CONVERSION OF A LAMB PRODUCTION SYSTEM TO ORGANIC FARMING: HOW TO MANAGE, FOR WHAT RESULTS?

Benoit Marc (1), Tournadre Hervé (2), Dulphy Jean-Pierre (2), Cabaret Jacques (3), Prache Sophie (2)
With the collaboration of J. Ballet, F. Bocquier, R. Jailler, G. Laignel, JY. Pailleux, Y. Thomas
(1) INRA LEE Theix, 63122, St Genès-Champanelle, France, Tel. 0033473624134,
marc.benoit@clermont.inra.fr
(2) INRA URH Theix, 63122, St Genès-Champanelle, France, Tel. 0033473624080
(3) INRA BASE, 37380 Nouzilly, France, Tel. 0033247427768

Key Words: Organic farming, lamb, meat, parasitism, economics.

ISOFAR Section 7: Animal Production Systems (APS)

Abstract

Two sheep flocks were managed organically for two years from conversion under different lambing strategies (1 lambing/year *vs*. 3 lambings every two years). The second system was tested because pf a producer's interest in high productivity, which is a guarantee of good economic results in conventional production.. Reproduction, feeding, lamb production, carcass quality, health (particularly internal parasitism), economic return of the flock, grass production, and pasture biodiversity were evaluated. The lambs were bred with low therapeutic inputs. No economic advantage of increasing lambing frequency was demonstrated, whereas this strategy complicated management and resulted in higher internal parasitic infection of the lambs, and finally showed lower stability. There were difficulties in establishing a very high feed self-sufficiency in both systems, especially the more intensive system (4 points lower), due to harsh climatic conditions. Following this five-year experiment, we are changing our strategy to provide nitrogen in the systems.

Introduction

Since 1999, the INRA (Institut National de la Recherche Agronomique) has been developing a research programme on Organic Farming-OF (Sylvander et al. 2002), with experiments on organic animal production being performed at Clermont-Ferrand (central France). The objective was to compare two reproductive systems in sheep meat production, and to explore technical solutions to the specific constraints of OF linked to reproduction (hormonal treatments forbidden), feeding (restrictions on the use of silage and concentrates), and health (restriction on chemical treatments). We used a local hardy breed (Limousin) capable of reproducing out of the usual mating season (mating at the end of May).

Methodology

We compared two lambing systems:

* The "Grassland farming system" (Grass Syst), which is based on one lambing per ewe per year and aimed at high grass self-sufficiency. This system is not particularly demanding for ewes, and was intended to limit problems relating to compliance with OF standards. It has the advantage of having counter-season reproduction to obtain two equal lambing periods (March and November), with meat produced both in summer (grass-fed lambs) and winter (stall-fed lambs).
* The "Accelerated reproduction system" (Acc Syst) is based on three lambings per ewe over two years, with each ewe mating every 8 months. The lambings were equally distributed among June, November and March, but farming techniques were adjusted to comply with OF standards, particularly concerning inputs (for health, feeding, and reproduction). Farmers are showing increased interest in this accelerated system as it is widely used in conventional farming, giving good technical and economic results.

In Grass Syst, the suckling period was as long as possible (88 +/- 19 days) whereas it was limited to 70 days (69 +/- 12) in Acc Syst because of the short interval between matings and the risk of excessive fat mobilization. In Acc Syst, lambs had access to concentrate just after lambing. In Grass Syst, lambs were given supplemental feed only when there was a grass shortage. In all cases, any concentrate

provided was restricted to 600 g lamb^{-1} day^{-1}, according to basic OF standards (30% to 40% of daily ration). The spring reproduction period (seasonal anoestrus) was chosen on the basis of experimental results (Tournadre et al. 2002) testing a "ram effect", i.e. introduction of rams in the flock to improve ewe fertility. The spring mating period began in the last week of May in both systems, and was limited to 45 days in the Acc Syst because of closeness to the subsequent mating period (October).
Each flock contained 100 ewes on 24 ha, i.e. a stocking rate of 0.8 LU/ha, and 5% of the total land was used for cropping (mixture of cereal and peas). The experiment was set up in summer 1999, with the 'administrative' conversion to OF becoming effective in January 2002. We report here the results obtained in 2001, 2002 and 2003 on economic performance, health (parasitism), carcass quality, forage production, crops, flora biodiversity, and consistency of both systems (adequacy among resources, production and health). The experiment was partly performed under the severe drought conditions of 2002 and 2003.

Results and discussion

Animal performance. Economic results in sheep farming greatly depend on numerical productivity (number of lambs alive per ewe per year). Its components are fertility, lambing rate, prolificacy, and lamb mortality. Fertility was higher in Grass Syst than in Acc Syst (89.8 *vs.* 70.7%, $P<0.0001$) because of lower fertility in the June and November lambing periods in Acc Syst, and because of the required shorter mating periods in this system. When mated, replacement ewe lambs also had a lower weight in Acc Syst than in Grass Syst, (42.3 kg *vs.* 44.9 kg). The lower prolificacy in Acc Syst compared with Grass Syst (154 *vs.* 165, $P<0.05$) was due to the acceleration in reproduction. Prolificacy increased steadily under the Grass System (160, 166 and 177 for years 2001, 2002 and 2003, respectively). The highest between-system difference was recorded in November (134 *vs.* 157). Lamb mortality was 17.9% in Acc Syst *vs.* 12.9% in Grass Syst ($P<0.05$), with more mortality at birth in relation to a higher abortion rate in Acc Syst in 2001. After age 10 days, there no longer was a significant difference. Finally, numerical productivity remained steady at about 1.53 in Grass Syst (standard deviation = 0.06). It was a slightly higher in Acc Syst (1.61) due to accelerated lambing (lambing rates of 129 and 104 in Acc Syst and Grass Syst, respectively), but more importantly it was very variable (standard deviation = 0.22). The mean numerical productivity of 16 private conventional farms in the same geographical context was 1.45 in 2003 and 1.49 in 2002 (Laignel et al. 2004). Our results in OF were therefore satisfactory. Regarding numerical productivity, average carcass weight produced per ewe over the 3 years was 19.2 kg in Grass Syst and 20.4 in Acc Syst.
The lamb's average daily gain (ADG) during the suckling period depended on the usual factors (birth weight, single or twin, sex). Differences were observed between seasons (ADG from 30 to 70 days of age being 48 g day^{-1} higher in November than in March) and in relation to the diet (concentrate and hay *vs.* grass). Although there were differences in weaning age (69 *vs.* 88 days in Acc Syst and Grass Syst, respectively), subsequent ADG and live weight at slaughter did not differ. Between 70 days of age and slaughter, ADG differed markedly in March lambing (200 g day^{-1} *vs.* 172 g day^{-1} in Acc Syst *vs.* Grass Syst, respectively), because of the earlier concentrate supplementation in Acc Syst than in Grass Syst. June was a bad season for lamb growth (165 g day^{-1} between 70 days of age and slaughter in Acc Syst), even with concentrate supplementation, because of the low quality of available grass,.
Carcass quality. Three-hundred and fifty-six and 396 lambs were slaughtered under Grass Syst and Acc Syst, respectively, at an experimental slaughterhouse. We measured age at slaughter, carcass weight, fattening and conformation scores, and firmness and colour of subcutaneous fat (Theriez et al. 1997). Firmness of subcutaneous dorsal fat was measured after 24 h of shrinkage using a finger test (values ranging from 3 for oil fat to 15 for hard fat). Colour of subcutaneous caudal fat was measured after 24 h of shrinkage using a MINOLTA CM-2002 (illuminant D_{65}, observer angle 10). The colour coordinates were expressed as lightness (L*), redness (a*), and yellowness (b*) in the CIELAB uniform colour space (CIE, 1986). Carcass weights averaged 15.7 and 15.6 kg in Grass Syst and Acc Syst in 2001 and 2002, respectively. In 2003, carcass weights were 1.4 and 1.8 kg lower because of exceptionally dry weather. Mean age at slaughter was 7 days higher in Acc Syst than in Grass Syst (144 *vs*. 137 days, $P<0.05$). Fattening and conformation scores were quite similar for the two systems. Firmness of subcutaneous fat was slightly lower in Acc Syst than in Grass Syst in all three years (10.2 *vs*. 11.1, $P<0.05$). This may be explained by a lower age at weaning in Acc Syst compared to Grass Syst ($P<0.05$), as lamb growth rate before weaning was similar for the two systems (258 and 261 g day^{-1} in Grass Syst and Acc Syst, respectively). There were no differences in fat colour between systems.

Health. Several health-related problems were recorded: zinc and copper deficiencies were seen at the beginning of the conversion to OF, and the ewes were treated accordingly to compensate for this deficiency. Treatment of the cestode parasite *Moniezia* using a commercially-available phytodrug was tested in several cohorts of lambs over two years. The results were not promising, and we had to focus on regular synthetic chemical drugs. One episode of intense skin pathology was encountered, and was treated with success using essential oils. Abortions were recorded in 2001 due to toxoplasmosis. There were no other major health issues. Due to adapted pasture management and treatment organisation, the intensity of nematode and cestode parasitism in lambs remained controlled. Estimated strongyle eggs per gram were higher in the Acc Syst *vs*. the Grass Syst group (161 *vs*. 80, Benoit et al 2003). In Grass Syst, 64% of lambs had no synthetic chemical treatment, including grass-fed lambs. Ewe mortality rates for 2000-2001 were 8.4% and 7.1% in Acc Syst and Grass Syst, respectively, and subsequently decreased to 3.6% and 2.3%, respectively (2003-2004). Indicators of a need for treatment were studied; these were based on faecal egg count, anaemia score (Famacha), or diarrhoea score (Disco, Cabaret 2004). The latter system appears useful but needs to be further refined for practical on-farm use.

Grass production. No exogenous fertiliser was used, as export of minerals (N, P, K) was very low (only 6 N and 2.3 P units ha^{-1}, as 11 kg of N and 1.5 kg P were introduced per ha by food purchases during a normal year). However, we followed the plant fertility index (K/N, P/N) and tried to optimise the use of compost. Herbage production decreased dramatically during the period 2002-2003 (6.4 tDM ha^{-1} for 2000 and 2001, 4.2 for 2002, 3.8 for 2003), as was the case for total plant N content (105 to 88 g.kg DM^{-1}), associated with a marked decrease in leguminous plants. This was more linked to weather (very dry summer) than to agricultural practices, since herbage production returned to 7.0 t ha^{-1} in 2004 (and N content 110 g.kg DM^{-1} for 2004). About 60% of the production was consumed by the animals, taking into account the sorting by animals. Each ewe and its litter needed 840 kg DM of forage per year (about 320 kg hay and 520 kg grass).

Feed self-sufficiency (based on the calculation of energy requirements) of the Grass Syst was 92% in 2001, 78% in 2002, and only 64% in 2003, because of dryness conditions. On average, over the 4 years, it was higher by 4 points in Grass Syst than in Acc Syst. The part of feed self-sufficiency provided by crops was 4 to 5 points. One study objective was to enhance self-sufficiency by both adapting stocking rate and increasing forage quality. The decrease in feed self-sufficiency may also be explained by an underestimation of the quantity of forage eaten by the lambs. Indeed, in compliance with the OF standards, concentrate distribution was limited to 40% of the lambs' diet. This led to a 3.4-fold increase in the quantity of hay offered (27 kg offered versus 8), with a significant impact at the system scale: we estimate the consumption of forage by lambs (hay and grass) at 9% of the total forage produced compared to 2% in conventional systems in the same area (all lambs indoors in stalls).Production of compost (straw + faeces after maturation) was 125 kg DM per ewe per year. Composition was 24/8/43 for N/P/K, respectively (g kg DM^{-1}). The compost (35% DM) was spread on hay meadows and crops. To have proper hay, an early grazing was practised during spring and, when possible, some meadows were cut early and conserved in round-wrapped bales (30% of total conserved forages). The N supply in the system was initially based on the leguminous plants in permanent grassland and on the protein-rich plants in crop associations. In our medium upland climatic conditions, peas disappeared 3 years in 4 due to frost. In the dryness conditions, with light soils, legumes in permanent grassland did not represent a sufficient proportion of flora. Three strategies were further evaluated: i) increase the proportion of legumes in permanent grassland by direct seeding ii) improve soil fertility of permanent grassland with a mechanical treatment aiming at aeration of the surface soil layer and degradation of excess organic material, and iii) cultivate short-term meadow and pasture based on legumes (red clover, alfalfa if possible). Crop rotation was based on 3 years of crops (mixture of triticale, barley, oat, and peas) followed by 3 years of meadow. The fertilisation was carried out on the second and third year of crops with 5 t/ha compost. Grain-yield was 3.4 t/ha, with a maximum 20% peas.

Flora biodiversity increased with the introduction of crops (+17 species) and the creation of ponds (+24). The initial total number of plant species was 132 and the final count reached nearly 200 without counting short-life spring plants (vernal plants). The non-use of synthetic N fertiliser also partly explained the increase in biodiversity. For example, in comparing organic and conventional sheep production, the number of plant species on a paddock scale was 53 *vs.* 33.

Economic results. The highest production cost in sheep production in our context is feeding and, above all in OF, concentrate use (price per kg: +70% above. conventional). The total amount of concentrates used was 121 kg (Grass Syst) *vs.* 156 kg (Acc Syst) per ewe (and its litter), but this may be lower in normal weather. Concentrate use was 43 kg per lamb in Acc Syst *vs.* 28 in Grass Syst, as the weaning age is later in Grass Syst and the availability of good quality grass for lambs is higher in spring. Gross margin per ewe was 9% higher under Grass Syst than Acc Syst (65 € *vs.* 59). If we focus on the better year for Acc Syst (2002, with numerical productivity at 1.93), the gross margin per ewe was only 5% higher (89.9 in Acc Syst *vs.* 85.5 in Grass Syst), because of production costs. If we compare Grass Syst to the same system on conventional farming (by simulation), the premium price on lamb meat would have to reach 12% (0.57 € kg^{-1}) to achieve the same economic result (current earnings); the premium price received in 2003 was 15%. If we compare this to a conventional intensive system with accelerated lambings (such as Acc Syst), the necessary premium price to achieve the same final economic result would be 23% (1.07 € kg^{-1} carcass), to compensate for i) the cost of the larger pasture area corresponding to a lower stocking rate, ii) the lower numerical productivity, and iii) the extra cost of concentrates and the cost of OF certification. We did not take into account additional work for the OF system. These results are in agreement with a study performed in the same upland farming context (Benoit and Veysset, 2003) in which the required premium price for the same current earnings was 1.13 € kg^{-1} if we compare it to conventional intensive upland farming, and 0.34 € kg^{-1} if we compare it to conventional "Medium" upland farming.

Conclusions

This 4-year study showed there is no conflict between the principles of OF and high zootechnical results, insofar as the system is consistent enough. An intensive OF practice in our context showed significant instability in animal performances and results. After 5 years of conversion to OF, the Grass Syst is still evolving (soil fertility, plants on pastures, parasitism, etc.) and we will observe new global balances and the stability of results over a longer period. In the future, we will focus on parasitism (diagnosis for end-users, alternative treatments) and specific lamb meat quality (nutritional and sensorial quality and traceability). We also plan to study flows of certain greenhouse gases (CH_4, CO_2, N_2O) and the possibility of improving the biological activity of soils (meadows) by mechanical treatments. Beyond the technical performances studied and the development of techniques, this work highlights the insufficient support to OF, as the current premium price is not high enough to induce farmers to convert to OF. A continuing premium for the OF system is necessary, based, initially, on the recognition of its environmental benefits.

References

Benoit, M., Veysset, P. (2003) Conversion of cattle and sheep suckler farming to organic farming: adaptation of the farming system and its economic consequences. *Livestock Production Science*, 80, 141-152.

Benoit, M., Laignel, G., Cabaret, J. (2003) Rearing healthy meat sheep at a reasonable cost: the Redon-Orcival project in France. In "Socio-economic aspects of animal health and food safety in organic farming". *Proceedings of the 1st SAFO Workshop, 5-7 September 2003, Florence, Italy*. 263-266.

Cabaret, J. (2004) Parasitisme helminthique en élevage biologique ovin : réalités et moyens de contrôle*, INRA Prod. Anim., 17, 145-154.*

CIE (1986) Colorimetry. 2nd ed. CIE Publ. No 15.2. Commission Internationale de l'Eclairage, Vienna.

Dulphy, J.P., Benoit, M., Laignel, G., Tournadre, H. (2003) Relation between forage and sheep production in a semi-dry context under organic management. In *Optimal Forage Systems for Animal production and the Environment. Volume 8. 656 p., Grassland Science in Europe. May 2003. Pleven. Bulgaria. Kirilov A., Todorov N., Katerov I., Eds, 522-525.*

Laignel G., Benoit M., 2003. *Résultats technico-économiques d'exploitations ovines allaitantes conduites en agriculture biologique en Massif Central Nord. Campagnes 2000 à 2002*. Note LEE, 10 p.

Sylvander, B., Bellon, S., Cabaret, J., Gautronneau, Y. (2002) Designing a Research Programme in Organic Farming in France: Systemic Approaches and Research in Partnership. *Proceedings of the 14th IFOAM Organic Word Congress* p289

Thériez, M., Aurousseau, B., Prache, S., Mendizabal, J., (1997) Les défauts de couleur des gras d'agneaux. *Rencontres Recherches Ruminants*. 4, 295-30.

Tournadre, H., Bocquier, F., Petit M., Thimonier, J., Benoit, M. (2002) Efficacité de l'effet bélier chez la brebis Limousine à différents moments de l'anoestrus. *Renc Rech Rum,* 9, 143-146.