Effects of the Grazing Animals and the Cutting on the Production and the Intake of a Morus alba-Subterranean Clover Association.

P. Talamucci, A. Pardini, G. Argenti

Department of Agronomy and Land Management,
University of Florence - Italy

Morus alba is native to temperate areas of Asia, where it was first planted for sericulture, feeding of the silkworm. Nonetheless, its uses were extended to firewood, timber, windbreaks, live fences, shade for food crops and forage for cattle and sheep in specialised plantations (ICRAF, 1999).

Nowadays it is cropped as multi-purpose tree in Europe and temperate Asia, as well as in subtropical and tropical climates, including tropical highlands in Africa, especially Tanzania and Kenya (Mbuya *et al.*, 1994; Boschini, 2000).

Morus alba is an important component of combined pastoral systems oriented towards the regularisation of the seasonal forage availability and the diversification of the pastoral resources (Talamucci *et al.*, 1990; 1996; Talamucci and Pardini, 1999), both these aspects are important for the variability of land use and consequently for the conservation of biodiversity, and thus for the sustainability of production. The interest of this tree species is due particularly to its plasticity of use, good palatability, chemical composition and productivity.

Early *Morus alba* introduction in Italy was done for silkworm feeding and for tutoring vines. More recently its use has been attempted in some farms with mixed cattle-sheep husbandry, were

it is planted in the form of the alley cropping, known in the Mediterranean Basin since the times of the Roman Empire, associated with grasses or sown pastures of annual legumes (Talamucci and Pardini, 1993; Talamucci et Al., 1997). Cattle use the upper part of the branches and sheep graze the sward and the lower leaves of the trees. These systems do not resolve completely the problems of forage availability for both species throughout the year: in winter cattle have difficulty to graze the pasture because it is too short, and in summer sheep have difficulty to get leaves from the tallest branches. With this system, both animal species require supplementation in the critical seasons, with hay or silage produced on farm or purchased.

Further more, livestock numbers are being reduced in Italy due to the European Union policies, and farms prefer to specialise in sheep. Some of them even prefer to switch completely to wildlife for hunting or tourism.

Sheep require a pastoral system with green forage easily available in summer. Such a system is largely used abroad (Nair, 1993), where leaves are made available by lopping trees weekly throughout the summer.

The aim of this research was to compare traditional and alternative management systems of *Morus alba* and their effects on animal diets in Central Italy.

Materials and Methods

Twelve hectares of *Morus alba* cv. "Kokuso" associated with *Trifolium subterraneum* cv. "Woogenellup" plus *T. brachycalycinum* cv. "Clare" were established in a private farm of Central Italy with fertile alluvial soils. Several experiments were conducted on that association and data were recorded for twelve years. The present article refers to data collected in the last trial, carried out between 1996 and 1999, thus, in a mature plantation.

Morus alba plants were micro-propagated and planted in October (Northern autumn) in rows 5m apart with 3m within rows. The mixture of subterranean clovers was sown soon after at the rate of 30kg/ha. Reseeding was done every 4-5 years.

The following treatments were compared in the association:

- Cutting season: a) in February (winter) in order to stimulate the production of leaves in spring and to limit the height of the crown, or b) in August (summer) as an immediate supplement of feed for the animals.
- Grazing animals: a) only cattle; b) only sheep; c) cattle and sheep.

All interactions were investigated, using fenced sectors in a split-plot design.

The association was managed as follows. Animals grazed all through the year, and were supplemented with hay when forage availability was not sufficient to satisfy their estimated needs. Sheep grazed all through the year and cattle only in summer to browse the upper leaves beyond the reach of sheep. Cattle were kept in different pastures for the rest of the year.

Two rows of mulberry were lopped at the beginning of the week, in the sectors with the summer cutting treatment, for a period of 90d. There were twenty rows of mulberry per treatment. Non-grazed lines were utilised for measurements.

The cattle were Chianina, a local tall and strong breed, resistant to extreme climates and well adapted for extensive grazing. Sheep were Sarda, milking type breed very common in the area. The mean annual stocking rate was 1.0 Livestock Unit. (one adult cattle of 500 kg or 6 sheep of the above breeds).

Measurements:

1. Forage production of subterranean clovers: monthly measurements with exclusion cages.
2. Forage production of *Morus alba*: weekly measurement with exclusion cages.
3. Forage residuals of subterranean clover and *Morus alba*: weekly measurements out of the cages.

Intake was estimated from the difference between forage availability and residuals.

Results and Discussion

Dry matter production (Table 1)

Morus alba. On average, sheep and sheep plus cattle allowed higher leaves yields (9.5 and 9.3 t.ha-1 respectively) than cattle alone (8.5). This was probably due to more than one reason. Sheep caused less stress to mulberry shrubs because they are shorter and ingest fewer leaves than cattle. They also competed with cattle and reduced their intake when grazing together. Moreover, sheep consumed more clover than cattle due to the grazing habits. This higher clover intake reduced competition with the shrubs. Spaced rows and good soil fertility suggest that the strongest competition was probably for water.

Morus yields in plots browsed by cattle were significantly higher with the winter cutting than with the summer cutting. This difference was probably due to the complete removal of leaves and branches in the summer. Mulberry shrubs might have mobilised root reserves to overcome this damage to allow re-growth during the autumn. Reserves were then not available for the early growth in the spring.

After the winter cut, root reserves are utilised for early spring growth. They are replenished by the summer and can maintain vegetative activity in autumn. The autumnal vegetation is maintained by using only part of the root reserves and remain available for the re-growth after the winter cut.

Sheep had the same positive effect on *Morus* cut in winter. This probably because the shrub re-grows well after the winter cut and sheep are able to consume only the leaves in the lower part, this happens especially in summer when the animals are hungry but most of the leaves are too high. This reduces the stress to winter only and nutrients are stocked again in the roots during the following spring.

On the contrary, nutrients are not stocked in the root system if *Morus* is cut in summer and the trees have a late and slow re-growth in spring.

Grazing with mixed species does not result in forage production significantly different from only sheep. In fact the cattle do not utilise care much for tree leaves while there is abundant and green pasture.

On average, winter cut allowed higher yields of *Morus alba* leaves compared to the summer cut. This was probably due to the longer period left to plants to form new reserves after last stress. Summer harvesting can reduce plant survival. Cutting season did not affect significantly clover yield.

The results of the interaction between the two analysed parameters (cutting season and grazing species) are reported here after.

Table 1. Mean dry matter production (t/ha) of *Morus alba* and clovers.

	Morus alba	**Clovers**	**Total**
Cattle - Winter cutting	9.5b	5.5c	15.0c
Cattle - Summer cutting	7.5c	4.5c	12.0d
Sheep - Winter cutting	10.5a	7.5b	18.0a
Sheep - Summer cutting	8.5b	8.5a	17.0ab
Cattle+sheep - Winter cutting	10.3a	6.3b	16.6b
Cattle+sheep - Summer cutting	8.2bc	7.9a	16.1b

Values having different letters are significantly different ($P < 0.05$).

Subterranean clover. Clover yields were higher when mulberry shrubs were cut in winter than in summer. This is probably because the winter cut limits the competition for light, water, nutrients during the spring which is the most important season of clover growth.

Subterranean clover yields were small when cattle grazed because these animals graze efficiently this legume only when it tall enough. Cattle return to the area already grazed after a minimum period of two weeks, when the clover grown back. This sort of self-controlled rotational grazing causes senescence of green tissues in lower layers of sward canopy and, in turn, reduces the photosynthetic efficiency.

Sheep stimulated higher pasture production than cattle. Probably the intensive grazing has favoured the young and more efficient plant tissues. Sheep also favoured seed production, crop persistency and productivity in the following years. Clover productivity was higher with the summer cut.

The combination of cattle and sheep allowed yields very similar to those with sheep only. This suggests that sheep impact shrubs more than cattle in the tested conditions.

Total dry matter production. Total yield was favoured by the presence of sheep, that have grazed intensely the clover and did not produce stress to the shrubs.

Forage availability *(Table 2).*

Forage availability in the critical season was different according to cutting season and plant species. *M. alba* availability was zero in winter and maximum in summer. Clover was available in good quantity in winter and a minimum was also present in summer as stalks and seeds. Forage availability of the association was more balanced than the two separately.

Table 2. Forage availability in winter and summer.

	Morus alba		**Clover**		**Total**	
	winter	**sum.**	**winter**	**sum.**	**winter**	**sum.**
Cattle - Winter cutting	0	25	10	4	10	29
Cattle - Summer cutting	0	20	11	3	11	23
Sheep - Winter cutting	0	74	14	2	14	76
Sheep - Summer cutting	0	60	12	1	12	61
Cattle+sheep - Winter cut.	0	13	13	1	13	14
Cattle+sheep - Summer cut.	0	14	10	1	14	15

Biomass intake *(Table 3)*

Morus alba. Mulberry intake was higher with cattle (6 t/ha, average of cutting season) and sheep + cattle (5.5t/ha) than with sheep only (4.7t/ha). Animal height made the difference. Differences in mulberry intake were not significant throughout. Only sheep on shrubs cut in winter had lower intakes (2.3 t/ha). Mulberry intake was influenced by cutting season and animal species.

Summer cut favoured mulberry intake because tall branches were grounded and thus available also to shorter animals. Also, clover intake was favoured by summer lopping. probably because green forage encouraged (dried) pasture consumption.

Table 3. Total, *Morus alba* and subterranean clover intake (t). Percentage (%) of ingested biomass on total production.

	Morus alba	**Sub–clovers**	**Total Intake**	**% intake**
Cattle - Winter cutting	6.5a	2.5c	9b	60b
Cattle - Summer cutting	5.5a	2.2c	7.7c	64b
Sheep - Winter cutting	2.3b	6.5b	8.8bc	49c
Sheep - Summer cutting	7.0a	7.6a	14.6a	86a
Cattle+sheep - Winter cut.	4.5a	5.3b	9.8b	59b
Cattle+sheep - Summer cut.	6.5a	6.7a	13.2a	82a

Values having different letters are significantly different ($P < 0.05$). The statistical analysis of values expressed in percentage was preceded by angular transformation according to Bliss.

Subterranean clover. Clover intake was proportional to leaf yields. Intake was influenced by animal species, but not correlated to mulberry cutting season.

Total intake. Total intake was higher with branches cut in summer with sheep (86 %) and with cattle + sheep (82.0 %). Maximum waste of leaf forage was on shrubs cut in winter with sheep (48.9%).

Conclusions

The larger variability of climatic parameters due to global climate changes will influence the reliability of yields. Increased diversification of resources will become more important,

especially in forages because of their sensitivity to climatic variations compared to other crops.

Higher diversification will imply more complex management of pastoral systems. The simplest grazing technique should be defined for each resource in order to simplify management. For the same reason, species number should be reduced.

Morus alba might be very interesting as a strategic resource for dry summer periods while subterranean clover for the winter. The results of this trial show that simplifications in management can be achieved by summer cutting and, contemporarily, by sheep grazing only.

Cutting season may influence mulberry growth, thus leaf yield and, in turn, on subterranean clover yields. Winter cut increased *Morus* production and reduced subclover. Cutting season will be less important in farms where cattle and sheep are still kept. Winter cutting should be chosen when plantation survival is of primary importance. Summer cutting when higher forage is sought.

Cattle benefit if shrubs are cut in winter. On the contrary, sheep have greater intake if shrub branches are lopped in summer. Mixed herds are the best users, but imply a more complicated management.

Further investigations could contribute to resolve questions. A first question is plantation persistence. Yields were reduced with summer cutting and this could suggest higher plant stress and possible reductions of shrub life.

References

Boschini, C. 2000. Establishment and management of mulberry for intensive forage production. This conference.

ICRAF 1999. Agroforestree database. CD-Rom. Nairobi, Kenya.

Mbuya, L.P.; Msanga, H.P.; Ruffo, C.K.; Birnie, A. and Tengnas, B., 1994. Useful trees and shrubs for Tanzania. SIDA (Swedish Intern. Develop. Auth.), Nairobi, Kenya, 542p.

Nair, P.K.R. 1993. An introduction to agroforestry. Kluwer Academic Publ., 499p.

Talamucci, P. and Pardini, A., 1993. Possibility of combined utilization of *Morus alba* and *Trifolium subterraneum* in Tuscan Maremma (Italy). VII meeting FAO sub-network on "Mediterranean Pastures and Fodder Crops", Published on REUR technical series, 28: 206-209.

Talamucci, P.; Pardini, A. and Piemontese, S. 1990. Primi risultati sul comportamento di alberi e arbusti foraggeri nella Maremma toscana (Italia centrale). Proc. Agrimed meeting held in Sassari I:207-218.

Talamucci, P.; Pardini, A.; Argenti, G. and Staglianò, N. 1996. Theoretical sylvo-pastoral systems based on seasonal distribution of diversified resources in an Italian Mediterranean environment. In: "Temperate and Mediterranean silvopastoral systems of Western Europe", INRA, Versailles, p183-194.

Talamucci, P.; Pardini, A. and Argenti, G. 1997. Mediterranean climate - Mediterranean agroforestry. Agroforestry Today, 9(3):28.

Talamucci, P. and Pardini, A. 1999. Pastoral systems which integrate woody plants. Invited paper at the Occasional Symposium of the European grassland federation, Thessaloniki, Greece, 24-30 May 1999. p331-341.