

## **Comments on: Integrated animal production in the oil palm plantation by S. Jalaludin**

**From Danilo Pezo Quevedo <dpezo@cariari.ucr.ac.cr>**

### **Comments on Integration of Animal Production in Coconut or Oil-Palm Plantations (Reynolds and Jalaludin's papers)**

The papers submitted by Reynolds and Jalaludin on the integration of animal production in coconut and oil palm plantation systems, are good examples illustrating the benefits of the combination of fruit woody perennials with pastures and grazing ruminants, but also of the complexity of the interactions occurring in such systems, which needs a multi- and/or interdisciplinary approach to be appropriately studied, as well as to modify the so-called "standard" research methodologies. For example, to evaluate pasture germplasm for pastoral systems, emphasis is put on attributes such as adaptation to biotic, soil and climate restrictions, forage yield, quality, and persistence under grazing, among others. As in silvopastoral systems there is at least one additional stratum of woody perennials, the evaluation of pasture germplasm to be introduced in such systems should consider their tolerance to potential interferences made by woody perennials (e.g., light transmission, nutrient and water competition, allelopathy, etc.); but some of these interferences may also function on the other direction (positive or detrimental effects of pastures on the woody perennials).

In both papers "nutrient cycling" is briefly discussed, but stressing the role of animals, and mostly with reference to the pasture understorey which is grazed and eventually partially returned through animal excreta. I wonder if the amount and quality (potential degradability) of the litter fall from those palms, and/or of the detached roots is not important (or has not been measured). Any way, if the litter coming from these palms is poor in nitrogen, it is expected that animal excreta will have a synergistic effect on organic matter mineralization.

Let me contribute with some information regarding pasture production and litter fall nutrient cycling in two silvopastoral systems studied by CATIE in Costa Rica, which may give an idea of the magnitude of these interactions with other woody perennials. Bronstein (1984) associated

African stargrass (*Cynodon nlemfuensis*) to either a timber (*Alnus acuminata*) or a foliage/fuelwood legume tree (*Erythrina poeppigiana*), the latter being pruned every 6 months. In these systems the amount of N, P and K cycled through fallen litter were 64.3, 6.2 and 29.3; and 185.6, 12.2 and 64.1 kg/ha/year, for *A. acuminata* and *E. poeppigiana*, respectively. Under these systems, grass yields were 1.5 and 3.5 times greater when associated to such trees than in monoculture, and broad-leaf weeds invasion was almost 3.0 times greater when African stargrass was grown in monoculture.

In the second study (Bustamante, 1991), seven grasses (identified as promising based on standard germplasm evaluation techniques) and African stargrass as a control, were evaluated in monoculture or associated to *E. poeppigiana* trees, which were pruned every 6 months, but pastures were harvested every 8 weeks. In this study, six grasses (*P. maximum* CIAT 16061, *P. maximum* CIAT 16051, *B. brizantha* cv. *Marandu*, *B. brizantha* CIAT 664, *B. humidicola* CIAT 6369, and *Cynodon nlemfuensis*) yielded 16.6 to 34.2% more biomass when grown under trees than in monoculture. In these species, positive effects of nutrient cycling overcome detrimental effects of shade (40% light interference in average). Only dwarf elephant grass (*P. purpureum* cv. *Mott*) and *B. dictyoneura* CIAT 6133 showed higher yields (10.7 and 11.4 %) in monoculture. As indicated by other authors (Wilson and Wong, 1982; Norton et al, 1991), in both studies, greater CP contents were observed when pastures were grown under trees, but no consistent effects were observed for IVDMD.

Finally, I would like to say that most of the future work needs identified by Reynolds for animal production/coconut plantation systems, also apply for other types of silvopastoral systems including timber or fuelwood trees, but I would add some modelling efforts, considering few trees as representative of the diversity of canopies and/or purposes of woody perennials, as well as pasture components and growth habits. These type of studies not only require strong collaborative work among pasture agronomists, foresters, animal nutritionists, soil scientists and economists, but also North-South cooperation.

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**From Chin Fook Yuen <chin@jph.gov.my>**

### **Comments on feed resources from large scale plantations**

The rubber and oilpalm plantations in Malaysia cover an area of 4 million hectares or more, providing a large quantity of forage dry matter, protein and energy in the form of the ground or undergrowth vegetation. In the early years of the trees, the ground vegetation presents a diverse collection of plants for livestock (a survey by Chen et al. 1974 found 60 different species) consisting of sown legume cover crops (normally *Centrosema pubescens*, *Pueraria javanica* and *Calapogonium mucunoides*) and naturally growing weed grasses, broadleaves and ferns. The feeding value of some areas of ground vegetation is comparable or even better than that of improved grasses cultivated in open pastures locally. Lane and Mustapha, 1983; Chen, 1990 and Chin, 1991 presented data to support this. The crude protein (CP) content of grasses under the plantation ranges from 8% to 17%, broadleaves weeds from 13% to 22% while that of sown legumes ranges from 15% to 18%. Higher Metabolisable Energy (ME) levels can also be obtained from this 'mixed pasture' under the trees.

Sustainable forage production as the tree crop matures (6 -7 years in the case of both rubber and oilpalm) has been the major concern in this tree crop/livestock integration system. The closing canopies due to trees maturing limits the amount of sunlight penetrating to the ground, to as low as below 10% of the light. Standing biomass can decline from 2000 kg/ha during the first 3 years to less than 1000 kg/ha by the 7th year. However, this fact, along with a consequential need for a lower stocking density under mature trees, is already well accepted and is an important consideration incorporated into the management system by livestock integrators. These integrators even graze beef cattle at a stocking density of 1 animal to 4 hectares in mature areas, successfully and viably. Besides, as trees mature, there is a significant change in botanical composition of the sward which can be and is now fully taken advantage of. In place of sown legume species, more shade resistant broadleaved weed species (such as the highly valuable *Asystasia intrusa* and *Mikania micrantha*, both of which can provide very good CP value of 20% on dry matter basis even at 8 - 10 weeks regrowth) and grasses (such as *Paspalum conjugatum*) thrive. A combination of *Asystasia* and *Paspalum* makes excellent pasture and, with a proper interval between

grazings of 8 -10 weeks regrowth, the forage yield can support good livestock production, without fear of overgrazing. One beef project rearing 400 head of the local Kedah Kelantan (KK), KK crosses and Droughtmasters, stocked at a density of 1 animal unit to 4 hectares, recorded good animal daily liveweight gains of 0.6 - 1.2 kg.

Thus the long term sustainability of this forage resource under plantation trees is successfully maintained through a well coordinated livestock-cum-plantation management package of proper grazing practice (through well-timed controlled rotational grazing using cheap single wire electric fencing) followed by removal of inedible shrub species (such as *Chromolaena odoratum*, *Clidemia hirta*, *Hedyotis* and *Lophatherum* spp) through selective spot spraying. The latter represents a further aspect of chemical weed control necessary for plantation management but this too can be stopped or reduced once the *Asystasia* based pasture is established under the trees. Using this technique, livestock integrators have now successfully 'guided' the evolution of such *Asystasia* pasture under mature trees of even 18 years of age.

Is the system sustainable (in terms of environmental, economic, market and social indicators)? Firstly, the integration is environmentally friendly as it cuts down on chemical weed control in plantations with the introduction of the grazing animals. Less usage of chemical herbicide means less exposure of humans, plants and other living things to these harmful chemicals. The adoption of proper grazing practice prevents overgrazing of the ground vegetation which can lead to soil and environmental degradation, an earlier fear of plantation management. There is a useful contribution of organic matter to the soil by grazing animals. There is also no additional need for chemical fertilisers for the forage resource. Economic gains and income generated from livestock production, and the savings in chemical weed control cost make the system sustainable in the long term. Marketing of beef animals is not going to be a problem for a long time as the country is only partly self sufficient in beef. Socially, small farmer-integrators in land schemes are learning the benefit of pooling their 'minds' and resources to work together and to enable a more efficient advisory and extension service from government agents to reach them.

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**From Steve Reynolds < Stephen.Reynolds@fao.org >**

**Comments on forage production in tree plantations**

I have read with interest the paper from Dr. Jalaludin on "Integrated Animal Production in the Oil Palm Plantation" and also the comments from Dr. Chin Fook Yuen.

One of the key issues is the reduction in forage production as the oil palm canopy closes with age. Dr. Chin Fook Yuen notes that standing biomass can decline from 2000 kg/ha during the first three years to less than 1000 kg/ha by the 7th year. He further indicates that this fact "along with a consequential need for a lower stocking density under mature trees is already well accepted and is an important consideration incorporated into the management system"....This is one approach yet Dr. Jalaludin mentions another "forage production in the inter-rows can be substantially increased even under mature palms provided the planting density is reduced". The greater light penetration results in increased forage production. This is a subject which has been addressed where forage production is integrated with various tree crops (rubber, oil palm, coconut, radiata pine etc.) and it is one that I have raised in a paper to be presented later in this electronic conference. I wonder if Drs Jalaludin or Chin Fook Yuen or other colleagues from Malaysia could address this further either now or later when my paper is circulated. I know that there is ongoing research in MARDI and the Rubber Research Institute of Malaysia to study the influence of wider oil palm spacing and hedgerow planting of rubber both on forage production and the tree crop yield. Some of this work has already been presented at workshops and in published papers but there may be up-to-date findings which could be discussed or an overview on the general information coming out of some of these trials may be useful at this stage.

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**From Reg Preston <101703.3245@compuserve.com>**

**Comments on shade effects of trees**

A point not mentioned so far concerning grazing under tree crops is the effect of shade on nutritive value. Maybe Steve Reynolds will discuss this issue when we have his paper later in the conference. He mentions it in his book.

As I understand it, the effect of shade on grasses is to increase the amount of the N in non-protein form and to decrease the concentration of soluble carbohydrates. Together these two factors represent a decline in nutritive value.

Can anyone comment on this issue and indicate if there are specific crops which are shade tolerant and which behave differently?

*Reg Preston*

**From Steve Reynolds <Stephen.Reynolds@fao.org>**

**Comments on the effect of shade on the nutritive value of forage**

With reference to Reg. Preston's point about the effect of shade on the nutritive value of forages under tree crops I attach the relevant pages from "Pasture-Cattle-Coconut Systems" (without figures or references) as this subject is not covered in my paper! There is evidence that low light intensities can adversely affect the nutritive value but research so far has produced mixed results. Perhaps Max Shelton or Dr. Norton at the University of Queensland can comment especially as there was ongoing work at the time of the paper presented by Norton et al. to the Workshop in Bali in 1990 which may not have been reported on elsewhere!

*Steve Reynolds, AGPC, FAO*

## **From Chapter 2 of Pasture-Cattle-Coconut Systems (FAO RAPA Pub.1995/7 pages 65-68)**

### **2.5 Nutritive value of shaded pastures**

There is evidence that low light intensities may adversely affect the nutritive value of forage species (Shelton *et al.*, 1987). Deinum and Dirven (1974) reviewed the effects of temperature and light intensity on forage quality. Wilson (1982) examined light as one of the environmental and nutritional factors affecting herbage quality and summarised the effects of shade on nutritive quality as:

- i) a lowering of plant soluble carbohydrate level with, usually, an accompanying increase in cell wall content (Deinum, 1966, 1984; Hight *et al.*, 1968; Masuda, 1977; Myhr and Saebo, 1969; Samarakoon, 1987; Wilson and Wong, 1982);
- ii) higher silica content and lignification (Deinum and Dirven, 1972);
- iii) lower cell wall digestibility (Garza *et al.*, 1965; Wilson and Wong, 1982; Wong, 1978; Deinum, 1984);
- iv) a decrease in the proportion of readily digested mesophyll tissue relative to the less digestible epidermis (Chabot and Chabot, 1977; Wilkinson and Beard, 1975a; Wilson, 1984);
- v) accentuated stem elongation and reduced tillering;
- vi) an increase in tissue percentage moisture content which may reduce herbage intake by animals; and
- vii) crude protein may sometimes actually be higher in shaded plants.

The effect of light level on the dry matter digestibility of green panic (*Panicum maximum* var. *trichoglume*) is reported by Wilson, 1982. However, in the same experiment Wong found no effect of shade on the dry matter digestibility of the legume Siratro (*Macroptilium atropurpureum*). Navarro-Chavira and McKersie (1983) determined the effect of maturity and irradiance on the nutritive value of guinea grass and Wilson and Wong (1982) and Wong and Wilson (1980) have further studied the effect of shade on the nutritive quality of green panic and Siratro. Wong *et al.* (1989) carried out further studies on the effects of shade (100, 60, 34 and 18% of sunlight) on dry matter production, forage quality and mineral composition of six tropical grasses in Malaysia. Common guinea and Signal grass ranked top in DM production at all

shade levels and there was no significant decline in vitro dry matter digestibility (IVDMD) of the whole plant tops for all grasses except for T grass. This finding agrees with that of Deinum (1981) but is contrary to the big reduction in IVDMD in green panic reported by Wong and Wilson (1980) in Australia. Wong et al. (1989) suggest that the lack of a consistent inverse relationship between shade and IVDMD augers well for the integration of livestock with plantation crops. In addition, it was noted that the grasses under shade had a higher nitrogen/crude protein content as already reported elsewhere by Deinum et al., 1968; Eriksen and Whitney, 1981; and Wilson and Wong, 1982. A longer cutting interval reduced IVDMD.

Recently Samarakoon *et al.* (1990a) found that the dry matter digestibility of *Axonopus compressus*, *Pennisetum clandestinum* and *Stenotaphrum secundatum* grown under shade was higher than that of herbage grown in full sun, a result contrary to much of the published literature (Wilson, 1982). However, although the increase in dry matter digestibility was up to a maximum of 5 percent units, in most instances it was only of the order of 1-3 percent units.

Norton *et al.* (1991) suggest that while shading reduces the total non-structural carbohydrate of grasses, it may have variable (positive and negative) effects on cell wall content and composition, lignin and in vitro digestibility of plant dry matter (Wilson, 1991), Shelton *et al.* (1987) quote the work of Fleischer *et al.*, (1984) Henderson and Robinson (1982) and Samarakoon (1987) as examples of studies where the effect of decreasing light intensity on in vitro digestibility varied with grass species tested and temperature.

In the southeastern USA Burton et al. (1959) showed that reduced light (in a comparison from 100-28.8 percent available light) decreased the herbage yields, production of roots and rhizomes, nutrient reserves for regrowth and total available carbohydrates in the herbage of *Cynodon dactylon*. Most significant for animal nutrition was the reduction in total available carbohydrates in herbage, particularly when less than 50 percent sunlight reached the grass canopy. The resulting energy value of grass could limit rumen flora activity and affect animal output. Shade significantly increased the lignin content of the herbage thus decreasing



digestibility. Therefore animals consuming forage produced under cloudy or shady sites could be expected to make less live weight gain (Crowder and Chedda, 1982). In an early study of the effects of reduced radiation levels on forage quality, Mayland and Grunes (1974) suggested that reduced radiation levels in Idaho, Nevada and Utah would probably result in a reduction in the amount of magnesium being made available to the grazing animal (resulting in grass tetany).

There have been few studies in the past where shaded and unshaded forages were evaluated as feed for animals, but this is an area presently receiving attention.

Hight *et al.* (1968) in New Zealand compared shaded ryegrass (*Lolium perenne*) at 22 percent light transmission with unshaded ryegrass and found that shading decreased soluble carbohydrate content by 3.7 percent units, dried forage digestibility by 0.6-3.6 percent units and voluntary feed intake by 9-15 percent. Live weight gains were reduced by 38 percent compared to sheep fed on pasture grown in full sunlight. Norton *et al.* (1991) suggest that the shading period (of 2-3 days) was probably too short for the results to have much relevance in terms of the interpretation of the longer-term effects of shading on tropical pastures grown under plantation crops.

Samarakoon *et al.* (1990b) studied the effects of much longer periods of shade (50 percent light transmission) on the nutritive value of buffalo grass (*Stenotaphrum secundatum*) and Kikuyu grass (*Pennisetum clandestinum*) for sheep. There were no significant effects of shading on digestibility (in vivo and in vitro) or cell wall composition but there was a marked depression (28-33 percent) in feed intake of sheep given shaded Kikuyu. It was suggested that the decreased intake was associated with the increased stem content of shaded Kikuyu grass, but as this effect was found in only one of the harvests Norton *et al.*, (1991) suggest that an alternative explanation for the reduced feed intake may be decreased palatability of the feed. However, the higher yielding capacity and maintenance of nutritive quality of shaded *S. secundatum* (compared with shaded *P. clandestinum*) confirms its potential usefulness for plantation agriculture. Samarakoon *et al.* (1990b) suggest that its quality is not as poor as generally believed.

Norton *et al.* (1991) undertook further experiments to investigate the effects of shading on the voluntary feed intake and digestibility of several tropical grasses by sheep. Grasses examined were setaria (*Setaria sphacelata* cv. *Kazungula*), green panic (*Panicum maximum* var. *trichoglume* cv. *Petrie*), guinea grass (*Panicum maximum* cv. *Riversdale*), Signal grass (*Brachiaria decumbens* cv. *Basilisk*), buffalo grass (*Stenotaphrum secundatum*), bahia grass (*Paspalum notatum*) and a mixture of mat grass (*Axonopus compressus*) and sour grass (*Paspalum conjugatum*) grown in full sunlight and under shade ranging from 68 and 50 to 30 percent light transmission. While there was no significant effect of shading to 50 percent on the intake and digestibility of grass species, there were changes in chemical composition (especially an increase in N concentration of shaded herbage) and sheep given feed from shaded pastures had significantly higher concentrations of ammonia in rumen fluid than did sheep fed herbage from non-shaded pastures. Fermentation patterns in the rumen of sheep fed shaded pastures also changed with propionic acid levels increasing and acetic acid levels decreasing (consistent with the fermentation of more protein in the rumen).

It was expected in an on-going (incomplete) experiment, where grasses were subject to very low light levels (30 percent light transmission), that detrimental effects could be produced.

Perhaps as suggested by Samarakoon *et al.* (1990b) only shade-intolerant species have their quality reduced by shade, because of greatly reduced total soluble carbohydrates, greater culm elongation (increasing their comparative 'steminess') and perhaps their greater susceptibility to fungal attack. This hypothesis needs further investigation through additional feeding trials with a greater range of species.

**From Miltos Hadjipanayiotou <miltos@arinet.ari.gov.cy>  
Comments on fourth paper (oil palm)**

It is stated by the author that palm kernel cake has got high oil content, especially when extracted by expeller. The high oil content causes rancidity leading to reduced intake/ palatability. We experienced the same

problem in the Mediterranean region with crude olive oil cake (around 10% oil). Large quantities of the by-product are available during the short rainy period and they cannot be utilised efficiently. As a result considerable part is wasted, and also creates pollution problems.

When we ensiled the crude olive oil cake, even without any other material, we managed to avoid rancidity and had a well preserved material available throughout a longer period of time, and we also had the choice to use the material at any stage of production and time period.

Are the problems mentioned above with olive cake applied to palm kernel cake?

Has the ensiling technique been used to improve storage qualities, distribution/availability of the by-product throughout the year?

Indeed, some by-products are causing toxicity problems because they are available seasonably and the animals are forced to consume large quantities, despite the fact that for a considerable part of the year there is scarcity of feedstuffs and of by-products.

"Oil Palm Fronds" can be economically utilised after being pelleted (9 mm). This is rather strange. How a bulky (?), high moisture content (?), and of long form material that requires high transportation costs (from the field to the processing/ pelleting plant and from the processing plant to the farm), dehydration (? sun-drying) and grinding can be economically used after imposing the additional expenses associated with pelleting?

**From Chin Fook Yuen <[chin@jph.gov.my](mailto:chin@jph.gov.my)>**

**Comments on rancidity in palm kernel cake**

With reference to the 4th paper and comments by the author and Miltos Hadjipanayiotou on palm kernel cake (PKC) and olive oilcake respectively, I would like to share some experience and information (unpublished data) on rancidity in PKC. This is of concern to us because, currently, Malaysia's production of about 1 million tonnes of PKC is mainly shipped to European countries as livestock feed, chiefly in the expeller pressed form. A small quantity of less than 5 % is used locally for feedlotting and supplementation purposes. Problems of rancidity have always been found with insufficiently pressed PKC which has high oil

content as stated by the author of the 4th paper. Well pressed PKC of between 7 to 12 % oil content however does not seem to pose rancidity problems within the first 3-4 months after production, based on experience and work we undertook to study rancidity as measured by free fatty acids (FFA)%.

A one-week old expeller PKC averaging 11.5% ether extract content was stored for 5 to 6 months between 27.2.93 and 14.8.93. At the time of storage, FFA value was 0.7%. Within the first 2 months of storage, FFA ranged between 1.4% and 1.9%. By the third month, FFA increased to a level of 4.8%. By the end of the study, this level had reached 42.5%. Our conclusion is that the normal expeller PKC would not pose rancidity problems three to three and a half months after production before FFA level reaches 5%.

In practice, our long history of using (as well as exporting) both the solvent extracted and expeller pressed PKC has not considered rancidity as a major problem with reliable production/supply partners, timely shipping, proper storage and timely feed-out.

I wonder if the use of FFA% is a good measure for rancidity in oilcakes or are there any better measures or indicators?

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