"Leucaena leucocephala as a multipurpose tree in crop and livestock production systems"

Charles K. Ssekabembe

Nomadic Peoples, Number 31, 1992

Nomadic Peoples 31:1992, Ssekabembe, pp.119–122

Leucaena leucocephala as a Multipurpose Tree in Crop and Livestock Production Systems[1]

Charles K. Ssekabembe

The increasing population in many parts of Uganda has led to increased tree cutting in order to open more land for agricultural production, but the planting of new trees by farmers is limited. One limitation to tree planting is that farmers prefer to invest their resources in shorter term gains from agricultural land use rather than in long-term benefits from tree-based land use systems (Huxley, 1981). In order for farmers to adopt land-use technologies based on tree planting, the basic needs of the farmers must be addressed and these include food, water, energy, shelter, raw materials for local industries, cash savings and investment and social production.

Land-use systems which combine agricultural crops with trees and shrubs and livestock may be a solution to this (*ibid.*), because trees can provide multiple uses to the farmers. Livestock production partly depends on increased production of forage for feeding, but farmers need simultaneously to address some of the other needs as well. Thus, the use of browse shrubs and fodder trees is now seen as a key way of supplementing animal feed. The objective of this paper is to give an overview of the nutritional value of a fodder tree, Leucaena leucocephala, and the ways in which it could be used on farmland and managed to provide forage and other outputs to farmers.

Leucaena leucocephala and Animal Production

Trees and shrubs can extend the availability of feed materials into unfavourable seasons in a very significant way, and this is especially important in arid and semi-arid regions. In the case of L. leucocephala, the available feed materials can be in the form of refuse from pruning which is not only used for mulch and green manure but also for supplementary high quality browse for small ruminants. In view of the conditions of rangelands in arid and semi-arid zones, supplementary browse by Leucaena (16 percent crude protein) is very important since protein content in the diet is the most limiting factor affecting live weight gains of livestock (Torres, 1983).

The nutritional value of Leucaena appears to be considerable. Torres (1983) quotes Jones (1973) who indicated that, in terms of beef fattening, Leucaena is comparable with concentrated protein sources, in limited amounts. Leucaena was also found to improve milk production but tainted the milk produced; this can be reduced by preventing cows from browsing Leucaena for several hours before milking. On the other hand, Malynicz (1974) found that when Leucaena was substituted for a commercial ration for growing pigs, the weight gain and feed conversion ration were adversely affected at levels higher than 20 percent.

The major limitation of Leucaena as forage is the presence of mimosine the degradation products of which depress cell division in animals which are unable to detoxify it (Humphrey, 1978, quoted in Kajuni, 1986). Hawaiian goats have microbes in the rumen fluid which can degrade mimosine and hence overcome Leucaena toxicity (Jones, Ford and Magarrity, 1984). In order to minimise Leucaena toxity, the National Academy of Sciences (NAS, 1977), advises that the proportion by dry weight of

Leucaena in the animal feed for poultry and pigs should not exceed 10 percent and for cattle, sheep and goats it should not exceed 30–50 percent.

Siting and Management of Leucaena for Multiple Outputs

Leucaena does not thrive on acid soils unless lime is applied, and its growth is greatly hampered on sandy and highly baked soils—ultisoils. Therefore, farmland with such soils may not be suitable for Leucaena. The tree does well in humid lowlands with high rainfall but the author has also observed good performance of the tree under semi-arid conditions. This is an indication that L. leucocephala can be planted in many parts of Uganda.

The soil conservation benefits of L. leucocephala can be utilised in highlands with rolling topograhpy and steep slopes, which are increasingly being brought under cultivation. Such areas exist in Kigezi District, in southwestern Uganda. Leucaena is traditionally planted in contour hedgerows for erosion control and soil improvement in Indonesia. Indirect terraces are formed and the washed-off soil is collected behind the hedges. The lopping and pruning from the hedgerow could also provide mulch to aid in preventing sheet erosion between trees. Such improvement in soil erosion control should result in improved soil fertility with positive concomitant effects on the yield of agricultural crops, as well as the tree itself. The spacing of trees in the hedgerow for erosion control should be close, up to 30 cm. But this may not be practical in dry areas because the trees would compete for the limited available water leading to severe tree deaths along the hedgerow.

The productivity of Leucaena will depend on the management strategy adopted. Table 1 shows the effect of various management practices used. Generally, narrow alleys give more total dry matter in the form of pruning refuse that can be used for fodder, mulch or green manure, than widely spaced hedgerows. When the pruning of Leucaena is delayed and with higher cutting heights, the tree provides more herbage for green manure or mulch. For forage production, earlier and/or frequent pruning at a low cutting height is preferable because it results in higher nitrogen content. However, there is need for research to determine whether mimosine content varies with the age or height of the tree and different cutting regimes. While tall stumps produce more coppices for green manure, mulch or fodder, the low cutting heights produce long coppices that can be used for fuelwood, stakes or building poles.

Most of the experimental evidence cited above was obtained when the hedgerows were managed in association with agricultural crops—hedgerow intercropping. In some instances, the farmers may wish to pay particular attention to the effect of the tree on the agricultural crop besides the amount of herbage produced for green manure, forage or fuelwood stakes. For instance, the wide alleys that give less biomass from the trees, actually give a higher yield of the agricultural crop, at least in the short-term (Rachie, 1983). Hence, the farmer may opt to use wider alleys. Similarly, a farmer with soil fertility problems may delay pruning time and use higher cutting heights that give more herbage for green manure, instead of adopting earlier or frequent pruning at lower cutting heights that give better quality forage for livestock feeding. A farmer may also wish to use a low cutting height in order to obtain long coppices for fuelwood (low cutting height in narrow alleys also reduces the shading of the intercrops). The results of Redhead, Maghembe and Ndunguru (1983) also seem to indicate that L. leucocephala intercropped with maize can produce small good-sized poles for fuelwood for village homes while that intercropped with beans is better for fodder or mulch production. This is because the Leucaena intercropped with maize is taller, unbranched and without flowers compared to that in monoculture or in association with beans.

Table 1. *The effect of various management practices on the relative outputs of Leucaena leucocephala*

Management regime	Comparison	Effect on output	Notes/ comment	Reference
Alley width	Narrow vs. wide alleys	More biomass from narrow alleys	Due to higher tree population	IITA, 1992
		Total dry matter less in wider alleys but with higher percentage forage fraction	Stems also thicker in wider alleys	Guevara, 1976
Pruning time	Early vs. late	Progressive decline in forage yield when pruning is delayed	4 months when 120–150 cm tall was best, in Hawaii	Takahashi and Ripperton, 1949
		Total dry matter and total nitrogen yield increased with delayed pruning	This was associated with less percent forage fraction and less percent nitrogen content	Guevara, 1976
Pruning/ cutting height	Low vs. high	Total herbage yield more from taller stumps	Trees could survive with up to 715 cm stumps	Vergara, 1982
		More coppices from taller stumps	Coppices were longer from low cutting height	Vonk, 1983
		Lowest cutting heigh best in terms of yield and quality of forage	Cutting height ranged from 715–90 cm	Alferez, 1980
Frequency of pruning	Frequent vs. long intervals	Frequent cutting decreased total dry matter and total nitrogen yield	Frequent cutting intervals gave higher percent forage fraction and higher percent nitrogen content	Guevara, 1976

Suggestions

Besides managing L. leucoephala in hedgerow intercropping systems, there are several other ways in which the tree can be used on farmland. Some of these need experimental verification and others involve management in ways described above. Where terraces for controlling soil erosion are constructed, for instance in Kigezi District, the steeper parts of bench terraces need to be kept under permanent grass cover. It may be desirable to add fodder trees the roots of which will stabilise the soil even more. One has to decide whether to plant the tree at the top of the steep part or at the bottom; trees planted at the top may reduce water run-off better. The established trees can then be managed for forage, green manure or fuel wood.

In Uganda, contour bands for erosion control are commonly planted with Paspalum grass. Fodder trees could also be planted on the contour bands to stabilise them further. Leucaena hedgerows could be planted around individual farmer's plots to serve as boundaries which are then managed for forage or green manure. Near homesteads the arboreal varieties of Leucaena can be planted to provide shade, and when branches are pruned they would provide herbage and fuelwood; the coppices would provide good forage. The use of Leucaena as a live fence for paddocks or cattle *bomas* could be explored. In order to avoid feeding on the young trees, the animals should only be introduced when the fence trees are mature and tall enough not to be grazed *in situ*. The trees would provide shade, and the lopped branches would provide herbage and fuelwood while the coppices would be harvested for forage.

Some of our farmers cultivate land continuously and rest it only when there is evidence that it is exhausted, resulting in low crop yield and the establishment of weeds such as Imperata cylindrica. The farmers often graze their livestock on such resting land which has few nutritious plants. If Leucaena was planted on such land and lightly grazed and/or left as a wood lot, it would improve the soil fertility faster. In order to avoid soil compaction (which would encourage soil erosion) some of the Leucaena used on the farmland in the above ways should be harvested on a "cut and carry" basis (zero grazing). Care should also be taken to ensure that the tree does not become a weed on the farmland or compete adversely with agricultural crops on the farm.

Note

[1] This article was originally published in P.R. Henderlong *et al.* (eds.) 1992, *Pasture Management for Livestock Production in Uganda. Proceedings of the First Uganda Pasture Network Workshop held at Makerere University, Kampala, 14–17 December, 1987.*

References

Alferez, A. C. 1980, "Utilisation of Leucaena as Organic Fertiliser to Food Crops". Second SEARCHA Professional Lecture, December 16, 1980.

Guevara, A. B. 1976, *Management of Leucaena leucocephala (Lam.) de Wit for Maximum Yield and Nitrogen Contribution to Intercropped Corn.* Ph.D. Thesis, University of Hawaii, Honolulu.

Huxley, P. A. 1981, "Agroforestry—Developing a New Research Discipline", in *Proceedings of Kenya National Seminar on Agroforestry.* Nairobi: ICRAF.

Jones, R. J., C. W. Ford and R. G. Magarrity 1984, *Conversion of 3,4—DPH by Rumen Bacteria.* Leucaena Research Reports 5.

Kajuni, A. R. 1986, "Leucaena Toxicity Trial at Liti Tengeru", *The PANESA Newsletter,* No. 2 (May):20–22.

Malynicz, G. 1974, "The Effect of Adding Leucaena leucocephala Meal to Commercial Rations for Growing Pibs", *Papua New Guinea Agric. J.,* Vol. 25. Nos 1 and 2:12–14.

NAS (National Academy of Sciences) 1977, *Leucaena: Promising Forage and Tree Crop for the Tropics.* Washington D. C.

Rachie, K. O. 1983, "Intercropping Tree Legumes With Annual Crops", in *Plant Research and Agroforestry.* Proceedings of a Consultative Meeting held in Nairobi, 8–15 April, 1981.

Redhead, J. F., J. A. Maghembe and N. J. Ndunguru 1983, "The Intercropping of Grain Legumes in Agroforestry Systems", in *Plant Research and Agroforestry.* Proceedings of a Consultative Meeting held in Nairobi, 8–15 April, 1981.

Takahashi, M. and J. G. Ripperton 1949, *Koahaole (Leucaena glauca), its Establishment, Culture and Utilisation as a Forage Crop.* University of Hawaii. Agric. Exp. Station Bulletin.

Torres, F. 1983, "Role of Woody Perennials in Animal Agroforestry", *Agroforestry Systems,* 1:131–163.

Vergara, N. T. 1982, "New Directions in Agroforestry: The Potential of Tropical Legume Trees", in Vergara (ed.), *Sustained Outputs from Legume-Tree-Based Agroforestry Systems.* Honolulu: East-West Centre.

Vonk, B. R. 1983, *A Study on Possible Tree Species for the Kathama Area.* Nairobi: ICRAF (in co-operation with Wageningen Agricultural University).

Charles K. Ssekabembe, Ph.D., is Lecturer in Agronomy/Agroindustry at the Makerere University.