

## ORGANIC-CONVENTIONAL DAIRY SYSTEMS TRIAL IN NEW ZEALAND: FOUR YEARS' RESULTS

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### Abstract

The Organic-Conventional Comparative Dairy Systems trial at Massey University began in August 2001, and the organic farmlet achieved certification in August 2003. The trial is unique because it is the only comparative grassland-based open grazing dairy study in the world. The organic and conventional systems are managed individually according to best practice, and both are intensively monitored for production, animal health, and environmental impacts. The systems remained similar for the first two years, but began to diverge in the third and fourth years. Production has been 10-20% lower on the organic farm, but environmental impacts appear to be less than on the conventional unit, and net incomes would be similar given a 20% price premium for the organic product. Animal health issues have been manageable on the organic farmlet, and not too dissimilar from the conventional farmlet. Full results after four years of the trial will be available and presented at the conference.

### Introduction/Problem

Organic farming systems are usually considered to be lower producing, perhaps less profitable, but better for the environment. Better information based on rigorous science would help individual farmers make the decision to convert to organic production. The long-term aim of this research is to better understand organic dairy farming systems by investigating component interactions in these systems, and by determining how impacts and interactions change over time as organic systems mature, and compare these changes to those on a conventionally managed system with nearly identical resources.

Soil and land are the most valuable resources on a dairy farm aside from human capital. Farming organically places extra restrictions on the dairy farmer, requiring him/her to be even more aware of the soil resource. Previous research comparing conventional and organic dairy farms indicates that the management changes made by organic farmers can lead to both positive and negative changes to parameters that are used to indicate soil quality, depending to a large degree on inherent soil quality (Reganold *et al*, 1993; Macgregor 2002).

Key long-term objectives for the project are:

1. develop farm and herd management systems that optimise performance over time;
2. compare the impacts of organically and conventionally managed dairy systems on soil health (quality, flora and fauna) & water quality, pasture and forage crop productivity (quantity and quality), and animal production and health;
3. identify management practices that improve the biological activity of soils, optimize clover content and best maintain biological N fixation, and best control mastitis and other health issues in organic milk production systems; and
4. determine the stability and sustainability of high biodiversity organic dairy pastures, including the control of weeds.

## Methodology

The Dairy Cattle Research Unit (DCRU) at Massey University in Palmerston North, New Zealand was split into two similar size farmlets, one conventionally managed (21.3ha) and the other organically managed (20.4ha), on 1 August 2001, at which time the organic farmlet began its organic conversion period. The DCRU was split in such a way that both farmlets were as similar as possible, including the herds. On 1 August 2003, the organic farmlet achieved its full AgriQuality (IFOAM accredited) organic certification.

The herd was split by breeding worth (BW) and production worth (PW), somatic cell count history, age and size to provide two herds as similar as possible. Both herds consisted of the same number of cows (44 Holstein Friesians) in the first year, with the expectation that cow numbers in the organic herd would decrease over time. Due to the slight difference in size, the stocking rate was actually slightly higher on the organic farmlet through the second year, but this was reversed deliberately in the third and fourth years, with the stocking rate higher on the conventional.

Although the organic farmlet has achieved full certification, the actual transition from conventional to organic production is continuing, with many of the biological systems taking longer than two years to make the adjustment from conventional management (Dabbert and Madden 1986). Thus, the whole farming system, and resulting profits, is still in transition.

Each of the two DCRU farmlets is managed individually according to “best practice” for its particular type of management system and environmental conditions. Thus, no attempt is made to try to do the same thing on one farm as is done on the other farm. For the organic farm, best practice is guided by the certifying agency (Agriquality) and by an organic farmer advisory group. Comparisons between the two systems are made through regular intensive monitoring, and full economic costing methods are used to determine the differences in cost of production under the two systems, and to influence management decision making.

Animal growth and health status for both herds are carefully monitored. There is considerable focus on preventative management on the organic unit, with extensive use of a range of homeopathic, herbal and other alternative treatments, tonics and drenches. This is further enhanced by carefully selected fertilizer inputs, based on herbage and soil analysis results, and focusing on a far wider range of trace elements and minerals than is standard practice on the conventional unit. Balancing trace element intake is also carefully considered for a wider range of elements than on the conventional unit and appropriate supplements are given to the organic herd, mainly in the form of fish proteinated chelates in the water trough, sprayed onto pasture or drenched orally. The parasite status of the organic calves is monitored closely throughout the period of maximum risk.

Regular monitoring of the mineral status of both herds is carried out and supplementation adjusted accordingly. Serum copper, selenium and magnesium have been analysed on a regular basis either for the purposes of routine monitoring or to check that changes to a supplementation regime were having the desired effect. Testing for other minerals is also carried out when circumstances indicate the possibility of inadequate intake. This additional testing includes analysis of serum for calcium, vitamin B12 and zinc, and liver biopsy samples for copper and vitamin B12.

The pasture composition of the organic and conventional farms has been surveyed twice yearly in October/November and again in May, except in 2002 when only the May survey was carried out. These surveys include herbage accumulation in all paddocks in each system, botanical composition in each season by point analysis of the pastures (including weeds) along permanent transects, and seasonal nutritive value of the pastures and other feed sources.

A range of soil properties and processes are being measured on both farmlets. Soil physical characteristics that are being monitored include; bulk density, infiltration rates, macroporosity, and aggregate stability. A range of indicators of soil micro- and macro-organism activity are also being measured including respiration rate, earthworm populations, microbial-C, total C, and degradation of cellulose strips.

Soil nitrogen dynamics are being studied in detail, with monitoring of nitrogen availability to pasture (total N, ammonium-N, nitrate-N and mineralisable-N), and nitrogen losses to the aquatic

environment. Nitrogen leaching is measured using a network of suction cup samplers, and drainage is sampled as it enters surface water from pipe drain outlets. Soil chemistry monitoring includes inorganic and total organic forms of phosphorus, along with resin extractable, sodium bicarbonate extractable, sodium hydroxide extractable, and acid extractable fractions. A range of acidification indicators are monitored including pH in water and KCl, and pH buffering capacity. Cation exchange capacity and exchangeable cations are also measured.

## Results and brief discussion

In general, the results of the first two years of the trial (2001-03), the conversion period for the organic farmlet, showed little difference in productivity, animal health, and soil and herbage quality between the two farms. The conventional and "in conversion" organic farms produced similar amounts of milksolids per cow and per hectare, and somatic cell counts were low for both herds. In the first season, milksolids per hectare were 959 and 993 and per cow were 436 and 451 for the organic and conventional farms respectively. These compare favourably with the district average of 314 kgMS/cow that year. In the second season, with a very dry summer, milk production again was similar on both farmlets (723 kgMS/ha and 745 kgMS/ha respectively for conventional and organic). However, the cost per kg of milksolids produced was 23% higher on the organic farmlet, due mainly to the fact that it was a very dry summer and organic feed had to be brought in from off farm.

Animal health issues did not appear to differ significantly between the two units and there were no significant issues recorded on either unit during the first two seasons. Mastitis and somatic cell count data were analysed and reported by Lopez-Villalobos, *et al* (2003). The trial appears to indicate that the fish proteinated chelates are effective for a range of minerals. These products are a relatively inexpensive, easily administered but untested organic alternative to conventional mineral supplementation practices and the benefits of these products to all farmers are worthy of further investigation.

The third season (2003/04), the first in fully certified production, was characterised by average rainfall, but lower than average temperature and sunshine during Spring and Summer, with an extremely wet February. Overall, it was a very good dairy season. During this first season of full certification (01/07/03 – 30/06/04), the organic farmlet consistently grew less pasture than did the conventional farmlet, 11 tDM/ha on the organic farmlet compared to 13.5 tDM/ha on the conventional, so that less pasture was consumed and more supplements were fed on the organic farmlet. In particular, the conventional farmlet produced more pasture in early spring due to the application of urea fertiliser. The number of cows on the organic farmlet that season was lower than on the conventional side, 46 and 51 respectively. Because of these differences, milksolids production by the organic herd was lower both per cow (410 kgMS/cow vs. 457 kgMS/cow) and per hectare (925 kgMS/ha vs. 1094 kgMS/ha) than the conventional herd.

The 2004-05 season was characterised by a cool wet spring and early summer followed by a warm and dry late summer-autumn period, resulting in reduced pasture growth and milk production levels from the previous season. Stocking rates were down on both farmlets, with 43 cows and 48 cows respectively on the organic and conventional units. The dry autumn resulted in the organic herd and some of the conventional cows being dried off earlier than usual, contributing to the reduced production levels, particularly on the organic farm. Milk production on the organic farmlet was lower per cow (-14%) and per hectare (-20%) than on the conventional farmlet.

Both herds had similar body condition scores, and somatic cell counts were similar, though higher in both herds than in the two previous years. The organic herd had a higher incidence of *Staphylococcus aureus* infection in 2003/04 and 2004/05. Mastitis has been controlled in the conventional herd by the use of antibiotics and dry cow therapy, whereas homeopathic remedies were the frontline remedies for the organic herd. Other animal health indicators were also similar between the two herds. The organically reared calves have grown exceptionally well and tended to be slightly heavier and in better condition than their conventional counterparts. Parasite levels revealed no cause for concern at any stage. Similarly, the rising 2 year old heifers which have had a similar feeding regime have done well.

Soil monitoring up to autumn of the third season revealed no differences between the conventional and organically managed paddocks for ammonium-N, nitrate-N or mineralisable-N. The values for respiration rate, which is often viewed as a key indicator of micro-organism activity, were identical on the conventional and organically managed paddocks. Likewise, there is no difference in earthworm

populations between the two systems. Preliminary results suggest that nitrate-N concentrations in drainage water are lower on the organically managed areas, but further monitoring is required to have confidence in this result. Some differences in soil nutrient status may be beginning to emerge between the systems – there is a hint that a gap in Olsen P, sulphate-S and potassium values may be developing between the conventionally and organically managed areas. These values are slightly greater under conventional management, presumably as a result of fertiliser inputs to this system.

The species composition of the pastures on the two farms has remained similar, except the white clover percentage on the organic farm has slightly increased relative to the conventional farm, but this is still a sub-optimal clover percentage for a dairy pasture. The most likely reason for the greater clover percentage on the organic farm is its lower pasture cover in spring.

There have been two approaches to increasing the clover percentage on the organic farm. First, grazing management objectives that include maintaining pasture masses in the 1500-2600 kg DM/ha range, particularly in spring, and grazing the poorer pastures hard (<1,000kg DM/ha) in autumn. Second, the worst pastures on the organic farm are being renewed by cultivation and sown with a mix of perennial ryegrass, white clover, red clover, chicory and plantain. One half of a paddock was established in September 2004 and the other half was established in late February 2005 to compare establishment and weed ingress in spring and autumn.

Both farmlets are high producing units, and continually perform well above the district averages. Financial analysis reveals that with the exception of a very dry second season, both operate profitably. However, as a result of production per hectare differences, even though the absolute costs on the organic unit were less, the cost of milk production (\$/kgMS) was 9%, 20%, and 16% greater for each of the first three seasons respectively – financial analysis for the fourth season of the trial will be available and presented at the conference.

## Conclusions

It is still premature to draw any firm conclusions from this trial, since three plus years is quite a short time in the transition to a stable organically managed farming system. However, some preliminary indications are worth noting. Pasture production, and hence milk production, is less on the organic farmlet, most likely due to the inability to cost-effectively apply nitrogen fertilisers at critical periods in the spring. Mastitis, though more of a challenge on the organic farm, is manageable and has remained below tolerance levels; other animal health issues have not been a problem under organic management. The trial so far has demonstrated that organically rearing young stock is feasible, and in fact may be a very viable option for dairy farmers. Impacts on the environment in the form of nitrate-N contamination to ground and surface water may be less under organic management, but further monitoring is needed to be able to conclude this with any confidence. Finally, with a price premium for organic milk, the organic dairy system seems to be an economically viable option for dairy farmers.

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