the end of the 18th century in Africa as shade trees for coffee, tea and cocoa plantations but it was recognised only a few decades ago that they provide a valuable feed, with 20 to 30% N in the leaves, 14% CF, and digestibility ranging from 50 to 75% according to the type of animal. Their main role now is to serve as a supplement to the natural flora (mixed with 50% grass) for feeding livestock, especially during the driest part of the year.

Erythrina burana was used by Central Ethiopian farmers to shade the coffee plantations. It is very common in this part of the world but its properties became known only recently to scientists. The buranas give a much appreciated fodder for the dry season and the leaves, pods and even bark are palatable to animals. The tree is easy to multiply from

seeds or cuttings (large cuttings of 2m long and 10 cm diameter are usually used). It is therefore a very much appreciated multi-purpose tree in agroforestry.

SYSTEMS OF PRODUCTION

Trees are used both under natural conditions in range areas and under cultivation in farming systems.

Trees on ranges are subject to negative natural selection: animals browse the best first. But they also browse mixtures of browse and herbage, which constitute a more balanced diet with fewer risks of poisoning or intoxication. Animals also play an important role in the dissemination of the seeds through the faeces. The key problems are often the increasing rarity of the valuable species, reduced performance of livestock and poisoning due to increased consumption of "useless" browse.

The concept of usefulness is relative. It varies according to conditions but in the natural environment livestock usually select what is good for them.

In artificial agricultural systems, one of the key problems is the optimum density of tree plantations in relation to the system - direct browsing or cut-and-carry - and the timing and periodicity of their use, with the associated crops (if any) and the types of animals, etc.

NUTRITIVE VALUE

A large percentage of, but not all, fodder trees are legumes. Most of the legumes are rich in crude protein but they are not the only plant family which is rich in protein and a high protein content is not the only factor which makes a good fodder plant; the digestibility, which varies with the type of animal, is of great importance.

Leaves and fruits of ligneous species have a much higher level of digestible protein (DCP) than other fodder sources; in Senegal, it is 180 to 200 g DCP/kg DM in browse compared to 100 to 130 for groundnut leaves and 50 to 70 for leaves and fruits of various herbaceous species (Guérin *et al.*, 1986). Cattle spend a lot of time browsing: 50% in May

and June and more than 30% during the rest of the dry season. The regime is properly balanced when there is a sufficient diversity of ligneous species.

THE ARID ZONE

Acacia tortilis

One of the major difficulties with *Acacia tortilis* (Forssk.) Hayne is that the distribution of the species is very extensive and therefore its provenances are quite different. The nomenclature is still somewhat confused and hybridisation exists in the large species. For most modern authors, several species are distinguished: *A. tortilis*, *A. raddiana*, *A. heterophylla*, *A. spirocarpa*. The most elementary precaution in using seeds or material from any tree of the "tortilis" group will therefore be to enquire about the provenance. In addition, some authors have written that the palatability and the digestibility of *Acacia tortilis* (Forssk.) Hayne subsp. *tortilis* Brenan varied considerably according to the provenance. Its tannin content may be high and cause toxicity problems.

THE SEMI-ARID ZONE

Faidherbia albida

The great value of this tree as browse is due to its production of highly nutritive pods which can easily be kept for the dry season but it may have been considered too much as a miracle tree. At least two sub-species (A and B) are recognized. The production of pods is quite irregular but a tree may give up to 350 kg in a good year. Gassama (1989) has developed a technique of micropropagation from nodes collected on suckers.

Halophytes

In dry areas, whether warm or cold, halophytes are common on salty soils. They have a greater biomass than non-halophytic plants. In Algeria, *Atriplex halimus* produced 3.7t DM/ha compared to 0.8 to 1t DM/ha with *Artemisia herba alba* or *Arthrophytum scoparium*. In 1988, Iran had already planted more than 43 000 ha of rangelands with *Atriplex*

canescens, *A. lentiformis* and *Haloxylon persicum*, so doubling the fodder productivity of its arid and semi-arid territory.

Climatic effects

In Northern Senegal, Poupon (1979) found that climatic variation may have an important effect on ligneous plants. During the 1972 drought, foliation was delayed by 4 to 7 weeks and its intensity was reduced; leaves did not regrow after they were browsed and the majority of flowers did not take shape, resulting in a very low and negligible fruit production.

In the semi-arid zone, there are relatively few species, but a large percentage of them is used as fodder and especially as browse by the animals. Wildlife is relatively more important, at least potentially, than domestic livestock. *Acacia* and related genera are the most important browse species, with most of the Capparaceae in the arid zones themselves, together with other genera such as *Balanites* and *Albizzia*. Le Houérou (1977) has established that in *grosso modo* in the Mediterranean basin each millimetre of rainfall was producing 4 kg of aerial biomass or 2 kg of palatable DM or 0.66 feed units (FU) and that in the Sahelian zone the production of one millimetre of rainfall is roughly equivalent to 2.5 kg of aerial biomass or 1 kg of palatable DM or 0.40 FU.

THE SUB-HUMID ZONE

Leucaena leucocephala

Although this small tree has been used with success in semi-arid zone, it is in the humid and semi-humid zone that it gives the best results. Like the two other species already briefly considered, the problem of lineage is very important. Many varieties have already been isolated and are being used. The big danger with the species is its extremely broad distribution through agroforestry and other development projects, which makes it a particularly sensitive species to diseases and parasites such as psyllids. The presence of mimosine in several cultivars has created problems with some animals, now better controlled by "vaccination" with rumen fluid from resistant livestock. The odour and taste given to milk

of animals fed with *L. leucocephala* may be avoided easily by preventing the animals from eating *Leucaena* for two hours before milking. Inversely, the quality of the meat may be influenced by the nature of the feed: *pré-salé* mutton, produced for example in the Bay of the Mount Saint Michel in France is an example.

The toxicity of mimosine in *Leucaena* is comparable to many other similar phenomena caused by the consumption of legumes and other browse. *Gliricidia sepium*, for example, is reported in some parts of the world as having an anti-nutritional effect: livestock are fond of it but do not grow when eating it even in large quantities. Perhaps inoculation of rumen fluid from resistant animals could help to cure this. These anti-nutritive substances seem to appear in some geographical regions or with some specific races or lineages of animals. It is embarrassing when some provenances of *Gliricidia sepium* were recognised as giving as much as 12 to 20 kg DM/tree/year in Maseno (Kenya).

These production figures are surpassed by the production of *Calliandra calothyrsus* which, in Yaoundé (Cameroon), reached 4.69t DM/ha at one year of age with 10,000 trees/ha when *Leucaena leucocephala* was giving 3.78t DM/ha, *Gliricidia sepium* 2.30t DM/ha and *Racosperma auriculiforme* 1.56t DM/ha.

Cutting ligneous vegetation may sometimes increase the total available biomass; this is why the American and Australian ranchers have, for decades, suppressed ligneous vegetation as much as possible from their ranches. But other research has shown the positive action of ligneous vegetation on the total biomass productivity and on its qualitative amelioration.

THE HUMID ZONE

Guilelma gasipaes

The peach palm, *Guilelma gasipaes*, is a real multi-purpose tree species. In addition to providing the Indians of Amazonia with a fruit which gives oil and starch, it is also an important source of browse for the animals. The fruits, given mainly to pigs and poultry, are too small for human consumption, damaged or have some malformation. They are left on the

tree until they become overripe, otherwise it has to be cooked as it contains a diastasis which inhibits an other proteolytic enzyme which is necessary for the proper utilisation of protein by animals.

Jessenia battaua

The management of the bataua palm, *Jessenia battaua*, from South America, which exists only for the time being in wild state, seems to be theoretically comparable. But the value of its oil, which costs ten times more than the oil of the oil palm tree, could modify its potential for management.

THE ROLE OF BROWSE TREES

A publication by the Commonwealth Agricultural Bureau in 1947 (Whyte, 1947) states: "Specialists of herbaceous pastures should be modest when they realise that there are more many animals feeding on trees and shrubs or on plant associations where these play an important role than on pastures based on herbaceous legumes or grasses". Goats and camels feed essentially on ligneous plants: camels in Northern Kenya spend 50% of their grazing time in browsing plants at a height of over 1.6m.

There are ligneous plants which provide important quantities of fodder although their main importance lies in other products. In the Salmé area in the medium range elevations of Nepal, forest and wild trees provide the most important part of the available fodder. Each tree has its owner and some of them are shared by several. There are traditional rules for the period and the frequency the tree is to be lopped for browse. Sometimes the products of a cutting are for sheep, sometimes for goats, sometimes for cattle. In addition, there are trees and shrubs elsewhere which are specially protected, or even planted and cultivated, for honeybees, silkworms or other small animals; the economic returns from these small animals are usually greater than those from larger ones.

In the Chinampas of Mexico, trees and vegetables are grown on strips of land. Many of the trees are multi-purpose species, but most of

them produce fodder. A similar system is in use in the eastern marshy lands of China; here, on the strips of land, livestock (usually goats) are partly bred and fed on the foliage of the trees and shrubs, mainly *Populus* and *Salix* species. The reason for breeding livestock in such this environment is to provide the soil with manure, which is necessary for the production of vegetables and mushrooms. In the Ban Tré Province of Vietnam, a comparable system has been studied where the leaves trees are used to feed fish.

The oldest agrosilvipastoral system recorded in the world, the combination of olive tree, cereal and sheep breeding, is common all around the Mediterranean. From the browse and fodder point of view, the olive tree not only provide browse when it is cut (twigs and leaves) but it favours the growth of finer and tender grass in its shade.

OTHER ROLES OF TREES

In addition to their role in production of browse, trees have other production and service role. They produce wood for fuel and building purposes. They give food, fibre, drugs, fruits, pollen, nectar, dyes, gums, waxes, resins, etc. They play a very important role as wind-breaks, in providing shade and protection against heat and cold and in reducing erosion.

FUTURE RESEARCH

A lot of work remains to be done in the area of trees and shrubs as browse species. One of the first requirements is a comprehensive list of browse species and their foliar physiology should receive more attention. It could be useful also to select lines of trees which keep their leaves longer than usual on the stem.

More should be known on the management of browse species. This would make it possible to avoid the disappearance of some species by over-utilisation, as occurs with *Terminalia avicennioides* in the region of Maradi (Niger).

Combining research on meat, browse and wood production may yield interesting prospects. In the Mediterranean zone, consideration

should be given to:

- chestnut plantations for fruits
- research on controlled fire and clearance of land by grazing with llamas or goats
- study of the effect of animals on trees in order to better quantify the tree/animal interaction
- quantitative studies of browsing and grazing, like in New Zealand
- identification of the best fodder trees for a specific zone

The response of the ligneous and herbaceous biomass to the density of grazing animals is also an important area. Animal preferences for certain species should be better investigated. The preference may vary with external or internal conditions and may not correspond to the most productive choice from the point of view of plant growth. Allelopathic phenomena also deserve systematic investigation.

CONCLUSION

As a conclusion, one can imagine the ideotype of the perfect browse tree as follows:

- **Adaptability:** the species should be easily established and maintained in good condition in the selected environment.
- **Palatability:** it should be readily accepted by animals; different animal species have different taste and the taste of a species varies with age and with physiological condition. The ideotype should remain palatable in all circumstances and for every type of animal.
- **High nutritive value:** sometimes the palatability is high but not the nutritive value. These two characters have to be evaluated separately.
- **Growth and productivity:** it is economically and practically important that the maximum quantity of feed is produced on every hectare of land.
- **Hardiness and resistance:** the plant should be capable of resistance to intense utilisation and to varied use (browsing, lopping, leafing, etc.). It should be able to recover quickly after intense utilisation and to form leaves again after these have been browsed or lopped.

- Shade tolerance: the ideotype should be able to grow in the shade of other ligneous plants in order to maximise the total production
- rooting :in order not to cause any inconvenience to other crops, it should be deep rooting, which allows it to absorb essential nutrients from a greater depth.
- Non-toxicity: the ideotype should not be toxic or noxious to animals. It should not have spines, hooks or spurs, nor have allelopathic properties, if it is to be associated with crops.

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