Organic Milk Production

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Information leaflet 1: Farm production and performance

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INTRODUCTION

Until 1996 converting to organic milk production was not a viable option for many dairy farmers due to the relatively high gross margins from more intensive systems and the lack of an adequate price and market for organic milk in many areas of the UK.

However, following a sharp rise in the demand for organic products, an increase in the premium payable for organic milk and a decline in the basic milk price there has been an increase in the number of farms converting to organic production. In 1994 MAFF introduced the Organic Aid Scheme to provide financial support during the conversion period and this has contributed to the increased interest in organic production.

Converting from conventional to organic farming has an impact on both the management of the farm and the level of crop and animal production as shown by the results below. For many farms the change from a system based primarily on monoculture ryegrass swards grown with purchased fertilisers to organic management will lead to either an increase in the land area required for the dairy herd or a reduction in the stocking density.

The information in this Bulletin is based on the experience obtained from converting the Tŷ Gwyn farm at IGER, Trawsgoed to organic production. The farm was previously managed as a conventional dairy unit with a fertiliser input of 380 kg N/ha. It was converted to an organic management system in 1992 and received full organic certification in July 1994. The crop rotation established on 70% of the field area is based on perennial ryegrass/white clover and Italian ryegrass/red clover leys with cereal crops which are cut for whole-crop silage. The remaining fields have been maintained as permanent pasture with the clover content increased by strip seeding where necessary. No fertilisers, other than lime, have been applied since 1991.

Physical details of Tŷ Gwyn farm, Trawsgoed

Location: 12 km SE of Aberystwyth in mid Wales

Farm area: 94 ha

Altitude: 60 - 100 metres
Rainfall: 1200 mm

Soil: fine loams with areas of gley soils

SOIL FERTILITY

A primary objective of organic agriculture is to maintain a healthy soil with a high content of organic matter and high biological activity to encourage the efficient recycling of nutrients. As organic matter accumulates under grass swards, soils on grassland farms generally contain satisfactory levels of organic matter, whether they are managed organically or conventionally. However, this organic matter also represents an important reservoir of N and must be managed carefully if the N is to be used effectively by the crop and if excessive losses are to be avoided.

Biological fixation is the main form of N input to organic farms. At Tŷ Gwyn, the annual input by fixation was estimated to be about 100 kg N/ha when averaged over the whole farm area. However, purchased feeds were also an important source of N. Together with other minor inputs, these provided a total annual input equivalent to 180 kg N/ha. As in all productive dairy systems, whether organic or conventional, only a small proportion of the N input was recovered in the milk and livestock sold from the farm. At Tŷ Gwyn, this accounted for 21% of the input, leaving a surplus of 140 kg N/ha to be accounted for in other ways. Some of this N may have been incorporated into soil organic matter but the remainder will have been lost through leaching and as gaseous emissions. All these forms of N loss may cause environmental damage; however, the size of the surplus and direct measurements of leaching at Tŷ Gwyn indicate that losses are less than would be expected from an intensive, conventional dairy farm.

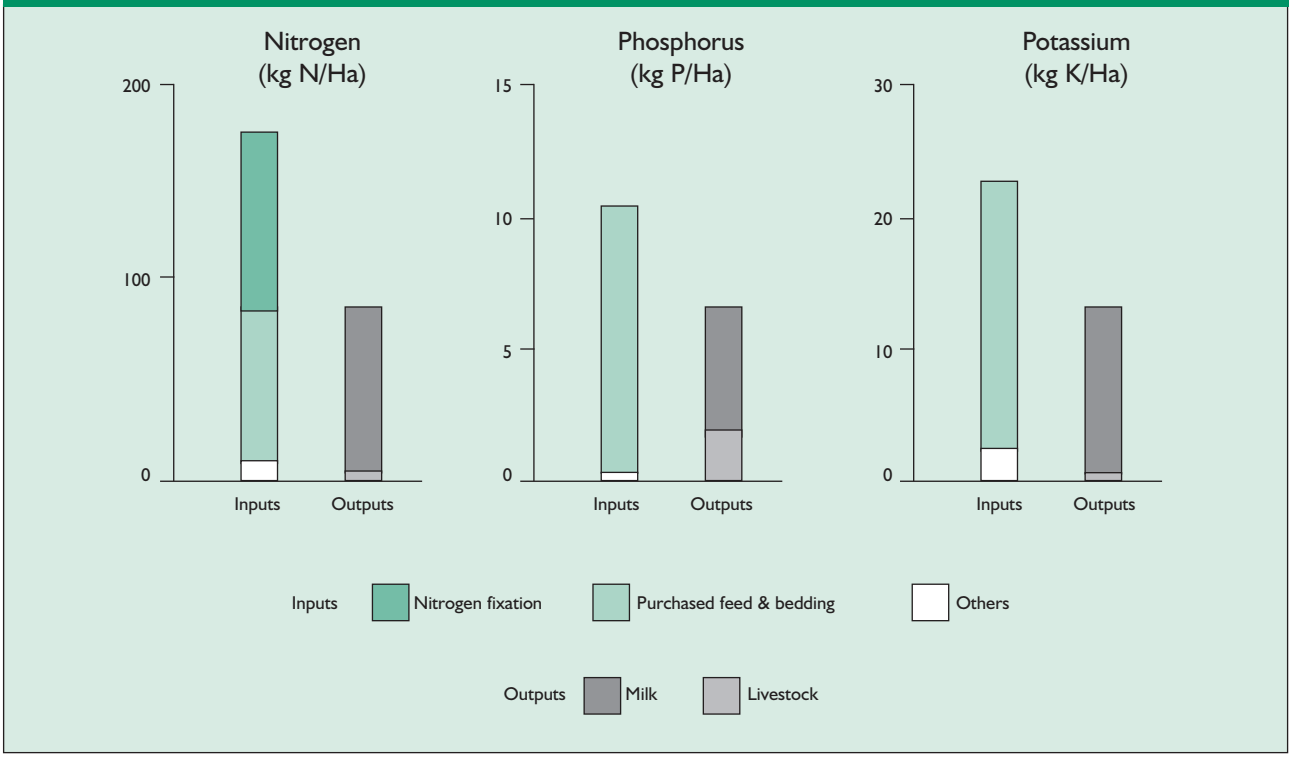
Ploughing of grassland increases the risk of nitrate leaching and may be of particular concern in organic farming because of the high proportion of short-term leys. However, the risks should not be overstated as only a proportion of the farm is generally ploughed in any one year and will have less impact on the overall loss from the farm as a whole. To minimise

losses, it is important to ensure that soils are not left uncropped in the autumn and winter. In the rotation at Tŷ Gwyn, leys that are to be sown with cereals are ploughed in spring and undersown with a grass/clover mixture. This allows the following ley to become well-established before autumn. The sward is able to utilise N that is released through mineralisation of soil organic matter and which otherwise would be at risk of being leached. In some rotations, it may be necessary to include catch crops to utilise the N that is mineralised during autumn.

Although the productivity of the organic system is largely determined by the input of N, this is reliant upon biological fixation and the presence of a satisfactory proportion of clover in the sward. It is therefore important that soil contents of P and K should be sufficient to maintain a healthy clover population. In the absence of regular inputs of fertiliser, an organic farm will be dependent on soil reserves and on the P and K supplied in purchased feeds. Purchased straw for bedding is usually only available from non-organic sources but may also provide significant quantities of K. At Tŷ Gwyn, the quantities of P and K brought into the farm in feed and bedding were sufficient to replace the nutrients exported in milk and livestock sales. There were small surpluses which approximately balanced the quantities that would be expected to be lost through unavoidable leaching losses. Measurements of the contents of extractable P and K in soils at Tŷ Gwyn (and on other organic dairy farms) also indicated that balances were satisfactory. Contents showed no evidence of a decline during 6 years of organic management, in spite of no fertiliser having been applied. It is too early to determine to what extent the release of P and K from soil reserves built-up during the previous conventional management may have contributed to the maintenance of satisfactory P and K levels.

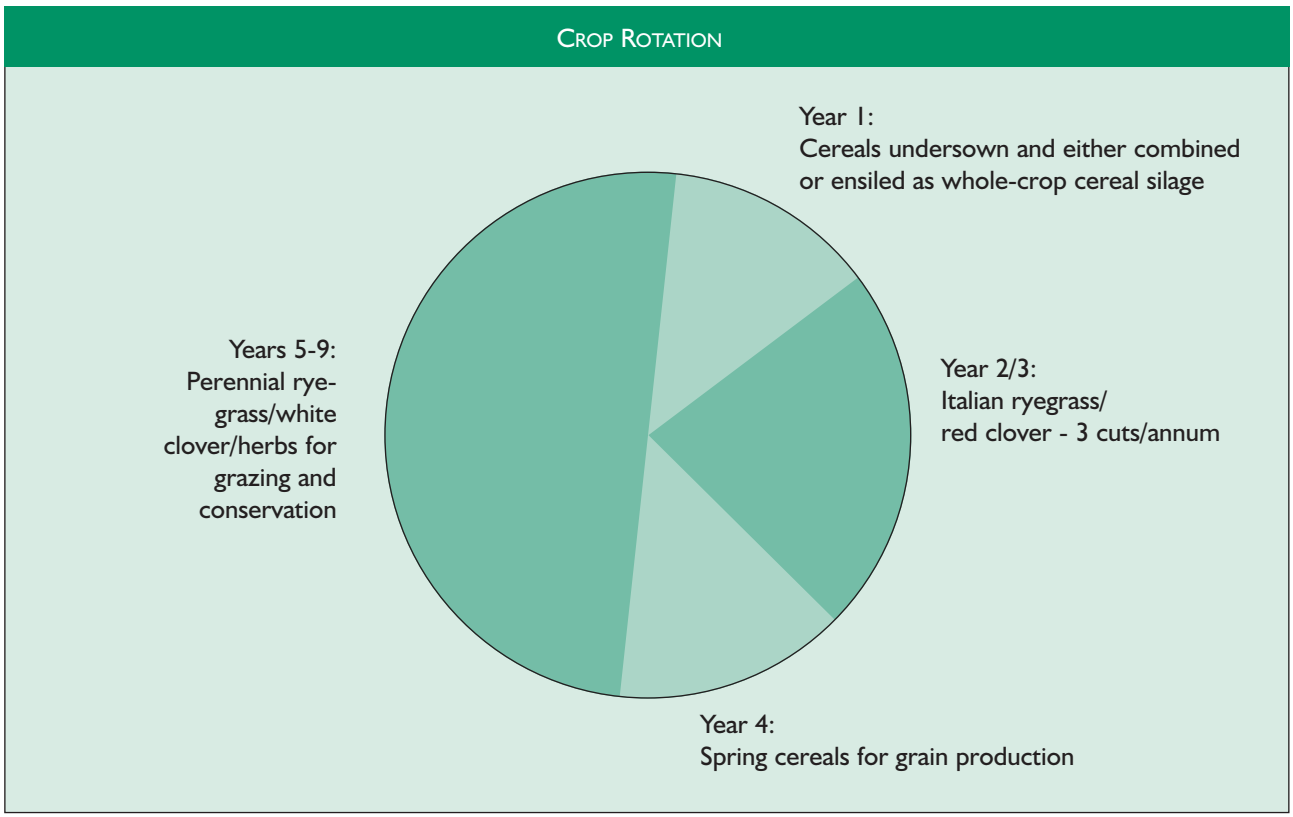
The nutrients entering the farm in purchased feed and bedding are returned to the fields in slurry and manure, together with the nutrients removed in previous silage crops. With the limited supplies of P and K available to the organic farmer, it is important that manures are used efficiently to supply the nutrients where they are most needed. In most dairy systems, this will be to replace the large quantities of P and K removed from fields that are regularly cut for silage.

ANNUAL BUDGETS FOR N, P AND K FOR THE ORGANIC DAIRY FARM AT TY GWYN, TRAWSGOED, COMPARING INPUTS OF NUTRIENTS WITH QUANTITIES RECOVERED IN AGRICULTURAL PRODUCTS (MEAN 1992 – 1998)



CROP PRODUCTION

Organic production requires the establishment of an effective legume-based crop rotation that includes both N-fixing (e.g. white clover, red clover, lucerne) and N-demanding (e.g. grass, cereals, fodder crops) crops. On farms where for practical reasons all the land area cannot be included in the crop rotation other techniques including slot-seeding, slurry injection and the application of composted manures are available to increase the productivity of these permanent swards whose diversity of plant species will include not only perennial ryegrass and white clover but also many other broad-leaved species and grasses.

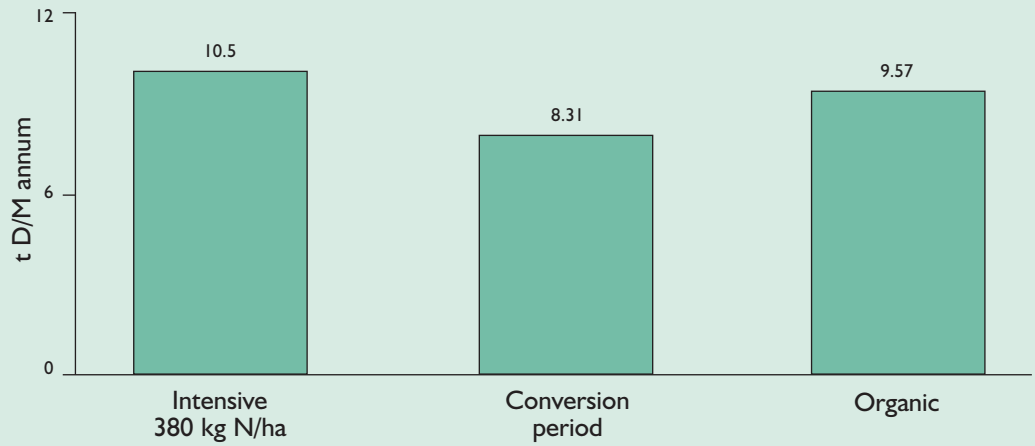


Crop production will be lower during the conversion period but increase when the crop rotation is fully established and both red and white clover are contributing 100-150 kg N/ha to the system. The graph below shows the changes in yield when a dairy farm is converted from a high nitrogen system in the minimum conversion period of two years. The changes in yield are less marked for farms either changing from a less intensive system or converting over a period greater than two years.

Italian ryegrass/red clover swards grown with only slurry and on-farm manures will produce an average of 10.4 t DM/ha (range 9-14), re-seeded perennial ryegrass/white clover swards 9.7 t DM/ha (range 8-11) and permanent pastures 8.5 t DM/ha (range 7-10). In addition to the production from grass/clover mixtures spring-sown cereals harvested at 25-35% DM have the potential to produce 8.5 t DM/ha when harvested as a whole crop and ensiled as silage.

The production of adequate quantities of herbage both for grazing and conservation is dependent not only on the nitrogen produced by clover fixation but also on the efficient utilisation of the on-farm wastes produced by the dairy herd. An effective strategy for the utilisation of on-farm wastes may include the application of slurry primarily to the Italian ryegrass/red clover swards that are conserved as silage with solid manures applied to the perennial ryegrass/white clover swards prior to the grazing season. The use of a dual spreader to ensure the solid manure is chopped finely and distributed evenly over the whole field will prevent spoilage of the herbage and improve production from these grazing swards.

CHANGES IN ANNUAL HERBAGE PRODUCTION (t DM/ha)



The technique of slot seeding Westerwold ryegrass, Italian ryegrass or rye into the existing swards during the autumn period will provide extra yield and early growth, with the result that the dairy herd can be grazed 10-14 days earlier in the spring period. Slot-seeding allows the organic herd to commence grazing in the Spring at the same time as conventional herds start grazing fertilised ryegrass swards.

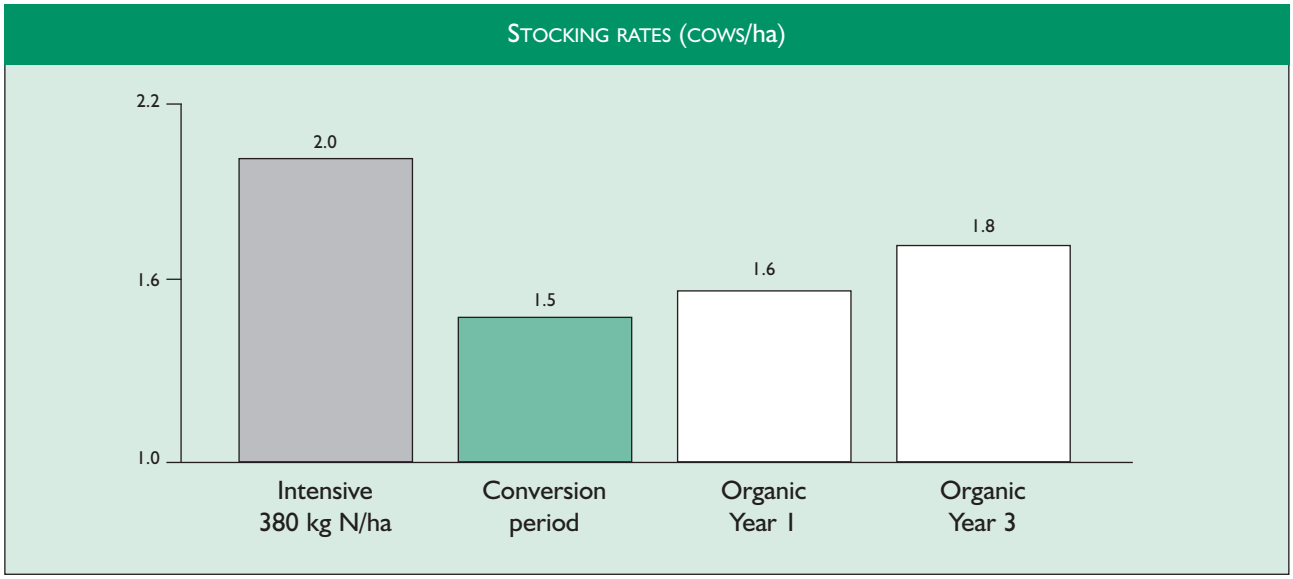
Weeds, with the exception of docks, are not a major problem. The establishment and maintenance of dense swards, good grazing management and topping during the grazing season prevents docks increasing. Conservation of newly-sown, open swards leads to an increase in dock numbers.

In addition to aiming for optimal yields from the crop rotation the production of high forage quality is essential to meet the nutritional requirements of the dairy herd. The following table shows the average quality of grass/clover silages conserved with an inoculant and the differences recorded in quality between years and silage types:

Silage type:		Perennial ryegrass /white clover		Italian ryegrass /red clover	
	Year:	1	2	1	2
Cut 1:	pH	3.80	4.08	3.80	3.85
Crude protein %		13.7	14.1	17.8	16.2
ME (MJ/kg DM)		10.6	11.3	10.7	10.9
Ammonia N (% of total N)		4.97	2.30	5.71	6.71
Cut 2:	pH	4.07	4.98	3.95	4.73
Crude protein %		17.5	20.3	20.7	20.5
ME (MJ/kg DM)		10.3	10.2	11.3	9.7
Ammonia N (% of total N)		7.76	9.00	4.16	7.54

ANIMAL PRODUCTION

The graph below shows the changes in the stocking density of the IGER Trawsgoed organic dairy farm. The changes in total herbage production following the conversion of the farm from an intensive system led to a decline in stocking density from 2.0 cow equivalents/ha when the farm was managed conventionally to 1.5 during the conversion period. However, with the establishment of the crop rotation and improvement in the performance of the permanent pastures the stocking density increased to 1.8 cow equivalent/ha in the third year of organic management.



The integration into the rotation of crops to provide concentrate feeds has a beneficial effect in terms of achieving a better nutrient balance within the whole-farm system. However, stocking densities will be lower and the production of home-grown concentrate feeds needs to be evaluated in relation to both financial viability and the effect on the nutrient supply within the system.

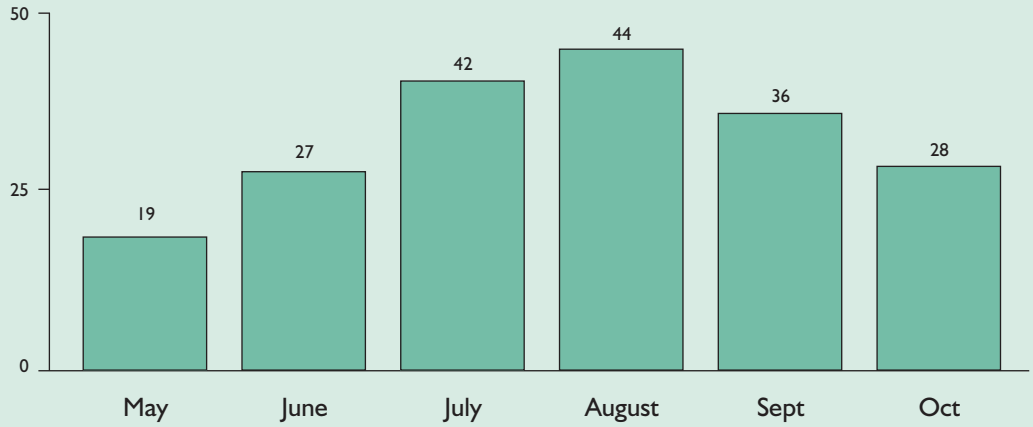
Although the standards for organic milk production restrict the proportion of concentrate feeds in the total diet, differences recorded between organic herds in the forage to concentrate ratio has been shown to have a marked effect on both stocking density and nutrient balance of the whole-farm system.

Grazing management of the grass/white clover swards is key factor in the successful operation of the system and experimental trials have shown that over-grazing of swards can lead to a reduction in the following year of both total herbage yield and the proportion of white clover in the sward. Good management of the swards can be achieved using a set stocking system for the dairy herd. When swards heights are measured using a rising-plate meter the optimum height of the available herbage (excluding contaminated areas) will be 6-7 cm. At this height over-grazing of the grass/clover sward is avoided, ensuring that the annual contribution of white clover to the total herbage yield remains above 30% and herbage quality remains high throughout the grazing season.

Measurement of the average digestibility of continuously-grazed perennial ryegrass/white clover swards maintained at a constant sward height throughout the grazing season will be 75.6% and the crude protein content 21.2%. Herbs sown with ryegrass/clover seed mixtures provide an extra source of minerals for the herd. However, some herb species will persist in the sward for only a short period of time.

When cows are allowed daily access to an adequate supply of herbage the incidence of bloat is generally low. However, restricting the quantity of available herbage prior to the grazing of lush clover-rich swards will increase the risk of bloat problems.

AVERAGE CONTENT OF WHITE CLOVER (%) IN A MIXED GRASS AND CLOVER SWARD



The management of an organic dairy herd requires the feeding of high forage diets and depending on the stage of lactation forage (either grazed or conserved) will provide 60-100% of the total daily feed requirements. Many herds in the UK are housed for 190 days or more each year and in addition to adequate herbage for grazing, the rotation must provide between 2.8 and 3.5 t DM/cow of silage and other forages for feeding during the winter period. The supplementation of forage with concentrate feeds has a major effect on the physical and financial performance of the system depending on whether these feeds are home-grown or purchased. A reserve stock of forage should be maintained for utilisation in seasons when crop growth is lower or the length of the winter housing period longer than normal. Unlike conventional systems the organic farm does not have the option of increasing concentrate inputs when forage stocks are either low or of poor quality.

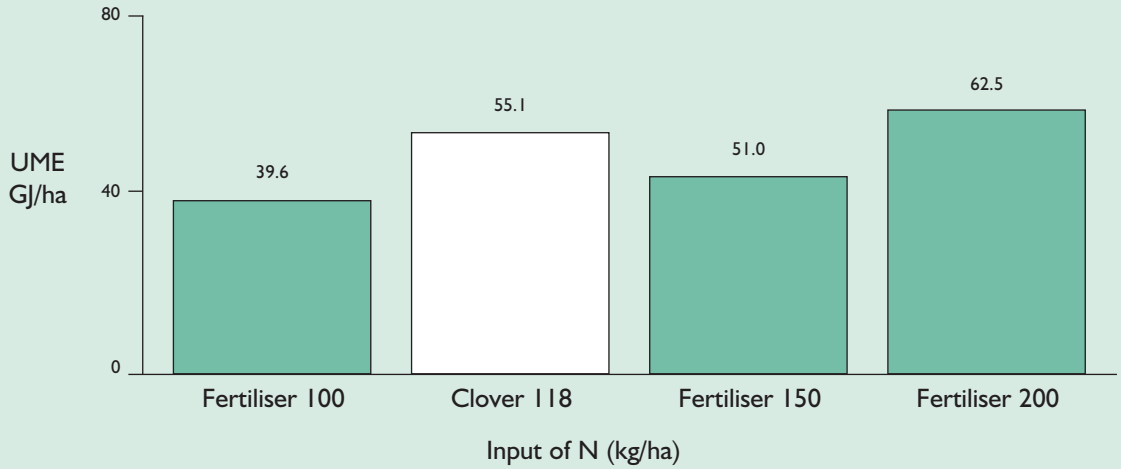
When grown in mixed grass/clover swards the high intake characteristics of both red and white clover have the potential to improve feed intake and milk output from organic diets based on a high content of forage. Holstein-Friesian cows in early lactation offered 6.5 kg of concentrates per day and allowed *ad libitum access* to Italian ryegrass/red clover silage recorded an average total feed intake of 18.85 kg DM/day, silage intakes of 12.35 kg DM/day and 36.6 kg of milk/day.

When mixed swards are conserved as silage the high protein content of the clover plants allows the inclusion in the diet of concentrate feeds with a lower protein content, leading to a reduction in total feed costs. For many farms a shortage of energy in the total diet, especially for cows fed silage-based diets during early lactation, will be a more critical factor than a lack of protein. Lack of energy in the diet is correlated to low protein concentrations in the milk and the inclusion of starch-rich feeds, including cereals, is essential.

The level of production of milk from forage is an important factor on dairy farms and calculation of the utilised metabolisable energy (UME) is a useful method of estimating the efficiency of forage utilisation on the farm and can be readily calculated from the data that is recorded on most farms. The graph overleaf shows the effect of increasing fertiliser inputs on improving the UME values of conventional dairy farms compared with an organic farm where red and white clover replaced purchased fertiliser as the main source of nitrogen for crop growth. When an effective crop rotation has been established the average UME value for the organic farm is comparable to the UME values recorded from conventional systems that are based on ryegrass swards and purchased fertiliser inputs.

The effect of conversion on the performance of a Holstein-Friesian dairy herd is shown overleaf. Milk quality improved following the conversion of the herd and by the third year of organic management total milk production/ha was comparable to the yields recorded when the farm was managed as an intensive system. By the third year of organic management home-grown forages (both grazed and conserved) contributed 84% of the annual feed requirements for the dairy herd and organic feeds 90% of the total ration.

THE RELATIONSHIP BETWEEN NITROGEN INPUTS FROM DIFFERENT SOURCES AND UME VALUES (GJ/ha)



Perfomance of a Holstein-Friesian dairy herd during conversion	Intensive 380 kg N/ha	Conversion period	Organic Year 1	Organic Year 3
Total annual milk production/ha (litres)	10,080	7,737	8,604	10,073
Annual rolling average/cow	5,040	5,158	5,378	5,596
Annual rolling average/cow (corrected for fat and protein %)	4,890	5,146	5,496	5,755
Average lactation yields/cow	5,494	5,663	6,132	6,105
Concentrates/litre (kg)	0.22	0.27	0.28	0.22

Managing an organic farm: the KEY factors:

- a clover-based rotation and the effective utilisation of on-farm manures
- high forage diets balanced with organic cereals and acceptable protein supplements
- crop production without artificial fertilisers, herbicides and pesticides
- managing the farm to standards for organic production

FURTHER READING

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