# Preliminary Report on Organic Dairy Farming

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**Introduction**

The organic farming sector get lots of media attention. Hardly a week goes by without some news paper article, or TV programme exalting the virtues of organic farming.

Certainly in Europe, the interest in organics has been quite intense in the past number of years, with buoyant demand for organic produce resulting in increasing numbers of farmers getting into the business. The market for organic food in Europe has more than doubled over the last five years and is currently worth £4.5 billion, or about 2% of the overall food market. The average amount of land farmed organically in the EU is 2.1%, with Austria and Denmark farming 8.4% and 6.0%, respectively, compared to 1.8% in the U.K. Some 32,000 ha are devoted to organic production in Ireland, which is less 0.5% of the utilized agricultural land area devoted to organic agriculture. Fruit and vegetables account for 40% of the organic food market with dairy produce account for a further 18%.

**Background**

Only a few decades ago, agriculture was evaluated exclusively on it's capacity to produce plentiful, cheap food. The main aim of both farming and society was to achieve efficiency of production, resulting in lower prices. The increasingly intensive methods of agricultural production were often employed at the expense of the environment and natural resources. In more recent years, discussions on farming are not just focused on efficiency alone but also on the use of resources, environmental impact, landscape aesthetics, bioethics and food safety. Growing concerns about animal welfare, food quality and safety have increasingly focused public interest on the methods employed in food production. These concerns are stronger in Europe than in many other parts of the world. Europe has been at the centre of discussions about production surpluses and environmental impacts of intensive agricultural systems. These concerns have been accompanied by a rapid growth in the demand for organic food and led to the introduction of statutory support for organic farming in the EU in 1992.

Organic farming has been defined by the US Department of Agriculture as a production system, which avoids or largely excludes the use of synthetically compounded fertilisers, pesticides, growth regulators and livestock feed additives. But organic farming is more than just "farming without". The aim of an organic farm is to establish a self-stabilising production system, in which pests and diseases are kept at reasonable levels by predators and by enhancing the natural resistance of crops and livestock.

The key elements of organic farming are:

- The extensive management of livestock, paying due attention to the housing and welfare needs of the different livestock involved.
- Creating nitrogen self-sufficiency through biological nitrogen fixation and the recycling of plant and animal waste.
- Maintaining the long-term fertility of the soil by aiding biological activity and minimizing mechanical intervention.
- The elimination of agrochemicals and inorganic fertiliser as well as limiting the use of antibiotics.
- Controlling weeds, disease and pests in crops by well designed rotations, resistant varieties, and increasing diversity
- Conservation of wildlife and natural habitats.

In Europe, agricultural policies are continuing to move towards stricter environmental legislation. These include control of land use, nutrient inputs, animal husbandry, product quality and traceability. Organic farming has preceded these emerging priorities of the EU by offering a "package deal" which guarantees consumers strict standards for all aspects of production, from nutrient inputs to biodiversity and landscape, and from animal welfare to absence of residues in food. EU legislation defines production standards for organic farming within Europe. EU-certified inspection bodies also control the implementation of these standards. Moreover, produce from organic farming is marketed for a premium price under one label that has international recognition.

**Irish Organic Dairy Production**

The Irish organic dairy market is estimated to be worth approximately £1.6 million. This represents about 0.3% of the total dairy products market, significant less than in most other European countries.

There are several reasons for this:-

1. The failure of large dairy processors to become involved in producing organic dairy is largely considered to be a result of the small and fragmented supply base at farm level. Dairy processors do recognize that organic products represent an attractive growth market that offers a good premium, however, they are reluctant to become involved in the sector due to difficulties developing a supply base. There are only a small number of organic dairy farmers in Ireland at present, and any markets that are developed would be limited to the level of raw milk supply.
2. Farmers, for their part, are reluctant to get into organic milk production for a variety of reasons. One is the lack of outlets for their milk and the lack of a guarantee of a premium price. Other difficulties that arise are :-
   a) Land to Quota Ratio – there is clearly a greater land requirement to produce a quota organically than through conventional production. Young farmers starting organic milk production should have access to extra land or extra quota as an incentive.
   b) Housing Standards – the need to increase cubicle size and/or have a large straw bedded area does not appeal to large commercial producers.
   c) Animal Health – there are major concerns among commercial farmers in relation the treatment and prevention of disease. Routine vaccination and routine antibiotic use, and mineral supplementation are not allowed and these are regarded as serious drawbacks for disease control and prevention.
   d) Adequate Feed Supply – adequate feed supply is a major problem, particularly early spring grass. The provision of an organic protein source is also problematic. The provision of organic cereals in a rotational system is difficult and problematic, particularly in soils that are not particularly suited for tillage.
   e) Soil Fertility – maintenance of soil fertility is an integral part of the creation of a sustainable farming system. It will be necessary to replace the nutrients lost from the system from alternative sources. Nitrogen supply and nutrient budgeting are skills essential to maintaining a viable organic system.

There is a need for a coordinated approach to support organic farming in terms of advice, education and research. Teagasc is ideally placed to service these needs on a national basis and could provide a menu of organic training courses at centres in each region of the country.

However, there is a need to research and develop a blueprint for organic production similar to that developed for conventional production at Moorepark

Research Centre in the 60's. In relation to organic milk production, this is now being addressed at Johnstown Castle. There is a 40,000 gallon milk quota. The aim is to draw up a blue print for organic production and to examine it's economic feasibility.

The purpose of this paper is to take a pragmatic view of organic farming. It is proposed to look at the various areas, with a view to identifying the problems, suggesting some solutions and indicating where more research is required.

Fig. 1 outlines the broad areas of activity on the farm.

The areas examined in this paper are:

1. Profitability
2. Cow choice
3. Development of systems
4. Soil Fertility
5. Clover Growth
6. Pasture Production
7. Cereal production
8. Animal Health
9. Animal Housing

## 1. PROFITABILITY

The profitability of organic milk production will be a major factor affecting farmer's plans to convert to organic dairying.

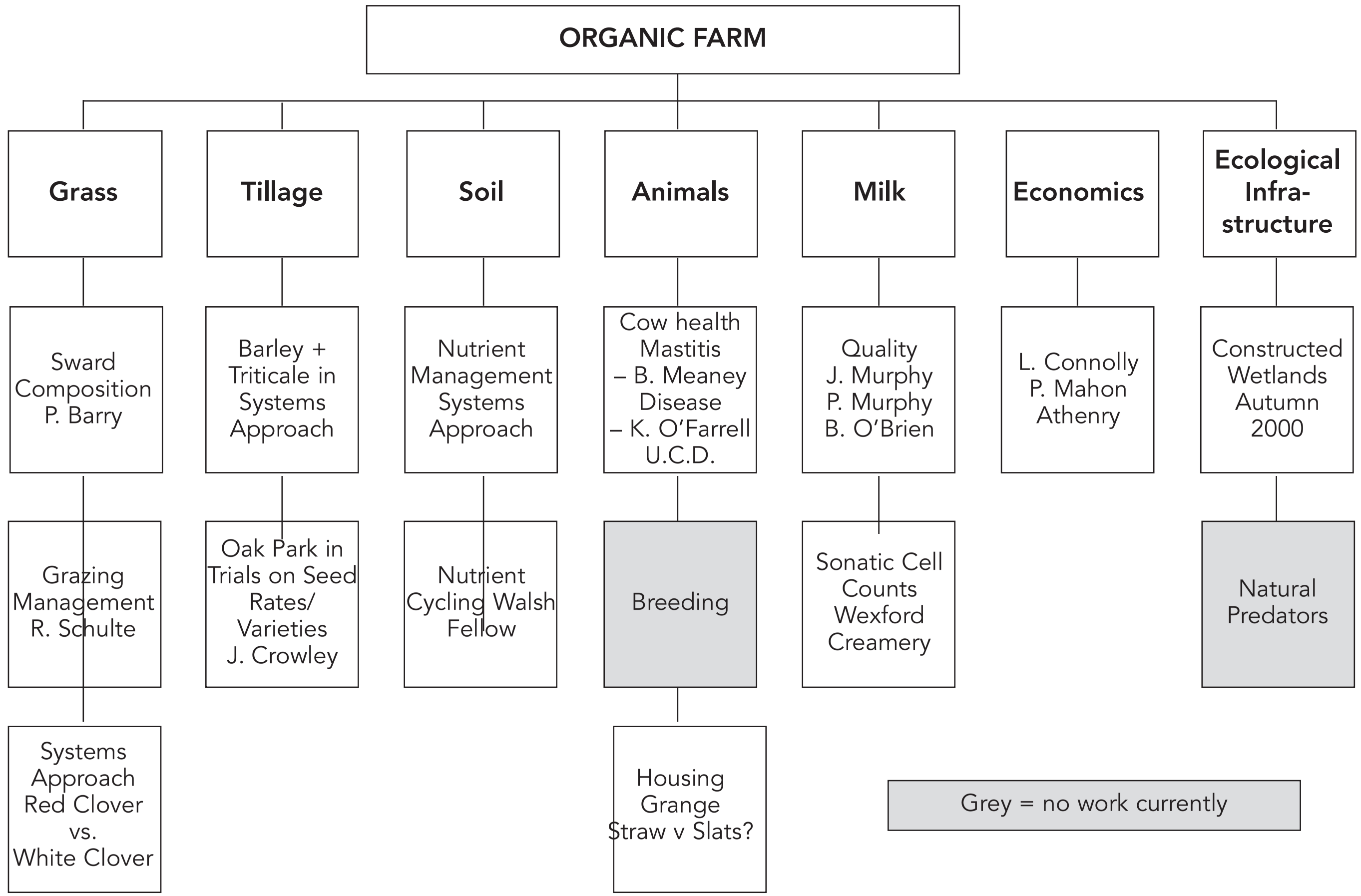
Dairy cow yields

In examining the relative performance of organic versus conventional dairying it is important to differentiate between performance per cow and performance per hectare. Performance per hectare will, in general, be lower for organic production due to lower forage yields and stocking rates. Research on dairy cow yields from other European countries suggest yields for organic dairying in the range 75% to 105% of conventional yields. However, lower stocking rates on organic farms results in milk production per hectare being only 50% to 80% of conventional milk production.

Milk Prices

There is little published information on organic product prices within the EU, either at farm gate or at consumer level. The premia varies from country to country depending on supply and demand, ranging from 8% in Switzerland to 20% or more in Austria, France, Norway and the Netherlands. In our financial analysis of organic dairying in Ireland we have assumed an organic manufacturing milk price of £1.2 per gallon, £1.25 for liquid milk and £0.98 for conventional manufacturing milk.

Fig. 1: Research in the Organic Dairy Farm at Johnstown Castle – July 2000



**Costs**

Reduced variable costs occur on organic dairy farms due to the absence of fertiliser, pesticides and other chemical inputs. However, more expensive purchased concentrates can partially offset this saving. The requirement to use straw bedding for organic production also adds to the costs. Studies carried out in the UK showed organic variable costs at 67% of conventional costs, with organic fixed costs at 112% of conventional costs.

**Organic v Conventional Milk Production**

FINPAK was used to determine the relative profitability of organic and conventional milk production. Two different scenarios were evaluated and a number of options were examined under each scenario.

Scenario A: High performance liquid milk was compared to efficient organic liquid milk. Farm size evaluated was 56.65 ha (140 acres).

**Table 1: Scenario A: Output costs and incomes – conventional liquid milk versus organic liquid milk (56.65 ha).**

| | Intensive Liquid Milk | Efficient Organic Liquid Milk |
|---|---|---|
| Farm size | 56.65 ha | 56.65 ha |
| No. of cows | 60 | 62 |
| Yield (litres/cow) | 5455 | 4546 |
| Milk price (£/litre) | 0.23 | 0.27 |
| | £ | |
| Output (sales + subsidies) | 114,791 | 99,028 |
| Total costs | 61,357 | 55,658 |
| Net income/farm | 53,434 | 43,369 |
| Net income per ha | 943 | 766 |

Scenario B: In this scenario average production of conventional manufacturing milk is compared with that of average production of organic manufacturing milk. Farm size was smaller in this scenario at 44.5 ha.

**Table 2: Scenario B: Output, costs and incomes – conventional manufacturing milk versus organic manufacturing milk and average organic liquid milk (44.5 ha).**

| | Average Conventional Manufacturing | Average Organic Manufacturing |
|---|---|---|
| Farm size | 44.5 | 44.5 |
| No. of cows | 40 | 44 |
| Yield (litres/cow) | 4546 | 4130 |
| Milk price (£/litre) | 0.98 | 1.20 |
| | £ | |
| Output | 62,835 | 64,148 |
| Total costs | 34,332 | 33,955 |
| Net income/farm | 28,502 | 30,193 |
| Net income per ha | 640 | 677 |

With the exception of intensive conventional liquid milk, the output is higher for organic systems due to the premium price for milk. In dairy systems, the additional organic REPS payment was offset by reduced livestock premia as the number of drystock on the farm is reduced.

Net margins were similar for conventional and organic manufacturing milk, but higher from organic liquid milk. At average performance, organic liquid milk yielded £100 more per ha than conventional manufacturing but intensive conventional liquid milk resulted in the highest net margins (£943/ha).

## 2. COW CHOICE

It is clear from the very limited study on profitability that the efficiencies that influence conventional farming should also influence efficiencies of organic milk production. Issues like milk yield, stocking rate, reduced inputs all have a direct bearing on profitability.

One of the first decisions to be made when going organic is the choice of cows. At the outset of the Johnstown Castle project two contradictory pieces of advice were given. The first was to have low yielding, robust cows that would require little feeding, would be extremely healthy and would give milk yields of 2,700-3,150 L. The second advice was in view of the low stocking rate, high genetic merit cows should be used. The decision taken was to acquire British Friesian cows with a genetic potential of circa 4,500 L. As we reach the end of the first year this milk yield has been achieved with a mean stocking rate of 1.6 cows/ha, with approximately 550 kg of meals being fed per cow.

In retrospect, we now feel that cows of higher genetic merit should be used. The objective of the Johnstown Castle herd is to have yields of circa 5,500 litres, at a stocking rate of 1.7 cows/ha. Steps are being taken through the use of A.I. and possible purchase of heifers to upgrade the cow quality. The emphasis will remain on having British Friesian cows, rather than on Holsteins.

## 3. DEVELOPMENT OF SYSTEMS

The quota at Johnstown is 40,000 gallons. It is produced from a spring calving herd (means calving date was March 1). A model has been constructed by W.E. Murphy to determine stocking rates. Grass growth rates, daily intakes throughout the year, silage yields and management inputs were all used in the model to determine the optimum stocking rates and where the likely weaknesses are in an organic system in which perennial ryegrass/white clover provides the main feed. The components of the model are outlined in Figure 2. The main weakness are the lack of early grass and silage yields. This model is currently being tested with 20 of the 40 cows at a stocking rate of 1.5 cows/ha.

In an attempt to improve efficiency a second system was devised using red clover/perennial ryegrass swards for conservation (Fig. 3). Red clover can fix up to 200 kg N/ha, leading to large volumes of silage being technically possible. The model suggests that stocking rates can be improved significantly under this system. The second herd of 20 cows in currently testing this model.

Data on herbage on offer in both of these systems, and in comparison to a sward managed conventionally are summarised in Figs 4 and 5.

The first year of production is still not quite finished, but the milk yields to date are summarised in Table 3.

**Table 3: Yield Parameters**

| | Yield/Cow (L) | Yield/ha (L) |
|---|---|---|
| White Clover Herd | 4200 | 6300 |
| Red Clover Herd | 4400 | 7500 |

**Fig. 2: Model for organic milk production**

| | | | White clover system | | |
|---|---|---|---|---|---|
| Period | Off grass | Date<br>25-Oct | Week No.<br>44 | Meal feeding (kg/cow/day) | Days |
| 1 | Dry off | 15-Dec | 51 | 2.0 | 51 |
| 2 | Mean calving date | 1-Mar | 10 | 0.0 | 77 |
| 3 | On grass by day | 1-Apr | 14 | 4.0 | 31 |
| 4 | Close for 1st sil cut | 2-Apr | 15 | 1.5 | 1 |
| 5 | On grass full time | 10-May | 20 | 1.5 | 38 |
| 6 | Off meal | 10-Jun | 24 | 1.5 | 31 |
| 7 | 1st sil cut + 10 days | 15-Jun | 25 | 0.0 | 5 |
| 8 | Close for 2nd sil cut | 20-Jun | 26 | 0.0 | 5 |
| 9 | 2nd sil cut + 10 days | 1-Sep | 36 | 0.0 | 73 |
| 10 | Start aut. meal feeding | 1-Sep | 36 | 0.0 | 0 |
| 11 | Off grass again | 24-Oct | 44 | 2.0 | 53 |
| | Wt of calf (kg) | | 42 | | |

| | |
|---|---|
| Milk yield/cow(kg) | 5000 |
| 1st cut silage DM yield (kg/ha) | 3500 |
| 2nd cut silage DM yield (kg/ha) | 2500 |
| Ratio area cut1/area cut2 | 2.00 |
| Cut 2 as a fraction of cut 1 | 0.50 |
| Area cut 1 sil/cow(ha) | 0.35 |
| Area cut 2 sil/cow (ha) | 0.17 |

| | | |
|---|---|---|
| Efficiency of utilization of grazed sward (Consumed as % of production ) | = | 85% |
| Efficiency of utilization of silage sward (Consumed as % of production ) | = | 80% |
| % of intake derived from grass when cows are in house at night | | 33% |
| Sward yield as a percentage of JC model | | 70% |
| Sward yield | | 7217 |

| RESULTS | | | |
|---|---|---|---|
| S Rate (cows/ha) | | = | 1.53 |
| Area (ha) req for | 20 Cows | = | 13.10 |
| Possible surplus silage (tonnes) | | = | 126.7 |

| | | |
|---|---|---|
| Silage area req.(ha) —1 cut system | | 9.48 |
| Silage area req.(ha) — 2 cut system | cut1 | 6.99 |
| | cut2 | 3.49 |
| Total meal fed per cow (kg) | | 455 |

**Fig. 3: Model for organic milk production**

| | | | | | |
|---|---|---|---|---|---|
| | | | Red clover system | | |
| | | Date | Week No. | Meal feeding (kg/cow/day) | Days |
| Period | Off grass | 25-Oct | 44 | | |
| 1 | Dry off | 15-Dec | 51 | 2.0 | 51 |
| 2 | Mean calving date | 1-Mar | 10 | 0.0 | 77 |
| 3 | On grass by day | 1-Apr | 14 | 4.0 | 31 |
| 4 | Close for 1st sil cut | 1-Apr | 14 | 1.0 | 0 |
| 5 | On grass full time | 10-May | 20 | 1.5 | 39 |
| 6 | Off meal | 10-Jun | 24 | 1.5 | 31 |
| 7 | 1st sil cut + 10 days | 15-Jun | 25 | 0.0 | 5 |
| 8 | Close for 2nd sil cut | 15-Jun | 25 | 0.0 | 0 |
| 9 | 2nd sil cut + 10 days | 25-Aug | 35 | 0.0 | 71 |
| 10 | Start aut. meal feeding | 1-Sep | 36 | 0.0 | 7 |
| 11 | Off grass again | 24-Oct | 44 | 2.0 | 53 |
| | Wt of calf (kg) | 42 | | | |

| | |
|---|---|
| Milk yield/cow(kg) | 5000 |
| 1st cut silage DM yield (kg/ha) | 5000 |
| 2nd cut silage DM yield (kg/ha) | 4000 |
| Ratio area cut1/area cut2 | 1.00 |
| Cut 2 as a fraction of cut 1 | 1.00 |
| Area cut 1 sil/cow(ha) | 0.18 |
| Area cut 2 sil/cow (ha) | 0.18 |

| | | |
|---|---|---|
| Efficiency of utilization of grazed sward (Consumed as % of production ) | = | 85% |
| Efficiency of utilization of silage sward (Consumed as % of production ) | = | 80% |
| % of intake derived from grass when cows are in house at night | | 33% |
| Sward yield as a percentage of JC model | | 70% |
| Sward yield | 7217 | |

| RESULTS | | | |
|---|---|---|---|
| S Rate (cows/ha) | | = | 1.71 |
| Area (ha) req for | 20 Cows | = | 11.66 |
| Possible surplus silage (tonnes) | | = | 102.0 |

| | | |
|---|---|---|
| Silage area req.(ha) – 1 cut system | 6.64 | |
| Silage area req.(ha) – 2 cut system | cut1 | 3.69 |
| | cut2 | 3.69 |
| Total meal fed per cow (kg) | | 455 |

Fig. 4: Grass Covers 2000 kg DM/ha

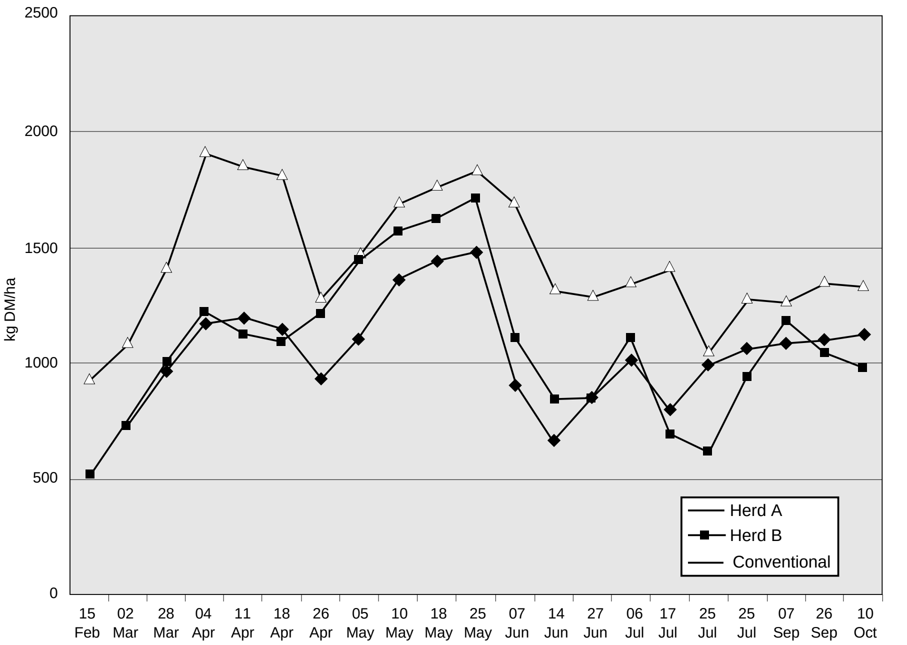
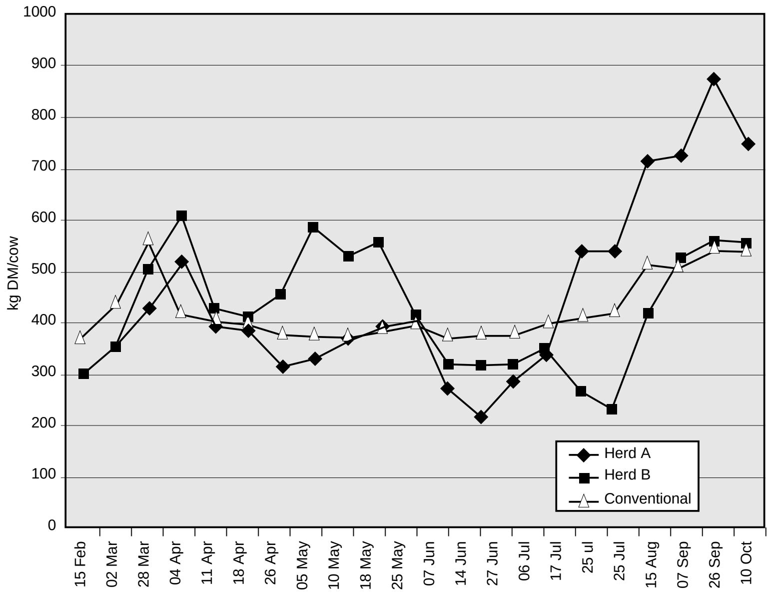



Fig. 5: Grass Available per Cow (Covers over entire grazing area) kg Dm/cow



## 4. SOIL FERTILITY

One of the basic tenants of organic farming is the maintenance of soil fertility through very efficient recycling of nutrients. The soil is not merely a substrate for grass and crops to grow in : proper aeration and liming, and large quantities of microflora micro-insects and earthworms are essential to improve soil structure and to increase the availability of nutrients and minerals from the inert reserves. Soil life, grassland mixtures and cereals in rotation will deepen the soil profile and thus increase the amounts of accessible nutrients.

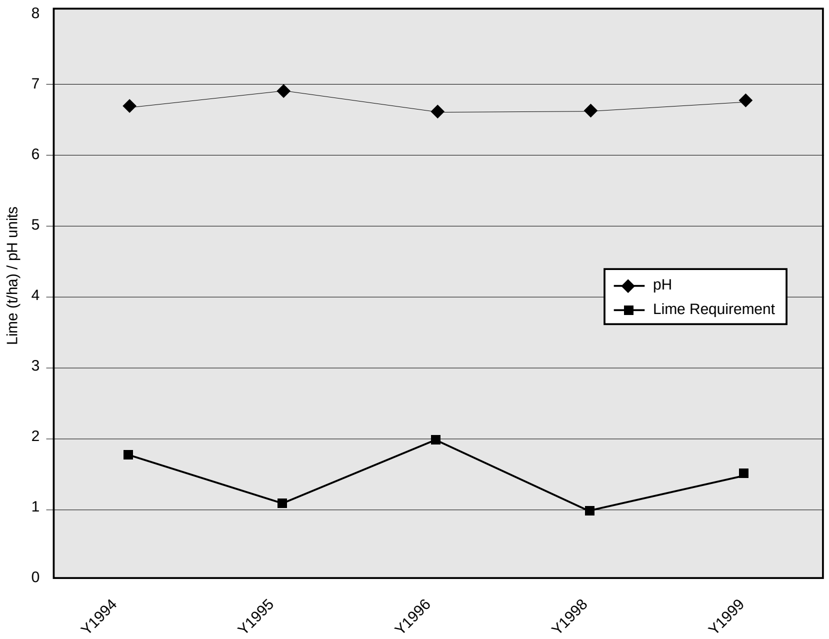
On pastures most of the nutrients and minerals are recycled in the form of animal waste. The majority of nutrient and minerals taken from silage ground are recycled in the form of farmyard manure. This means that conservation of nutrients is of critical importance and there must be very little leakage from heaps of farmyard manure. Farmyard manure must be kept under cover. The lime status and the K states on the Organic farm since 1990 are summarised in Figs 6 and 7.

Even with very efficient recycling of nutrients, there will be a net loss of nutrients from the farm. In the case of cattle and sheep, the actual output of nutrients and minerals off the farm is quite low. One kg of P is removed with every 100 kg of liveweight gain. In the case of dairying, there is considerable removals of nutrients i.e. there is one kg P per 1000 L of milk. If organic farming is to be sustainable these must be replaced. When reserves are low ground rock phosphate or rock potash can be applied.

The organic farm at Johnstown Castle has been in existence since 1990 and nutrients have been recycled as efficiently as possible. Nonetheless Fig. 8 shows that phosphorus levels (using Morgan's extractant) have fallen from above 9 mg/kg in 1990 to a little below three 3 mg/l in 1999. This raises several issues.

- The Current P recommendations are based on replacing P removed by the agricultural system (Teagasc, 1998). Over the past 10 years, the removals have been relatively small and yet the P levels have fallen. All of these fields have been ploughed at least once over the 10 years period and this may have influenced the P status, in that the P has been distributed throughout the soil profile, rather than staying at the surface of the soil.
- Soil samples have been taken at various depths in the profile and using a range of extractions, there is very little evidence of Morgan's P anywhere in the profile (Table 5). Analysis for total P, organic and inorganic P are currently underway in an attempt to account for where the P has gone.
- The phosphorus status in the grazed herbage at various times of the year was analysed and the results are presented in table 6. This shows

**Fig. 6: Soil pH and Lime Requirement on soil samples 1994–1999.**




reasonable P status (mean of 3.4% P for the entire year), certainly enough to meet the dietary requirements of dairy cows (ARC, 1988). This then raises the issue of the role of soil testing and/or soil test methodology in organic farming. Note the low N status over much of year, reflecting the relatively low amounts of clover in the sward, especially in the April/May/June period.

**Table 5:**

| Depth – Soil Profile (mm) | Morgans | mg P/kg Brays | Olsens |
|---|---|---|---|
| 0 mm – 50 mm | 3.20 | 3.27 | 12.85 |
| 50 mm – 100 mm | 3.40 | 3.24 | 13.35 |
| 100 mm – 150 mm | 1.55 | 1.74 | 9.76 |
| 150 mm – 200 mm | 1.65 | 1.41 | 8.18 |
| 200 mm – 250 mm | 0.80 | 0.74 | 6.85 |

**Fig. 7: Averagae K Values Organic Farm 1994–1999.**

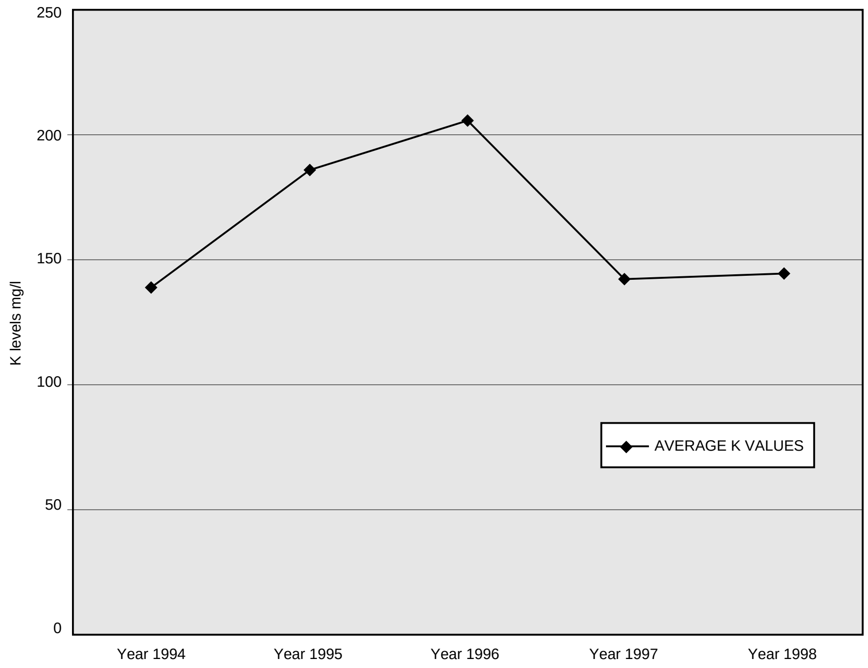



**Fig. 8: Average Soil P levels Organic Farm 1990–1999**

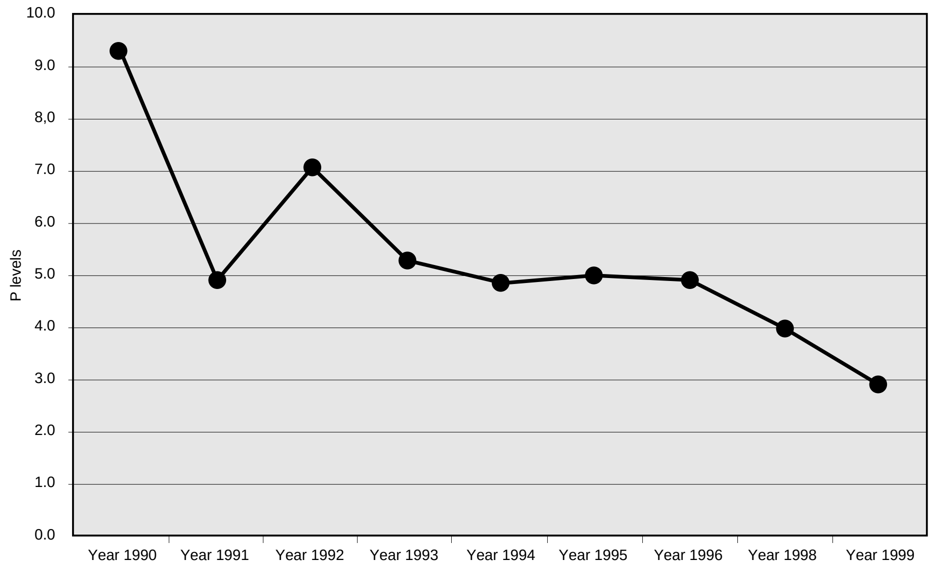


**Table 6: Mineral Status of grazing swards in Year 2000**

| | 21/3 | 9/5 | 31/5 | 13/6 | 4/7 | 26/7 | 3/8 | 7/9 |
|---|---|---|---|---|---|---|---|---|
| P (g/kg) | 3.47 | 2.85 | 3.22 | 3.07 | 3.62 | 2.8 | 3.31 | 4.1 |
| N (g/kg) | 34.2 | 16.8 | 18.6 | 20.0 | 23.4 | 30.0 | 25.4 | 34.2 |
| K (g/kg) | 30.21 | 24.7 | 26.7 | 27.2 | 32.0 | 34.7 | 27.9 | 31.4 |
| Mg (g/kg) | 2.48 | 2.13 | 2.55 | 2.71 | 2.70 | 5.7 | 3.24 | 2.84 |
| Na (g/kg) | 2.36 | 1.74 | 2.1 | 1.62 | 1.40 | 1.0 | 1.47 | 1.8 |
| Ca (g/kg) | 5.38 | 4.86 | 6.0 | 8.42 | 6.64 | 10.0 | 6.3 | 8.0 |

In organic circles there is a belief that farmyard manure is better than slurry, and also that compost is a very valuable commodity. There is very little Irish information on this issue. A Welsh Fellow from University of Limerick has commenced work at Johnstown Castle comparing slurry, compost and farmyard manure for silage production.

The fertilisers allowed and not allowed in organic farming are summarised in Appendix 1.

## 5. CLOVER

A healthy grass/clover sward is the engine that leads to high productivity in organic farming. Assuming reasonable soil fertility levels, nitrogen supply to the plant is the key to sustainable levels of grass growth. White clover, through it's ability to fix atmospheric nitrogen, can transfer nitrogen to the grass plant and thereby encourage grass growth. Grass, without a supply of nitrogen will produce in the order of 5-6 tonnes DM/ha/year and will produce grass in the months of May to September. A clover-based sward can increase the output to 8-8.5 t DM/ha and the grass will be produced from mid-April to late September/early October.

Moreover, clover has the advantage that it can retain it's digestibility right through the season. It is more palatable and leads to better animal intake. A high yielding sustainable clover based system is one that has 80-90% clover ground cover in July/August. This amounts to some 50% of the dry matter production in these months. These targets are difficult to achieve and difficult to maintain.

Table 7 summarises the benefits of a clover based sward in dairying on various parameters of milk production.

**Table 7: Effects of clover on cow performance**

| | Milk Yield (kg/day) | Milk Protein (g/kg) | Milk Solids (kg/day) |
|---|---|---|---|
| Grass – low clover | 23.1 | 27.6 | 2.14 |
| Grass – medium clover | 25.4 | 28.9 | 2.36 |
| Grass – high clover | 25.9 | 29.3 | 2.80 |

The introduction of clover into swards can be done by a variety of ways, i.e. ploughing and reseeding in the normal way, using one pass machines to drill in clover into existing swards and broadcasting clover into pre-prepared existing pasture. It is not proposed to deal at length with these methodologies in this paper, but there are a few basic principles that apply, regardless of methodology.

1. Clover seed is very small and if it is buried too deeply, it will not have sufficient energy to emerge above the ground.
2. The seed must come into intimate contact with the soil. If the seed falls on a matt of old grass, the seedling may germinate, but will not establish satisfactorily.
3. There must be reasonable levels of soil fertility to encourage rapid establishment. Soil P levels and pH are critically important. Generally soil P levels in Index 3, and a pH of 5.3 are considered the conventional norms that should be provided.
4. A firm, flat seedbed is essential.
5. While the seeding rate can vary, the normal seeding rate found in most mixtures of 1.0 kg/ha is simply not enough. In reseeding tillage land 2 kg/ha is probably enough, while with grass to grass reseeding on heavy land, some 4 kg/ha may be required.
6. Time of sowing is critical. Currently over 50% of reseeding is conducted in autumn and if clover establishment is a serious objective of reseeding, then the reseed should be completed by mid August. It is imperative that stolon development commences before the advent of winter.
7. Modern varieties of clovers should be used, such as Aran, Susi, Tara or Donna. A blend of varieties with varying leaf sizes can help ensure successful establishment and maintenance.
8. Clover thrives best in swards with relatively low tiller density. Hence, 40-50% tetraploids, which generally have a low propensity to tiller, should be included in the grass seed mixture.
9. In the months immediately after sowing it is critical that the companion grass be prevented from shading the young clover plants.

### The grazing management of sheep on clover swards

R. Schulte, a Welsh Fellow at Johnstown Castle has worked on management of grass clover swards and some of his findings are recorded in this section.

The grazing of mixed swards with sheep has frequently been associated with a declining clover content (e.g. Evans *et al*, 1992). Sheep have a strong preference for clover, and due to their small mouths, as opposed to cattle, they are able to select white clover leaves from between the grass (Grant *et al.*, 1985). However, the grazing management decides to which extent sheep can exploit their preference. There is experimental evidence that white clover survives better under strip-grazing with sheep than under lenient grazing, i.e. grazing for long periods (Curll, 1982). Whereas sheep are forced to eat grass after the clover under strip-grazing, they may continue to select for regrowing clover leaves under lenient grazing.

A trial is currently being conducted at Johnstown Castle in which sheep rotationally graze a number of paddocks of different sizes (De Wolf & Schulte, *in prep.*). Paddock areas range from 10 $m^2$ per ewe up to 95 $m^2$ ewe, which corresponds with grazing times from approximately 1 day up to 1 week. Preliminary results shows a stronger regrowth of clover during the rest periods on the smaller paddocks than on the larger paddocks:

**Table 8: Influence of grazing times on clover regrowths**

| paddock size ($m^2$ per ewe) | average grazing time (days) | average clover regrowth (kg dry matter per ha) |
|---|---|---|
| 20 | 1 | 1195 |
| 50 | 2.5 | 1150 |
| 100 | 4 | 952 |
| 158 | 6.5 | 904 |
| 190 | 8 | 723 |

The trial will be continued during the following year in order to identify the maximum paddock size at which clover performance can be maintained.

### Management of Grass-Clover Swards

The management of grass-clover mixtures has posed some challenges, as mixed grasslands have frequently been associated with a fluctuating and hence unreliable herbage production. Clover performance depends on a complex of environmental and ecological factors, but can be influenced to a great extent by the grassland management.

## Short-Term Management

### Silage cutting

On the short term (2-3 years), clover growth can be stimulated under a cutting regime (Evans *et al.*, 1992), as this leads to a removal of nitrogen from the field. When the soil nitrogen status is low, clover can compete successfully with grasses, since it is able to fix its own nitrogen from the atmosphere (Curll *et al.*, 1985; Barthram *et al.*, 1992; Nassiri, 1998) Additionally, clover benefits from the open swards, with low densities of grass tillers (Gilliland, 1996), which are left after silage cutting. Silage should be cut at an early stage, before the clover is fully shaded by grass (Schulte, *in prep.*). Large-leaved clover varieties, such as Aran, are able to compete better with grasses in tall swards, and therefore will benefit most from a cutting regime (Evans *et al.*, 1992; Nassiri, 1998).

### Fertiliser applications

On the short-term, applications of fertiliser nitrogen have a detrimental effect on clover, as nitrogen increases the competitive capacity of perennial ryegrass. In absence of fertiliser nitrogen, clover can instead take advantage of its own fixation of atmospheric nitrogen (Curll *et al.*, 1985; Barthram *et al.*, 1992; Nassiri, 1998). In that case, it can only reach its full potential growth when phosphorus and potassium are adequate (Wind *et al.*, 1993).

### Grazing

In contrast, clover performance generally declines under grazing, especially under continuous grazing by sheep (Evans *et al.*, 1992). Sheep, and cattle to a lesser extent, show a strong preference for grazing clover, and are able to select clover leaves from between the grass (Milne *et al.*, 1982; Grant *et al.*, 1985; Binnie & Chestnutt 1994). The larger intake of clover gives grass a competitive advantage. The selective grazing can be reduced by using small-leaved clover varieties, such as Tara (Evans *et al.*, 1992). These varieties keep their leaves so close to the surface, that not all are accessible to the grazing animals (Noy-Meir, 1975; Schulte, *in prep.*)

## Long-Term Management

### Cutting

On the long term (> 3 years), however, a cutting regime inevitably leads to instability, and to strongly fluctuating silage yields between years. The strong clover growth under cutting stimulates its nitrogen fixation, which leads to high organic nitrogen levels in the soil. This nitrogen is made available to both grass and clover, only after mineralisation by the soil-life. The sudden release of nitrogen gives grasses a competitive advantage, resulting in the notorious "clover crash". Only when the grasses have fully depleted the soil from its mineral nitrogen, may clover be able to compete successfully again (Schwinning & Parsons, 1996a; Schulte, *in prep*.).

**Fertiliser applications**

The strength of these grass and clover fluctuations depends largely on the time-span between the fixation of nitrogen and its release through mineralisation. When the fixed nitrogen is made available to grasses, shortly after it has been fixed by clover, the yield fluctuations are smaller and a more stable grass-clover mixture may arise (Schwinning & Parsons, 1996a; Schulte, *in prep*.). It is known that the mineralisation rates by micro-organisms are stimulated by a high soil pH. (Bath *et al*., 1984; Rijtema *et al*., 1991). Therefore the stability and reliability of silage swards can be enhanced by regular lime applications (Schulte *in prep*.), maintaining soil pH levels between 6 and 7.

There is some experimental evidence that the fluctuations of grass and clover under a cutting regime may be smaller when a small amount of fertiliser nitrogen (50 kg $ha^{-1}$) is applied in early spring (Lantinga, *pers. com*; Schulte, *in prep*.). This external nitrogen input may counteract the nitrogen cycle between grass and clover. However, the stabilising effect of small amounts of fertiliser nitrogen is still speculative, and opposite results have also been found (Schwinning & Parsons, 1996b). In no case should large quantities (> 50 kg $ha^{-1}$) of fertiliser nitrogen be applied, as these will turn unstable grass-clover mixtures into equally unstable grass monocultures (Schulte, *in prep*.).

**Grazing**

Contrastingly, grazing leads to stable grass-clover swards in the long term (> 3 years). Although individual patches may still fluctuate as a result of the delayed nitrogen cycle, all patches are continuously set "out of phase" by manure, urine, and the grazing of animals. Therefore the patches compensate for each others fluctuations, which leads to stable and reliable yields of the field.

Moreover, when clover leaves are grazed, most of the nitrogen is excreted, and made available immediately to grasses. Therefore there is no delay between fixation and the release of nitrogen. As a result grazing leads to a stable clover content in the sward (Schwinning & Parsons 1996; Schulte, *in prep*.).

**Conclusions**

In conclusion, cutting silage improves the production of clover in the short term, but leads to instability on the long-term. A grazing regime reduces

Chicory (*Cichorium intybus*) is probably a native species of Britain and may have been introduced into Ireland but it is not common here. (Foster, 1988). Chicory grows well under all soil conditions and once established it is very productive (Thomas *et al*., 1952; Turner, 1955). It has a slightly raised crown producing leafy top growth over a thick, deep tap roots, it has prostrate leaves in winter but as temperatures increase in spring a large number of erect leaves are produced (Rumball, 1986). It's deep roots according to many authors (Thomas et al., 1956; Clapman et al., 1962, Foster, 1988) gives it its drought resistant properties. The best month for germination rate is August but even then it is poor – 51%. Chicory's persistence is high particularly in swards which are not heavily grazed. According to Thomas *et al* (1952) it is the richest of all herbs in phosphorus and also has high levels of potassium, sodium, chlorine, manganese, iron, copper and cobalt which are present at concentrations of two to three times greater than those normally found in perennial ryegrass.

To date, very few conclusions have been drawn, except to state that, in all probably, perennial ryegrass will remain the main-stay of mixtures, with a range of legumes and possibly herbs included at a level that allows for improvement in mineral composition, but does not interfere with yield potential of the sward.

b) Early grass production: One of the main problems with legume based systems is the lack of early grass. Grass measurement made on the organic farm and on the conventional farm at Johnstown in Spring 2000 demonstrate this very clearly (Fig. 5). Grass growth in March 2000 was 40 kg/ha/day in nitrogen rich swards and was 25 kg/ha/day in the organic farm.

The easiest solution to this is to make more silage. However, as in conventional farms, one of the principal methodologies used to reduce costs is to maximize grazed swards, and minimize the amounts of silage required. Therefore there must be emphasis on increasing the availability of early grass. The elements that determine early grass are well known, autumn management, soil phosphorus levels, sward type, soil type, timing and rate of N application and temperature in spring. There is some work ongoing that is examining the effects of dates of autumn closure on growth in spring. The influence of biomass on clover survival into the following year is part of this study. Patterson, Laidlaw and McBride (1995) showed that stolen numbers can suffer a net loss as a result of the presence of a high grass canopy over winter. Yet, if grazing is too tight in the back-end, growth in March/April is retarded (Culleton and Lemaire 1991).

productivity, but over time results in stable and reliable grass-clover mixtures. In order to safeguard both the productivity and the stability of grass-clover pastures, alternation of cutting and grazing appears to be a promising compromise. Swards should be cut when clover levels fall, and grazed as soon as satisfactory levels have been reestablished (Laws & Newton, 1992; Fothergill, 2000). There is some evidence that the clover variety Alice may be most suitable under such alternating management systems, due to its flexible leaf size: Alice produces large leaves under cutting, and very small leaves under grazing.

Lime should be applied regularly, in order to maintain a soil pH between 6 and 7. Phosphorus and potassium levels should be adequate.

## 6. PASTURE PRODUCTION AND QUALITY

There are a wide range of issues that need to be tackled in this area, although to date, we have only succeeded in tackling two of them.

a) Mineral Supplementation
b) Early grass production

An important role for herbs has been identified in organic farming where routine mineral supplementation is not allowed, so increased mineral consumption must be provided from other sources. Grass on many Irish farms can have low nutrients levels, especially under high nitrogen regimes as well as multiple deficiencies of trace elements such as Cu, Se, I and Co (Murphy & Rogers, 2000).

Herbs have been considered as deep-rooting mineral-rich plants which can aerate the sub-soil through their long tap root system and can bring minerals from far down the soil profile to above-ground parts of the plant where they can enrich the sward and upper layers of the soil and subsequently improve the diet of the animals (Foster,1988).

The species which are included in seed mixtures for the establishment of pasture are generally plantain (*Plantago lanceolata*) and chicory (*Cichorium intybus*).

Plantain (*Plantago lanceolata*) is a native perennial species which is widely distributed throughout the British Isles particularly in grassy places on basic and neutral soils (Clapham *et al.,* 1962). Plantain is defoliation resistant and is highly palatable to animals. The taproot penetrates deeply into the soil and confers drought resistance in dry grasslands. Plantain contains good levels of phosphorous, calcium, potassium and chlorine, also of nitrogen particularly in the leaves, higher levels of sodium than in any other plant but low levels of magnesium, of the minor elements plantain is rich in copper and cobalt but poor in manganese. (Thomas et al., 1952).

## 7. CEREAL PRODUCTION

As in conventional farms spring calving cows require in the order of 500 kg of concentrates per year. Currently organic cereals cost in the order of £200 @ tonne. One way of reducing this is to grow barley on the farm. A crop rotation to supply adequate barley for cows has several advantages:-

a) Cheap source of concentrates
b) Supply of straw
c) Opportunity to reseed and reinvigorate the clover sward.

Against this background cereals have been grown on the Johnstown Farm since 1990, will only limited success. Yields of winter barley in the order of 2.5-4.0 tons/ha were achieved in 1999. Because of the low yields, Oak Park, who are the specialist cereal researchers have become involved in this project. In 2000, winter barley, spring barley and Triticale yielded 3.9, 4.5 and 4.7 t/ha respectively. Oak Park is currently allocating 12-15 ha to exclusively organic cereal production.

To date no work has been conducted on protein requirements of cows, or on the growth of crops that could supply increased levels of protein. The whole area of cow nutrition in organic systems has yet to be tackled.

## 8. ANIMAL HEALTH

In organic farming prevention of diseases in the main objective in respect of the animal health. Routine dosing of conventional drugs is therefore strictly prohibited. In cases where diseases occur, herbal or homeopathic medication is preferred. Nevertheless, if strictly necessary, conventional drug treatment of individual sick animals is permitted in exceptional cases.

In organic farming the objective is to sustain animals in good health by adopting effective management practices, including high standards of animal welfare, appropriate diets and good stockmanship, rather than depending on the use of conventional veterinary intervention with prophylactic antibiotics, anthalmintics, vaccines or micronutrient supplementation. The hypothesis that adoption of appropriate management negates much of the intervention in modern dairy farms is based on the premise that these interventions are unnecessary and merely symptomatic of deficiencies in management practices.

While a limited amount of literature in available on the health of organic herds much still remains to be investigate (Weller and Cooper, 1996, 2000).

In the course of the last year there have been various diseases incidences and it has become clear that research is urgently required on whole range of issues. The diseases that caused the most problems were mastitis, stomach worms, pneumonia, with the odd case of bloat.

A new study was initiated in July 2000, in conjunction with the Vet College in U.C.D. The aims of the project are as follows:

1. To establish baseline data on disease incidence on Irish organic dairy farms.
2. To compare these data with data from matched conventional Irish dairy herds.
3. To measure the economic cost of disease and analyse the cost/benefit of any intervention.
4. Using the newly established organic dairy farm at Johnstown, to design and implement treatment protocols for individual diseased animals in organic herds.
5. Using the newly established organic dairy farm at Johnstown, to design and implement disease prevention protocols for organic dairy herds.
6. To assess indicators of animal welfare on the Johnstown organic farm.
7. To study the selected immune responses of animals on the Johnstown organic farm.
8. To study antimicrobial resistance patterns in organic dairy farms.
9. To investigate implications of manure composting on animal health in organic farms.
10. To critically examine regulations governing organic farming, their implementation, and implications from an animal health perspective.

Probably the biggest problem is mastitis. To date, we have earned that diligence and care in the milk parlour are the most important facets of mastitis prevention. After detection, cows are milked 2-3 times/day. Cows have also been treated with both herbal medicines and by homeopathy. It is not known at this stage which (if any) are effective. It is an area that warrants very urgent attention.

## 9 ANIMAL HOUSING

From a farming point of view, the issue of animal welfare, as manifested by the type of housing for overwintering is of crucial importance. The organic movement has a strong preference for straw bedding, as opposed to slats or cubicles. There is considerable debate about this issue. Cubicles and slats must be treated quite differently. Modern well-designed cubicles are extremely comfortable and it is likely that a compromise will be reached that allows cubicles with, perhaps, chopped straw, provided the cubicles reach certain minimum sizes.

It is unlikely that slats over the entire house will be acceptable to the organic movement and there is some scientific evidence that given a choice, beef animal preferred straw, to slats (Lowe, Steen and Beattie, 2000). The objective of their work was to examine cattle preferences for different floor types, in order to provide scientific information that will be valuable in formulating a policy on the housing requirements of beef cattle. They concluded that finishing beef cattle preferred straw, then saw dust, then rubber mats and then slats. In particular, these preferences were prevalent in lying choices. It is likely that comfort for lying is the main feature determining the choice of flooring.

The problems with straw bedding are the availability of straw and the cost of labour in bedding every day.

**Future**

It is very difficult to predict what the future holds for organic dairy production. There is little doubt that demand will continue to grow in Europe. However, without the entry of some processors, it is difficult to see a rapid expansion in the near future. In a recent report by Teagasc which was chaired by K. O'Farrell (Moorepark) it was envisaged that this sector could grow from 20 farmers at the moment to perhaps 300 by 2006.

One of the problem with dairying is quotas versus land, in that for many dairy farmers a change to organic would involve:-

a) Disposing of part of the quota and this is unlikely
b) Disposing of all the other enterprises, like dry stock production or tillage.
c) Renting/buying more land.

This quandary will, in all probability, get worse in a post quota era, when production restrictions are removed, where cow yields will have to improve dramatically and stocking rates will probably get even tighter. The contrast between intensive production and organics will become even more extreme.

Despite this, the fact remains that there is a market for organic milk products and in all probability a premium will remain for the foreseeable future. Against this background these will probably be a slow but steady increase in organic dairy production.

The prospects for the beef sector are perhaps a little brighter in that there is already a demand for organic beef; there are processors who are actively looking for organically grown beef animals. Finally there are many farmers who could convert to organic beef production, without too major a shift in their production systems.

**Conclusions**

1) The organic dairy unit is nearing the end of the first grazing year. The output was 960 gallons/cow at a stocking rate of 1.55 cows/ha. 500 kg of meals was fed per cow.
2) The aim is to improve the milk yields per cow to 1,200 gallons and to improve the stocking rate to 1.7 cows/ha.
3) British Friesian have proved successful and also give a good beef calf.
4) One of the main problems encountered is the lack of early grass. Work has commenced to find ways of improving early grass supply.
5) There is a problem with animal health, especially mastitis. This situation remains unsatisfactory. Work has commenced in this area.
6) The issue of mineral supplementation is being tackled by an investigation into the growth of herbs (plantain and chicory) in pastures.
7) The problem of poor yields of cereals is being tackled by Oak Park Research Station.
8) The maintenance of soil fertility is critical for feed supply and clover growth. This can only be done by efficient recycling of nutrients on the farm. Some supplementation with ground rock phosphate and/or rock potassium will be required in the long term.
9) White clover is the engine that drives organic farming and more work is required on the establishment and maintenance of it in organic farms.
10) The issue of animal housing, as expressed by strawing bedding systems v cubicles and slats needs to be resolved.

APPENDIX 1

**Supplementary Nutrients**

Mineral fertiliser should be regarded as supplement to, and not a replacement for, nutrient recycling within the farm. A slow and balanced uptake of nutrients by the plant must be aimed for. In general, only fertilisers that release nutrients through an intermediate process, such as weathering or the activity of soil organisms, are allowed.

Single mineral or naturally occurring compounds are recommended. Compounded organic fertilisers must be specifically approved by the Certification Panel before use.

Restricted use of some highly soluble nutrients, either naturally occurring or recycled organic material (e.g. blood meal) will be allowed in certain situations. In the absence of more acceptable inputs, restricted use of soluble fertilisers to treat severe potassium or trace element deficiencies is allowed with the specific approval of the Certification Panel.

| | |
|---|---|
| Permitted | Stone meal (ground basalt).<br>Herbal sprays.<br>Homoeopathic and biodynamic preparations as foliar feeds.<br>Rock Phosphate.<br>Feldspar.<br>Magnesium limestone (dolomite).<br>Calcium sulphate (gypsum).<br>Ground chalk and limestone.<br>Seaweed (free from non-approved products).<br>Unadulterated seaweed and plant-based foliar sprays.<br>Calcified Seaweed.<br>Basic slag.<br>Rock potash*.<br>Symbol approved organic fertilisers/liquid feeds.<br>Wood ash.<br>Fish meal.<br>Unadulterated Fish Blood and bone meals.<br>Calcined aluminum phosphate. |
| Restricted | Proprietary organic fertilisers and liquid feed without Symbol approval.<br>Dried blood – in spring or on over wintered crops.<br>Wool shoddy, hop waste.<br>Leather meal. |

| | |
|---|---|
| Restricted (contd.) | Sulphate of potash – only where exchangeable K levels are low and clay content is less than 20%.<br>Sulphate of potash magnesium.<br>Epson Salts.<br>Trace elements – boron, iron, copper, manganese, molybdenum, and zinc – following the submission of a soil/leaf/blood analysis.<br>Sulphur following the submission of a soil analysis.<br>Magnesium rock (Kieserite) – only where exchangeable K levels are low and clay content is less than 20%.<br>Meat, bone, hoof and horn meal – for horticultural field.<br>NB – Permission from the Certification Panel must be gained before<br>Restricted products can be used. |
| Prohibited | Fresh blood.<br>All other mineral fertiliser including:<br>Nitrochalk, Chilean Nitrate, Urea<br>Muriate of Potash, Kainit, Slaked lime, Quicklime<br>Guano<br>Meat, bone, hoof and horn meal – for agricultural field use. |

*Northern Ireland producers please note that rock potash is only allowed where it has a relatively low immediate solubility in water and a low chlorine content.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