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The Potential of Italian Ryegrass for Silage Production

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Traditionally Italian ryegrass has been sown as a component, and often a major component, in general purpose mixtures. In such mixtures it performed well for a few years at the expense of the other grasses and then tended to die out leaving an open, poor sward. As a result Italian ryegrass became unpopular as a variety. Nowadays, if it is included in a permanent mixture, it is only at the rate of 3-4 lbs/acre at most.

The importation of Italian ryegrass reflects this trend as shown in Table 1. The reason why its use has not declined further is that nowadays an increasing proportion is being sown as a monoculture and being managed as a specialist crop.

Table 1

Tonnage of imported Italian ryegrass

1966 - 1970	—	950 tonnes annually
1978 - 1979	—	800 tonnes
1980 - 1981	—	600 tonnes
1981 - 1982	—	700 tonnes

Against this background work began on Italian ryegrass at Johnstown Castle in September 1980, to evaluate Italian ryegrass as a conservation grass grown in monoculture.

There is a wide choice of cultivars currently available, but most of them are not sufficiently productive in yield or in persistency. On the Department of Agriculture's list (1) only 5 are recommended as shown in Table 2. The Danish cultivars lack persistency, the Dutch grass is rather

Table 2

Recommended list of Italian ryegrasses

Variety	Heading Date	Yield*	Persistency 1-9
Meritra	22 May	98	3
Dalita	24 May	93	3
Lemtal	24 May	100	3½
Delecta	26 May	95	2½
Ninak	26 May	97	3

* DM yields are shown as a % yield of the control, Lemtal (19.18 tonnes/ha).

suspect in yield and the English variety 'Delecta' tends to suffer from leaf diseases at silage time. Thus, the list is reduced to two cultivars, Lemtal and Meritra.

Meritra was chosen for the following reasons:

1. Yield and persistency are nearly as good as Lemtal.
2. Being a tetraploid, its digestibility at a similar stage of growth is slightly better than Lemtal and also the decline in digestibility after heading is not quite as rapid as in Lemtal (2).
3. It grows a little earlier in spring than Lemtal.

Italian ryegrasses start to grow a few weeks earlier in spring than the early perennials. They do not head until 24 May. An early perennial on the other hand such as S24, heads on 7 May. Thus, there is a long interval in which there is rapid growth; this growth is all vegetative and therefore digestibility remains high. Once flowering commences at the end of May, it continues to flower through to September and therefore digestibility is difficult to maintain during this part of the year.

The first trial commenced in late August 1980 and two management systems were imposed on it: a 5 cut and a 4 cut management system. The dates of cutting and the yields are given in Table 3.

Table 3

Cutting dates and yields of Italian ryegrass (kg DM/ha) 1st harvest year

	30 April	16 June	14 July	10 August	17 Sept.	Total
5 cut	4412	5639	2163	1941	2456	16,611
	10 May		29 June	10 August	17 Sept.	Total
4 cut	4692		5767	5490	2484	18,433

The yields were extremely high; the 4 cut system exceeded the 5 cut system and the heaviest cut in both systems was in June.

The DMD values are given in Table 4. The 5 cut system had higher DMD values than the 4 cut system. By early application of nitrogen, it was possible to cut a good crop in late April and then take the major cut in June. Despite a heading date of 24 May, it was possible to delay this and therefore to delay the decline in digestibility until the 2nd cut is taken in June.

Table 4

DMD for 4 and 5 cuts of Italian ryegrass (1981)

	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5
5 cut	79.0	73.5	75.1	62.5	68.6
4 cut	76.4	70.2	61.4	67.0	—

Thus, both yield and quality can be maintained at a high level until mid-June, by which time over 60% of the total is harvested or a little over 10,000 kg DM/ha. Subsequently, yield declined in the 5 cut system but quality was maintained until the 4th cut when it declined to 62.5% DMD. Quality and yield increased in the final cut. In the 4 cut system high yields were maintained until August although the quality was poor. The final cut was similar in both systems.

In September 1981 a further trial was commenced and harvested during 1982. This trial consisted of a comparison between a 5 and 3 cut system. The yields and cutting dates are given in Table 5.

Table 5

Cutting dates and yields of Italian in first harvest year (site 2) kg DM/ha

Date of cut	23 April	9 June	9 July	17 August	17 Sept.	Total
5 cut	4337	4367	2027	2155	1049	13935
	24 May		9 July	17 Sept.		Total
3 cut	7513		4357	4579		16449

The most notable result is the reduction in yield in both systems from 1981-1982. Most of the differences can be explained by examination of meteorological data for the two years 1981 and 1982. Using a formula described by Brereton (3) it is possible to relate growth to accumulated soil moisture deficits. In 1981 there were no soil moisture deficits but in 1982 growth rate for the second cut in May and early June was seriously reduced by drought. Another difference in the two years was drought in late July and August. While the drought was common to both years, it lasted considerably longer in 1982 and again yields in the 5th cut were considerably less than in 1981.

Table 6

Accumulated soil moisture deficit (ASMD) and % reduction in growth rate due to drought in 1982

		ASMD	% Reduction in growth rate
April	1	0	0
	2	20	0
	3	44	14
May	1	46	17
	2	51	22
	3	54	25
June	11	51	22

Italian ryegrass is susceptible to drought in terms of tillering, leaf extension and leaf appearance (4) and this is confirmed by the results at Johnstown Castle. Also, digestibility values in 1982 were lower than in 1981. Because of the drought leaf appearance was reduced, yet the flowering head still emerged. This resulted in higher lignin and crude fibre levels and lower digestibilty. It is concluded therefore that this crop should not be grown in land that is liable to serious drought.

One of the main problems with Italian ryegrass is the drop in yield over a 2-4 year period and the lack of persistency. Individual plants of Italian tend to die out, leaving the crop progressively more open. Traditionally the approach has been to plough and reseed; more recently direct drilling has been tried. Since these methods can be expensive, a third technique is being tested namely, slurry seeding (5). After the last cut of silage on 17 September four treatments were imposed on the crop (Table 7).

Table 7

The tiller population/m^2 of slurry seeded and non-slurry seeded plots

	Established Tillers	New seedlings	Total Tiller Nos.
Control	1875	14 (2%)	1893
Slurry	1423	18 (2.4%)	1441
Seed + slurry mixed	1762	354 (48%)	2116
Seed + slurry applied separately	1640	215 (24%)	1855
S.E.	168	41	168

There were 6,000 gallons of slurry applied per acre and this rate proved high because some of the existing tillers were killed. The most successful method was mixing the seed with the slurry, where 354 plants/m^2 were established, although there was some success where the seed and slurry were applied separately. Yields are given in Table 8.

Table 8

Yield kg DM/ha of slurry treated and control plots

	Yield kg DM/ha
Control	12255
Slurry	12551
Seed + slurry mixed	13397
Seed + slurry applied separately	12757
S.E.	469

Results were variable and while differences were not statistically significant, there was a trend towards increased yields of 1000 kg DM/ha in the slurry and seed treated plots.

Nitrogen

In general, Italian ryegrass requires higher nitrogen levels than permanent pasture for two reasons :

1. Because of a high yield, it can respond to high nitrogen levels.
2. Italian is generally a fresh reseed and fresh reseeds are generally nitrogen deficient and respond well to nitrogen.

Table 9

Nitrogen recommendations for Italian ryegrass

1st cut	144 - 168 kg/ha
2nd cut	96 - 120 kg/ha
3rd cut	72 - 96 kg/ha
4th cut	60 - 72 kg/ha
5th cut	60 - 72 kg/ha

There is some evidence to suggest that if all the nitrogen is not absorbed in a particular cut, it may be available to the plant during the regrowth thereby reducing the amount of nitrogen that needs to be applied for the next cut.

Grazing

It was considered useful if the extra yield obtained in Italian ryegrass could be maintained by introducing some grazing into the conservation programme. The following treatments were examined :

1. Graze every 21 days for the whole season.
2. Two grazings in spring; silage cuts for the rest of the year.
3. Three cuts of silage; graze for the rest of the year.
4. Four cuts of silage; graze for the rest of the year.
5. Five cuts of silage only.

At each of the grazing treatments there was a lax and a severe grazing. The results are given in Table 10.

Table 10

Yields (Kg DM/ha) and tiller numbers/m² in Italian ryegrass

	Severe grazing	Lax grazing	Tiller count severe	Tiller count lax
1	9398	9680	792	1522
2	12638	13262	1344	1627
3	15804	14906	561	1007
4	14643	15119	844	872
5	17437		1606	

The complete silage cuts gave the highest yields and the complete grazing gave the lowest yields. The grazing in spring reduced yields substantially. It was shown in Table 3 that the first silage cut can be substantial; this cut will be seriously reduced in yield by early grazing. There was little difference between Treatments 3 and 4. The second part of Table 10 show the effects of the treatments on the survival of tillers. The constant silage treatments had the highest tiller numbers while the lowest numbers resulted from grazing severely after taking 3 cuts of silage. Severe grazing also reduced tiller numbers substantially. The lax grazing was not as severe on tiller numbers. It is concluded from this trial that grazing does not favour Italian ryegrass but where grazing is necessary, it should be lenient.

The silages in the 5 and 4 systems were fed to cattle in a winter feeding trial. All cattle were fed 2 kg pulp nuts and were implanted with Ralgro and Finaplex. The results are given in Table 11.

Table 11

Average animal performance (kg)

	5 Cut	4 Cut	S.E.
Initial live wt.	479.3	481.0	2.90
Final live wt	493.9	556.6	4.86
Live wt. gain/day	1.12	0.74	0.05
Carcase wt.	321.2	304.8	3.26
Carcase gain/day	0.59	0.43	0.03

The average performance of cattle on the five cut system was significantly better than that on the 4 cut system; there was a direct influence of management on liveweight gain/head/day.

Variable Costs of Italian Ryegrass and Perennial Ryegrass

On the basis of the 1982 Farm Management Manual (6) the variable costs of conserving three cuts of Perennial ryegrass were compared with five cuts of Italian. The costs were based on contractors prices. However, the contractor's price for cutting quoted in the manual was reduced slightly to allow for the fact that several cuts are being taken in the one year. It was assumed also that each cut is conserved in a different pit; there is a full charge for polythene in each cut. Because ploughing and reseeding is an integral part of growing Italian ryegrass, it is assumed that these operations are required every 3 years. Thus, the cost of reseeding is divided by three and added to the variable cost of the crop. Costs are given in Table 12.

Table 12

Variable costs for Italian and Perennial ryegrass

Cut 1 £86.00/acre	Cut 1 £81.00/acre
Cut 2 £73.00/acre	Cut 2 £67.00
Cut 3 £58.00/acre	Cut 3 £67.00
	Cut 4 £52.00
	Cut 5 £52.00
	Reseeding £27.30
Total £217.00/acre	£346.30/acre

The costs/acre for Italian are substantially higher than the cost of Perennial, but if the cost/tonne is examined more realistic prices become evident. Table 16 outlines the costs/tonne at various yields. If the Perennial yield is 20 tonnes the cost/tonne is £10.85. If the yield of Italian is 35 tonnes then the price/tonne is £9.89; if the yield drops to 30 tonnes then cost/tonne increases to £11.45.

Table 13

Cost per tonne of Perennial and Italian ryegrass silage

Perennial		Italian	
Yield	cost/tonne	Yield	Cost/tonne
20 tonnes	£10.85	35	£ 9.89
		30	£11.54
		25	£13.85

The critical factor therefore is the attainment of high yields.

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Production of Young Beef at Hillsborough

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Beef production in N. Ireland had traditionally been a fragmented industry with cattle being on 3 or 4 different farms between birth and slaughter. However, it is now well established that up to 50% of the potential net profit which can be made from a beef animal during its life is lost as transport and marketing costs and loss of performance when it is marketed three or four times during the production cycle. Production systems which are based on short term decisions to purchase or sell cattle to take advantage of fluctuations in market prices may increase profitability immediately but in this situation one farmer's gain is another's loss and ultimately profitability is reduced as well as being variable.

A more systematic approach to beef production which provides a basis for forward planning and which reduces fluctuations in profitability and permits a stable and reasonable income per animal and per hectare is therefore desirable, particularly to beef producers who require a stable family income. The production of young beef in calf-to-beef systems involving dairy bred calves which remain on the same farm from calfhood until slaughter is one method of providing such a basis. These systems also provide a basis for setting and achieving production targets which are important if a high level of profitability is to be consistently achieved.

The experimental programme on beef production at Hillsborough currently involves three calf to beef systems. These vary in intensity from a 14-15 month system in which spring-born calves are housed continuously and given a diet of grass silage and concentrates, to an 18-month system using autumn-born calves and a 22-24 month grass-based system using calves born during late winter. All three systems are currently based on Friesian bull calves which are artificially reared and weaned at six weeks old. Calves are fed milk substitute twice daily, the quantity of milk powder being restricted to 400 gms/head daily giving a total intake of 16-18 kg of milk powder per calf. Higher levels of milk substitute feeding, although improving performance during the milk feeding period, have not increased profitability. The calves are given silage rather than hay from weaning at six weeks old. All grassland used in the systems, both for grazing and silage making, receives 350 kg of nitrogen fertilizer per hectare (280 units/acre) and phosphate and potash as required.

14/15 month indoor beef

This is a relatively new system of beef production in Northern Ireland in which cattle are housed continuously and given grass silage supplemented with concentrates. The level of concentrate feeding depends on silage quality. With high quality silage 2.5 kg (5½ lb) of concentrates/head daily is adequate to produce a finished animal at 14 to 15 months of age, but with low quality silage 4 to 5 kg (9 to 11 lb)/head daily is necessary during the finishing period. With high quality silage, made in a 3-cut system, finished cattle of 480-510 kg live weight are produced at 14 to 15 months old with inputs of one tonne of concentrates and 8 tonnes of silage per animal. With lower quality silage made in a more traditional 2-cut system, 1.45 tonnes (29 cwts) of concentrates and 7 tonnes of silage are required per finished animal. The use of bulls and implanted steers in this system is currently being investigated. Six finished cattle are produced per hectare (2.4/acre) of silage devoted to the system.

18 month beef using autumn-born calves

Eighteen-month beef has traditionally been produced from calves born between August and December. These remain indoors until April when they are turned out to grass for a six month grazing period and are slaughtered at 18 months of age following an indoor finishing period of about six months. At Hillsborough October-born calves, mainly from the Institute's dairy herd, are used. After weaning at six weeks they are given silage supplemented with 2 kg (4½ lb) concentrates daily. If silage quality is good concentrate intake is reduced to 1 kg/day (2 lb) at the end of January but with poorer quality silage 2 kg concentrates/day are required until turnout.

The calves are turned out to grass in mid-April at 180-190 kg live weight and are set-stocked at a stocking rate of 15 calves/hectare (6/acre) until mid-June. They are then moved to an area of aftermath grazing which has been cut for silage during late May and are stocked at 10 calves/hectare (4/acre). They remain on this area until two further cuts of silage have been taken by the end of August. They then graze the total area devoted to this system at a stocking rate of 4.2 animals/hectare (1.7/acre) which is the overall stocking rate of this system. The move to aftermath grazing in June is of major importance in maintaining a continuous supply of high quality grass to the animals and in controlling the build up of parasitic worm burdens. Good grassland management is essential if a live weight gain of 1 kg/day is to be achieved at grass without concentrate feeding. The animals are housed in mid-October at about 360 kg liveweight.

During the winter the cattle are given good quality silage supplemented with 2.5 kg (5½ lb) concentrates/day and are slaughtered in April at an average live weight of 510 kg. With poorer quality silage 4 kg (9 lb) concentrates/day are required during the finishing period to produce a finished animal of this weight at 18 months. If high quality silage made in a 3-cut system is used, the total inputs for this system are 700 kg (14 cwt) concentrates, 6½ tonnes silage and 0.1 hectares (¼ acre) for grazing. With lower quality silage made in the more traditional 2-cut system the inputs are 1.05 tonnes (21 cwt) concentrates and 5½ tonnes of silage.

The animals are implanted when they are put to grass at six months old and again when they are brought indoors for finishing.

22-24 month beef

Calves born during January and February, mainly from the Institute's dairy herd, are used in the 22-24 month grass-based system. They are fed to maximise live weight gain from weaning until they are turned out to grass in May. As with the 18 - month system the calves are moved on to clean aftermath grazing at some stage during the summer. Again this move to clean grass is vitally important in maintaining a high level of performance at grass with young calves. Unless grassland management is very good it is usually necessary to give these small calves about 1 kg (2 lb) concentrates/day over the summer. The calves are housed at the end of October at 250-260 kg liveweight. Over the winter they should have a liveweight gain of 0.5-0.6 kg/day ($1\frac{1}{4}$ lb). This is achieved from high quality silage without concentrate supplementation, from medium quality silage supplemented with 1 kg concentrates/day or from poor quality silage supplemented with 2-3 kg concentrates/day. The animals are put to grass again in April at 350 kg live weight and with good grassland management should reach 500 kg by the time they are housed again in late September. It is important that these heavy cattle are housed early in the autumn as they tend to lose condition rapidly if kept out too long. After housing, they are given high quality silage and 3 kg concentrates/day until slaughter in early January at 23 months of age. The finished cattle are about 580 kg liveweight, producing a 300-320 kg carcass. The cattle are implanted when they are put to grass at 15-months and when they are housed for finishing at 20 months. There has been no response to implantation before 15 months of age with this type of animal. 2.5 finished cattle are produced per year per hectare (1.0/acre) of land devoted to this system.

Failure to achieve the production target for these calf to beef systems is likely to be due to problems in one or more of the following areas.

* Calf rearing. Excessive disease due to bad calf rearing accommodation often results in poor performance as well as high mortality.
* Grassland management. If young calves do not have a continuous supply of high quality grass, performance can be very severely affected.
* Control of worms, fluke and external parasites. Inadequate control of parasites especially worms is often a major contributing factor to poor performance in calves and growing cattle.
* Grass scarcity in autumn. When the quantity and quality of grass declines in autumn supplementary concentrates should be fed and cattle should be housed early to prevent serious loss of condition which must be regained during the winter by feeding extra concentrates.
* Silage quality. The production of poor quality silage due to late cutting increases the amount of concentrates needed to achieve the target levels of performance and reduces profitability.

Make the Best Use of Worm Drugs

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Usually when people consider the problem of controlling worms in livestock they think only in terms of worm drugs or anthelmintics, the main preoccupation being the merits of one drug over another. Such thinking ignores the fact that many animals do not require any dosing at all, due either to their age or to the way they are managed. This does not mean that anthelmintics are inefficient in themselves; quite the contrary. The fact is, though, that an over-emphasis on dosing tends to obscure the true nature of parasitism. This leads to gross overusage of drugs and also to a failure to recognise that their value often depends more on proper timing and on management factors rather than on actual drug efficacy. This paper outlines the different types of parasites in cattle and the treatment requirements of each for prevention or cure. A clear objective is essential for efficient and economical use of drugs for parasite control.

Before deciding on an anthelmintic, one should question the need for dosing in the first place. The answer will depend on such factors as class of stock, time of year and type of management. For example, cattle aged 2 years or more do not require routine treatment for roundworms and there is no point in giving a turnout dose to calves beginning their first grazing season. Similarly, single-suckler calves born in spring will rarely if ever need to be dosed for stomach worms. Spring-born sucklers, because they do not graze much in early summer, cause very little stomach worm contamination of their pasture and so are not exposed to the heavy late-season infection likely to be experienced by pail-fed calves or even autumn-born sucklers.

Next, it is essential to be clear about which type of parasite it is intended to control and whether the aim is prevention or cure. Other considerations that influence the choice of anthelmintics are cost and convenience. To summarise then, the points to be considered in choosing an anthelmintic are :

1. Is a dose needed, considering class of stock, time of year, management ?
2. Which parasites are we concerned with ?
3. What are we trying to achieve, prevention or cure ?
4. Cost.
5. Convenience.

When planning parasite control, including the choice of drugs, farmers should always consult their veterinary surgeon, both for his expert knowledge and his experience of local conditions.

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Which parasites ?

The main internal parasites that affect cattle are liver fluke, hoose worms and stomach worms, the last two being round worms. Table 1 shows that each type has its main effects in a broadly definable class of stock and at a fairly definite season of the year. It should be noted that the season at which stock are affected is not necessarily the time at which control measures should be taken—more often, control must be instituted before the expected onset of effects. All of these parasites have a pasture phase and a phase within the animals and there is continual interplay between the two. There are parasites in animals only because there are parasites on pastures. Similarly, only parasitised animals create infection on pastures. However, each of the three worm types has a unique form of development, both on pasture and in the animal, and animals react differently to each type.

Liver fluke

Part of the liver fluke's development takes place in the tiny mud snail *Lymnaea truncatula* which is found on wet land. When snails become infected from eggs which animals pass out in their droppings in spring, the development stages occur throughout the summer. Infection, in the form of cercariae, passes from the snails onto the herbage from late August onwards. The amount of infection is greatest following wet summers which increase snail numbers and also favour development in the snail and shedding of cercariae. After ingestion by the grazing animal, the flukes wander in the liver substance for about 10 weeks before settling down as adults in the bile ducts where they produce eggs which pass out in the dung, so completing the life cycle. In contrast to other parasites, liver fluke commonly affects mature as well as young animals.

Table 1

Parasites that affect grazing cattle

Parasite	Type of stock mainly affected	Time of year effects mainly seen
Liver fluke	Under 2 year old (can affect all ages including cows)	December-February
Hoose	First season calves	End of May-October
Stomach worms — Type I	Calves/weanlings	Late July-October
Stomach worms — Type II	Weanlings and older stock	February/March

Control of liver fluke is aimed at both the pasture phase within the snail and at the stages of infection in the host animal. In most years,

drug treatment will be advisable in December or early January but the timing and number of treatments will depend on the expected amount of infection in any given year. This information is supplied in the fluke forecast issued annually by the Department of Agriculture. Table 2 gives the available fluke drugs or flukicides, and the stage of infection at which they are effective. The significance of the latter is that a drug with an action against the late liver stages destroys many of the parasites earlier, i.e., around 4-6 weeks after initial infection, thus reducing the amount of fluke damage. If, on the other hand, the infection has been present for around 10 weeks or more, the choice of drug becomes less critical. Advice on this aspect should be obtained from a veterinary surgeon who may decide to send faeces samples to the laboratory as an aid to diagnosis. Users of these substances have an obligation to observe precautions, e.g., the worning issued with most flukicides that they should not be given to lactating cows if the milk is for human consumption.

Several products on the market combine flukicides with anthelmintics effective against hoose and stomach worms (Table 2). Such combinations

Table 2

Liver fluke anthelmintics (flukicides), 'combination doses' and an index of their cost

Trade name	Dosing method	Main stage(s) of fluke killed[a]	Efficacy for stomach worms		Price index[c]
			Type I	Type II	
1. *Flukicides*					
Trodax	Injection	Late liver and adult	—	—	74
Zanil	Drench	Adult	—	—	45
Flukanide	Drench	Late liver and adult	—	—	53
Bilevon	Injection	Adult	—	—	58
Parax	Drench	Adult	—	—	58
2. *'Combination Doses'*					
Nilzan	Drench	Adult	✓[a]	—	139
Ranizole	,,	Late liver and adult	✓	—	189
Valbazan	,,	Adult	✓	✓	177[b]
Parafluke	,,	,,	✓	—	106

[a]Efficiency around 90% or greater;

[b]Based on doubling the normal dose; one-and-a-half times the normal dose may be effective, giving an index of 131.

[c] Based on trade prices for a standard dose.

are useful in situations where cattle are exposed simultaneously to fluke and stomach worms, as might happen for instance when stock are outwintered. Also, a 'combination dose' would certainly be indicated if stomach worm control, say in weanlings, had been neglected up to the time appropriate for a fluke dose. In general, however, it is advisable to think in terms of treating for one type of parasite at a time. For example, the correct time to dose for fluke will often be the end of Decembser but that is never the right time to dose for hoose and hardly ever the right time for a stomach worm dose, especially in the context of prevention.

Roundworms

Table 3 lists anthelmintics for use against roundworms, together with their ranges of activity and a price index. It will at once be apparent that there is little to choose between most of these compounds regarding their efficacy for Type I ostertagiasis (the ordinary kind of stomach worm infection—see later) and that most of them are highly effective for hoose.

Table 3

Anthelmintics with activity for hoose worms and for stomach worms with an index of their cost

Trade name	Dosing method	Efficacy (c. 80-90% or greater)				Ectoparasites (Lice, etc.)	Price index
		Hoose		Stomach worms			
		Early	Late	Type I	Type II		
Dictol	Vaccination	Preventive		—	—	—	—
Thibenzole	Drench	—	—	✓	—	—	112
Nemafax	"	—	—	✓	—	—	61
Superil	"	✓	—	—	—	—	54
Nilverm	"	✓	✓	✓	—	—	101
Nilverm	Injection	✓	✓	✓	—	—	129
Panacur	Drench	✓	✓	✓	✓	—	105
Synanthic	"	✓	✓	✓	✓	—	95
Systamex	"	✓	✓	✓	✓	—	105
Valbazen	"	✓	✓	✓	✓	—	81
Bayverm	"	✓	✓	✓	✓	—	95
Paranil	"	✓	✓	✓	—	—	47
Paranil	Injection	✓	✓	✓	—	—	54
Ivomec	"	✓	✓	✓	✓	✓	227
Anthelpor	Pour-on	✓	✓	✓	—	—	98
Anthelpor Plus	"	✓	✓	✓	—	✓	142

[a]Based on trade price for a standard dose. In the case of Dictol an index cannot be quoted as dose is not related to bodyweight.

Anthelpor Plus and Ivomec are also active against ectoparasites such as lice, Ivomec combining this effect with activity for Type II ostertagiasis. Considering the range of actions shown by many of the compounds, they, like some of the fluke-killing drugs, could be regarded as 'combination doses'. However, the advantage of this in relation to the round worms of the lungs and stomach is again somewhat limited as we shall see when dealing with the differences between these two types of parasites.

Hoose

Table 3 shows the relative price of drugs suitable for the treatment of hoose worm infection, or its prevention in the case of Dictol. Many of these compounds are almost similar in their effectiveness for hoose worms so that, besides price, the choice will be largely governed by convenience, an aspect that will be dealt with later. Dictol is of course exceptional in being a vaccine and as such the only true preventative for hoose, a factor which must be balanced against its relatively greater cost compared with the anthelmintics. Also, anthelmintics may have to be given on more than one occasion whereas Dictol is a once-off prophylactic.

Hoose affects mainly calves in their first grazing season. Typically, infection on pasture rises and falls unpredictably between late May and the end of September, the rate of larval development responding quickly to changes in temperature and moisture.

When the initial infection is small, as is likely if it arises from over-wintered larvae or from dung of carrier animals, calves exposed to it may become resistant. Whether or not resistance develops, the calves soon begin to spread larval contamination on the sward and, under suitable weather conditions, this may produce a sudden increase in pasture infection. If the initial infection has failed to stimulate sufficient resistance, the calves will then succumb to clinical hoose.

Clinical hoose commonly arises too when infected calves, voiding large numbers of larvae in the dung, are mixed with non-infected calves that have not had previous exposure to infection.

Control of hoose is best achieved by Dictol lungworm vaccine. Calves must be a minimum of 8 weeks old before receiving their first dose of Dictol, a second dose being given a month later. It is recommended that calves be given both doses before they are let out and that they be with-held from pasture for 2 weeks after the second dose. These recommenda-tions are a serious limitation to the use of the vaccine. However, Institute research showed some years ago that vaccination could safely be admin-istered to calves after turnout, provided they get the second dose by mid-May.

If Dictol is not used, it may be necessary to resort to anthelmintics. Most of these have similarly high efficacies, as already mentioned. Monthly dosing, sometimes recommended for the control of hoose, tends to be wasteful and unreliable. A better practice is to watch the calves closely after turnout and make sure they are treated promptly as soon as early symptoms are seen. It is advisable to obtain veterinary advice since hoose symptoms can often be confused with other lung disorders such as those caused by bacteria or viruses.

Stomach worms

Stomach worms, in relation to the condition known as Type I oster-tagiasis, also have their most damaging effects in first season calves. Calves, being highly susceptible, are likely to cause far more worm contamination on pasture than older animals. Infection on the pasture is usually at a low level in spring and early summer, consisting of larvae that have survived from the previous summer. Nevertheless, as a result of acquiring these larvae calves turned out in the spring pass out large numbers of worm eggs in the dung in the early part of the grazing season. Larvae hatched from these eggs develop slowly at first when it is cool and then more rapidly when the weather gets warmer. Thus, the bulk of the eggs deposited on the sward between May and early June reach the infective stage at around the same time, resulting in a fairly sudden increase in herbage infection. Time of onset will depend on weather conditions but it will almost always occur at some time on calf pasture from late July onwards. Thereafter, the herbage remains heavily infected and causes damaging infection in calves.

This predictable pattern of pasture infection with stomach worms contrasts sharply with the largely unforeseeable fluctuations that have already been referred to in relation to hoose. There are other striking differences between these two types of parasitism and they are briefly summarised in Table 4. Two such contrasting kinds of parasite obviously require different approaches to control, underlining the point already made concerning the limited value of 'all-purpose' anthelmintics.

Table 4

Important differences between hoose and stomach worms

	Hoose	Stomach worms
1. Source(s) of infection on pasture	1. Overwintered larvae 2. Carriers 3. Field-to-Field spread (*Pilobulus*)[1] 3. Mixing infected with non-infected calves	Overwintered infections only
2. Season	Late May-early October	Late July-early November
3. Pattern of pasture infection	Very erratic — not predictable	Regular — predictable
4. Host resistance	"Strong"	"Weak"
5. Control	1. Vaccination 2. Vigilance — early treatment	1. Dose mid-July—move to clean pasture 2. Leader/follower 3. Dose at yarding 4. New systems (see Table 6)
6. Re-infection after dosing on infected pasture	Not usually a serious problem	Always a problem

[1]*Pilobulus* is a fungus that grows on the surface of dung pats. Hoose larvae crawl onto a part of the fungus which then bursts scattering the larvae, which may be blown for considerable distances by wind.

'Regular dosing' from July onwards, a routine sometimes advocated, will often fail to control Type 1 ostertagiasis. Because of the high level of pasture infection commonly occurring on pasture at that time, treatment to remove one load of worms will be vitiated by the arrival of another load. Control can be effected by dosing the calves in mid-July and then moving them to 'clean' pasture such as previously ungrazed aftermath. Table 2 shows that a large number of anthelmintics are equally suitable for controllnig Type I, if used correctly. A dose at housing in October/November is also usually advantageous, particularly as there will then be no chance of re-infection. Calves in a leader/follower system will have less stomach worm infection than calves grazing on their own. Although effective, both this and the 'dose-and move' system are apt to pose management problems and neither, incidentally, will control hoose. Hence, there is a need to develop alternatives that can be readily practised on farms and that overcome, for instance, the difficulty of providing clean pasture at a particular time.

New developments

The concept of what is readily applicable on farms — in a word, convenience — has a bearing on choice of anthelmintic as well as on the control system to be adopted. Also, inconvenient chores are likely to be left undone! One convenience factor is the size of the dose, and remarkable advances have been made in this respect (Table 5). These advances reflect the development in recent times of more potent substances. On the other hand, it will be well to bear in mind that the cost factor (see Table 2) may in some instances outweigh the handiness of a small-sized dose.

Table 5

Size of dose

Anthelmintic	Size of dose (ml per 100 kg)
Levamisole drench	50
Thiophanate	33
Oxfendazole	20
Levamisole injection	10
Ivermectin injection	2

Some 'control systems' are given in Table 6 together with their respective advantages. For instance, Anthelpor which is a pour-on anthelmintic, overcomes possible risks associated with drenching, such as the fatal pneumonia that can arise from a misdirected drench. The Paratect Bolus is given to calves at turnout and has the effect of reducing worm egg contamination of pasture, thus preventing the late season increase in stomach worm infection which was described earlier. An innovation developed in the Institute by the author in association with Dr. J. O'Shea, is the administration of 'continuous low-level anthelmintic' in calves' drinking water. This also suppresses worm egg output, thus keeping pastures 'clean' or free of serious infection for the whole grazing season (*Farm and Food Research,* April 1980). A fully automated device for this purpose has now been developed and the advantages of the system are briefly described in Table 6.

Table 6

Systems and innovations

System	Advantages
Vaccination (Dictol)	Prevents hoose for whole grazing season
Pour-on preparations	Safe; easy application
Paratect Bolus (Pfizer)	One treatment gives whole-season protection against stomach worms
"Continuous dosing" via the drinking water	No handling of stock for dosing; keeps pasture free of serious stomach worm infection for whole season; may be adaptable for hoose control and for dosing with other medicaments like minerals and growth promoters

Stomach worms usually attain the adult egg producing stage in the animal between 2 and 3 weeks after the infective larvae are taken in with the herbage. Larvae that have remained on the sward until autumn and early winter undergo an alteration which affects the way they develop in the host. Thus, larvae taken in from September onwards show an increasing tendency to delay their development, remaining for many weeks or months in the membrane lining the stomach and intestine. Large numbers of partially developed worms may accumulate in this manner. If many of them resume their growth to adults over a short period, they cause severe disease changes in the stomach, resulting in scour, loss of condition and possibly death. This is the condition known as Type II ostertagiasis, the symptoms of which occur at some time in a period of several weeks beginning January/February.

Preventing cattle from grazing during autumn/early winter in areas occupied earlier by calves will contribute to the control of Type II ostertagiasis. In addition, cattle should be dosed at housing with an anthelmintic active against the arrested worms that cause this condition (see Table 2).

Recent work at the Institute has shown that the anthelmintic phenothiazine, which is not nearly as potent as modern compounds, was nevertheless capable, when used rationally, of controlling stomach worms extremely effectively, including arrested worms that are potentially the cause of Type II ostertagiasis. These results, as well as examples in this article of proper drug use, illustrate that the way drugs are used is considerably more important than high drug efficacy, which is, in any case, common to a great many modern anthelmintics. Similarly, there is no point in paying more for a particular drug simply because it is effective for several types of parasite if, in reality, control should be more properly directed at only one type. It follows that a clear objective is the first essential in efficient and economical parasite control.

Ammonia Treatment as a Method of Improving the Feeding Value of Straw and Hay

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On tillage farms, straw which is a by-product of the grain crop has a low monetary value. In this context it is a cheap feed source but it is of very low feeding value. The dry matter digestibilities (DMD) of some common feeds are : barley 86%, high quality silage 70%, average hay 58% and good quality barley straw 40%. As over half of the conserved grass in the country is in the form of hay there is a considerable quantity of poor to medium quality roughage (hay and straw) available for animal feeding. Many chemicals have been tested with a view of increasing the digestibility of roughage and those showing greatest promise of commercial application were sodium hydroxide and ammonia. As the latter treatment is available commercially in Ireland this paper will be confined to ammonia treatment.

Method of treatment with ammonia

In most studies anhydrous ammonia has been used. There are two methods of application, a polythene sealed airtight stack involving a treatment period of up to two months or an enclosed oven where less than a day is required for treatment. The stack method has been used in the experiments at Grange. The roughage to be treated is stacked over a ground sheet of 500 gauge polythene and then covered with two similar polythene sheets The ground sheet and covering sheets are then rolled together (using laths) at the edges and weighed down with clay or sand. To ensure that the stack is completely airtight any damage to the polythene is repaired with adhesive tape. Anhydrous ammonia is then pumped into the stack at 30 kg/tonne of roughage.

Feeding Experiments

Treated and untreated roughages have been compared in two feeding experiments. In Experiment 1, barley straw was collected in the field by forage harvester and stacked using bales at the edges to confine the straw. The stack was sealed with polythene and treated with ammonia. Untreated straw was baled at the same time and stored indoors. These straws were used for the first 80 days of the experiment and conventional small bales either treated with ammonia or left untreated were used for the remaining 26 days of the feeding period. In Experiment 2, bales of both barley straw and poor quality hay were either treated with ammonia in a stack or left untreated and stored in a shed. In both experiments, the material was chopped before feeding in order to avoid wastage.

Roughage Digestibility

Digestibility (in-vivo) of the untreated straws differed considerably (Table 1).

Table 1

Digestibility of untreated and ammonia treated roughages

	In-vivo dry matter digestibility (%)		
	Untreated	Treated	Improvement
Experiment 1			
Straw A (fed for 80 days)	35	50	15
Straw B (fed for 26 days)	22	42	20
Experiment 2			
Straw	39	51	12
Hay	48	63	15

The straw (B) which was fed during the last 26 days of Experiment 1 had DMD of only 22 per cent and is not really suitable for feeding. Treatment of straw with ammonia improved DMD by 12 to 20 percentage units. The DMD of hay was increased from 48 to 63 per cent as a result of ammonia treatment which is comparable to the average improvement obtained with straw.

Feed Intakes and Animal Performance : Experiment 1

Forty-eight Hereford cross heifers (322 kg initial liveweight) were individually fed straw to appetite plus a barley based concentrate on the following four treatments for a period of 106 days :

1. Untreated straw + 3 kg concentrates containing 15% soyabean meal.
2. Untreated straw + 3 kg concentrates containing 30% soyabean meal.
3. Treated straw + 3 kg concentrates containing 15% soyabean meal.
4. Treated straw + 3 kg concentrates containing 30% soyabean meal.

Each concentrate contained 1.5% minerals/vitamins and 0.5% salt. All animals were slaughtered at the end of the experiment and to measure carcass weight gains a representative group of six animals was slaughtered at the start.

Treatment of straw with ammonia increased intake from 4.15 to 5.44 kg per day (Table 2). There was no effect of concentrate protein level on intake.

Killing-out percentages of animals fed untreated and ammonia treated straws were 47.2 and 48.7% respectively. Thus, because of the considerable difference in killing-out percentage which was due to differences in gut-fill, liveweight gain underestimates the improvement in animal performance resulting from ammonia treatment. Consequently carcass gains must be used as the basis for assessment of the effects of ammoniation. Daily carcass gains of animals fed the untreated straw were 0.20 kg and there was no difference between the two concentrate protein levels.

Table 2

Straw intakes, liveweight and carcass weights, killing-out percentages and weight gains of animals in Experiment 1

	Straw			
	Untreated		Treated	
Percent soyabean	15	30	15	30
Straw intake (kg/day)	4.13	4.16	5.36	5.51
Initial liveweight (kg)	322.1	321.1	322.9	322.5
Final liveweight (kg)	384.8	387.0	414.0	425.7
Cold carcass weight (kg)	181.8	181.8	200.5	208.4
Killing-out percentage	47.3	47.0	48.4	49.0
Daily liveweight gains (kg)	0.59	0.63	0.86	0.98
Daily carcass gain (kg)	0.20	0.20	0.37	0.45

Carcass gains of animals fed ammonia treated straw with concentrates containing 15 and 30% soyabean meal were 0.37 and 0.45 kg per day respectively. While these data show the expected response from ammoniation it clearly indicates that the increased crude protein content of the treated straw does not allow a reduction in the need for supplementary protein. In fact, the results suggest the need for increased concentrate protein levels with the treated straw due to higher potential weight gains.

Experiment 2

Forty heifers (314 kg initial liveweight) were individually fed roughage to appetite plus 3 kg of concentrates (78% barley, 20% soyabean meal, 1.5% minerals/vitamins and 0.5% salt) per head daily. The roughages fed with the concentrates were as follows:

1. Untreated hay
2. Ammonia treated hay
3. Untreated straw
4. Ammonia treated straw

The feeding periods were 79 and 111 days for the hay and straw fed groups respectively (Table 3). Treatment of hay with ammonia increased intake by 33% (4.75 to 6.33 kg/day). The corresponding increase in straw intake was 15% (4.33 to 4.96 kg/day).

Killing-out percentages were 48.6 and 51.5 per cent for the animals fed untreated and treated hay respectively. The corresponding figures for those fed straw were 46.1 and 48.2 per cent. As in Experiment 1 these data show the need to express the results in carcass rather than liveweight gains. Daily carcass gains of animals fed hay were increased from 0.34 to 0.54 kg per day as a result of ammonia treatment. The corresponding improvement in gain was from 0.22 to 0.37 kg per day when straw was

Table 3

Roughage intakes, killing-out percentages and weight gains of animals (314 kg) in Experiment 2

	Hay		Straw	
	Untreated	Treated	Untreated	Treated
Intakes (kg/day)	4.75	6.33	4.33	4.96
Feeding period (days)	79	79	111	111
Final liveweight (kg)	378.3	386.3	393.9	411.6
Carcass weights (kg)	183.8	199.1	181.4	198.3
Killing-out percentage	48.6	51.5	46.1	48.2
Daily liveweight gains (kg)	0.82	0.90	0.72	0.88
Daily carcass gain (kg)	0.34	0.54	0.22	0.37

fed. The better response from treating hay with ammonia is surprising as the lower the quality of the roughage the better the response expected from treatment.

Economics of Ammoniation

A number of approaches can be used to assess the economics of ammonia treatment. The most obvious is to compare the additional feed costs of animals fed ammoniated roughage with the value of the extra gain obtained. In the present experiments levels of concentrates fed were purposely kept low (3 kg/head daily) in order to ensure that the untreated and treated roughages provided a reasonably high proportion of the total feed. This approach resulted in low energy intakes, low weight gains and poor economic returns. Generally diets such as these used here would not be considered suitable for fattening. It was necessary to slaughter the animals to overcome the effects of gut-fill variations. When 3 kg of the 15% soyabean meal concentrate was fed in Experiment 1 the value of the additional gain from feeding ammonia treated straw exceeded the additional feed costs by £17 per animal (Table 4).

Table 4

Value of gain and feed costs in Experiment 1

Straw	Untreated	Treated	Difference	Untreated	Treated	Difference
Percent soyabean meal	15	15		30	30	
Carcass gain	21.1	39.5	18.4	21.6	47.5	25.9
Value of gain (£2.10/kg)	44	83	39	45	100	54
*Feed costs (106 days)	57	78	22	59	82	23

* Barley = £125/tonne Soyabean = £180/tonne Straw = £25/tonne
Straw treatment = £25/tonne

The corresponding figure when the 30% soyabean meal concentrate was fed amounted to £32. In Experiment 2, treatment with ammonia resulted in the value of extra gain exceeding the extra feed costs by £9 and £16 per head when hay and straw were fed respectively (Table 5).

Table 5

Value of gain and feed costs in Experiment 2

	Hay (79 days			Straw (111 days)		
	Untreated	Treated	Difference	Untreated	Treated	Difference
Carcass gain	26.8	42.4	15.6	24.4	41.1	16.7
Value of gain (£2.10/kg)	56	89	33	51	86	35
*Feed costs	56	79	23	61	80	19

* Barley = £125/tonne Soyabean = £180/tonne Straw = £25/tonne
Hay = £50/tonne Cost of ammoniation = £25/tonne

Ammonia treated straw plus concentrates can also be compared with grass silage. This comparison is shown in Table 6. It is assumed that the cost of producing 1 tonne of silage dry matter is £60 and a charge of £30 is allowed for land rental (£120/acre producing 4 tonnes silage dry matter). The quantity of treated straw plus concentrate DM equivalent in feeding value to 1 tonne of silage DM is shown in the table as is their cost when treated straw is charged at £50/tonne and concentrates at £137/tonne. These figures show that ammonia treated straw diets are competitive with silage except when the silage is of high digestibility. This indicates that treated straw has a more obvious role in diets for storing rather than fattening cattle.

Table 6

Ammonia treated straw (55% DMD) plus concentrates equivalent to 1 tonne of silage DM

Silage DMD (%)	Straw DM (kg)	Concentrate DM (kg)	Cost (£)
60	833	167	79
65	666	334	95
70	500	500	112

Cost of 1 tonne of silage DM = £90 (4 t. silage DM/acre—rented charge = £120/acre)

Conclusions

1. Treatment of straw with ammonia increased DMD by 12 to 20 per-

centage units, intake by 15 to 30 per cent and weight gains by 0.15 to 0.20 kg of carcase per day.

2. While the cost of treatment and the cost of alternative feeds will have a large effect on future application a more important factor is the improvement in digestibility actually obtained in practise. Results from other countries would suggest that the improvements obtained in our studies are greater than those achieved in practise.
3. Considerable variation has been noted in the DMD of straw and to achieve a DMD of treated straw of 55% the original material should be 40%, which is not always the case.
4. The process has greatest application on tillage farms where straw is available as a by-product. Purchasing expensive straw for ammoniation is not worth while.
5. When the stack is opened a proportion of bales will be actually wet and likely to contain a high concentration of ammonia. To avoid any danger of toxicity these should be fed with dry bales. Avoid feeding all wet bales at any one time.
6. The value of the increased crude protein resulting from ammoniation is questionable.
7. Ammonia treated straw is suitable in diets for growing cattle and dry suckler cows but not for fattening cattle due to its low feeding value.
8. Although the improvement obtained with hay compared favourably with straw further studies are required using hay.

Policy and Schemes in Relation to the Cattle and Beef Industry

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The purpose of this paper is to present an overview of the beef cattle industry and to examine national implications rather than the strictly farming aspects. It may be useful to take this overview under a number of different headings—breeding, production and marketing. The paper concludes with a summary of 'Support for Cattle and Beef' which attempts to systematise and codify the various regulations, conditions and schemes associated with the cattle and beef industry.

Breeding

Since 3 out of every 4 calves used in the cattle industry come from the dairy herd the decisions taken by dairy farmers have a profound effect on the quality of the raw material in the beef sector. The quality of calves in the dairy sector and the quality of cull cows cannot be ignored either in national breeding policy considerations or by the individual dairy farmer. While the price of calves is high the dairy farmer is likely to be conscious of this; nevertheless his prime interest is in maximising milk profit margins. The national policy of maintaining the dual purpose Friesian cows is based on this dependence of the beef sector on the dairy herd. To improve dairy merit at the expense of beef merit would have consequences for the beef industry which could not be ignored. The Holstein importations that have influenced Continental Europe and Great Britain means we cannot rely on English sales to provide us with suitable bulls in the future. A more positive attempt must be made through planned matings to provide the bulls for testing in the A.I. programme.

We will have 400,000 Friesian steers produced from the dairy herd if we assume 400,000 heifers for replacement purposes. The remainder of the dairy herd is mated to beef bulls. For this purpose a range of breeds and bulls is available from natural service and A.I. For the beef bulls used in A.I. it is essential to have as much information as possible available on calving difficulties, growth rate, conformation and carcase quality.

In the suckler herd—which provides only 25% of calves—there was some deterioration in conformation in recent years due to:

(a) the proportion of cattle from dairy herd has increased (from 66% to 75%);
(b) reduction of shorthorn breed in the whole breeding herd;
(c) reduction in fat levels due to factories penalising for excess fat;
(d) in general more dairy types occur in the dairy herd;
(e) more Friesian type cattle in the suckler herd.

The technical breeding programme is comprised of a number of separate schemes. These are :

(i) on-farm recording

(ii) central performance testing (Tully testing was redesigned recently to achieve greater labour efficiency and to increase testing space from 96 to 200 places)

(iii) progeny testing for both Friesian and beef breeds in A.I.

(iv) judicious importations.

This latter programme is essential. It reduces the danger from inbreeding in small pedigree populations and provides access to improved types elsewhere.

Production

The important features of the Irish production scene have often been described. These can be summarised as follows :

— multi-stage systems with consequential excessive trading in calves and cattle
— inadequate supply of good quality winter feed
— low stocking rates
— poor technical efficiency
— demographic problems related to elderly or unmarried or part-time farmers. In many cases these are aggravated by poor land, small and/or fragmented holdings.

The beef industry at production level is not very homogeneous. Supply of calves is reasonably static where as a buoyant demand can often result in very high prices. It can be said we have the highest calf prices accompanied by the lowest cattle price in the E.E.C. Given these factors and the general lack of efficiency and the high credit costs is it not surprising that returns are small ?

It is imperative to expand cattle numbers in the beef sector. There are a number of schemes to encourage and facilitate this development. The concept of the producer group should be encouraged and developed to bring some measure of efficiency at producer level. The long term solution to the cattle sector requires land reform and land mobility. Unless there is considerable improvement in the beef sector substantial assets—land and human—will remain totally underutilised.

Marketing

Far too much emphasis is placed on the price support mechanism of the CAP. While this is undoubtedly important there is ample evidence that the major advantages of CAP are not fully recognised. The operation of intervention was important since access to the Community in maintaining producer prices. It has also helped meat factories to modernise. The slaughter, chilling, freezing, deboning and cutting facilities have greatly increased. However, the greatest advantage of CAP is access to the relatively high priced beef markets of the rest of the Community. This has often been lost sight of, while greater consideration is given to secondary elements. Other elements of the CAP are frontier control and


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export refunds. The Beef Suckler Scheme and the Calf Premium Scheme are integral parts of the CAP.

We have suffered from poor marketing in the past. There was a tendency to over rely on intervention. This was understandable and commercially logical for some plants. No bad debts were incurred and the actual marketing operation was relatively simple. We relied on intervention unnecessarily. This is borne out by the fact that after cow intervention was suspended in 1975 cow prices continued to rise. Good commercial outlets existed while the intervention option was over-utilised. This has implications for commercial selling of beef. Also we tend to sell too much beef through the wholesale 'circuits' like Smithfield where price fluctuations are greatest. Regularity and continuity of supply and quality control are essential if maximum commercial returns are to be obtained.

Finally—a brief comment should be made on the meat/live cattle debate. It would increase added value and employment if all our cattle were marketed through plants. This, however, would concentrate economic power in one outlet. This would have repercussions for producers especially if circumstances similar to 1974 returned. Producers returns could fall with consequences for the size of the national breeding herd. In 1974 live exports failed to increase in line with the unprecedented increase of 42% in volume of off-farm cattle disposals. This was primarily due to the absence of any support arrangements in the U.K. Factories made considerable profits. Producers suffered badly and the beef herd was dramatically reduced by 250,000 in the following 3 to 4 years. Under EEC rules it is illegal in any case to prevent live exports.

SUPPORT FOR CATTLE AND BEEF SECTOR

Support for the beef industry is covered by a number of EEC measures which are as follows:

1. **Beef Intervention (EEC Regulation 805/68)**
   - (a) Each year the Council fixes a guide price for cattle. The Intervention price is fixed at 90% of the guide price.
   - (b) In Ireland a derogation from this rule applies whereby intervention purchasing may continue when market prices for intervention categories are above the intervention price provided that the average market price for all cattle does not exceed 85% of the guide price.
   - (c) Intervention buying-in is limited to nominated categories. In Ireland Steers I and II are eligible.
   - (d) 1981 was the first full year of operation of the Commission's new policy of seasonal restriction of intervention purchasing. The policy aims to confine intervention support to that part of the market which is weakest at a given time of the year.

(e) Intervention intake and value is as follows :

	Total Purchased (Tonnes)	Value £(m)
1979	90,000	132.4
1980	102,000	161.0
1981	47,000	82.9
1982	52,000 (est.)	

2. **Aid for Private Storage (EEC Regulation 2826/82)**

(a) This was introduced in the Community as a supplementary price support measure.

(b) The present scheme is for hindquarters and is applicable from 25 October to 10 December 1982.

(c) The rate of aid is £400 (approx.) per tonne for a 5 month period.

(d) The following table outlines the amount of aid received by Ireland (and the tonnages) under these schemes in the past.

Regulation No.	Type of cut	Tonnes	Aid £
1198/79	Forequarter	2,980	703,000
2061/79	Hindquarter	2,770	979,000
2536/80	Hindquarter	500	194,000
3092/81	Hindquarter	1,275	268,000

(e) Recoupment from the EEC . . . . 100 per cent

3. **The U.K. Variable Premium (EEC Regulation 1200/82)**

(a) Premium is payable to U.K. producers for adult bovine animals other than cows.

(b) The amount payable is the difference between the market price and the seasonalised target price (average target price is equal to 85% of the guide price).

(c) The following are the approximate rates of expenditure incurred under the scheme for the export of Irish beef to the U.K.

	£m
1979	0.04
1980	2.8
1981	7.5

(d) Recoupment—100 per cent of the above expenditure is recovered from the U.K. who in turn received 25% recoupment from FEOGA in the 1981/82 marketing year, 40% for the 1982/83 marketing year.

4. **Export Refunds (EEC Regulation Number 2773/82)**

(a) Export refunds bridge the gap between Community prices and prices prevailing on export markets in third countries for beef and live animals.

(b) The following are the expenditures on export refunds.

	1979		1980		1981	
	Quantity (Tonnes)	£(m)	Quantity (Tonnes)	£(m)	Quantity (Tonnes)	£(m)
Beef	15,000	9.1	17,000	17.9	57,000	48.4
Live Cattle	42,000	17.8	105,000	47.0	135,000	66.5

(c) Recoupment from EEC . . . . . 100 per cent

5. **EEC Frontier Controls for Beef**

Frontier controls consist of Customs duties of 16% on live animals and 20% on beef. In addition there is a variable levy system related to the difference between the Community and World prices.

Duties and levies are reduced or abolished in the following preferential agreements

(a) GATT Quota for pedigree breeding stock of Alpine breeds
— 5,000 head per annum at 4% duty; levy free.

(b) GATT Quota for mountain breeds
— 385,000 head per annum at 4% duty; levy free.

(c) Young male bovine animals for fattening
— 235,000 head per annum at 20% duty with a reduction of 60-70% in the levy.

(d) High Quality Beef (Hilton Cuts)
— 29,000 tonnes beef at 20% duty; levy free.

(e) ACP Quota
— 35,000 tonnes of beef at 90% reduction on import duty.

(f) Yugoslavian Baby Beef
— 50,000 tonnes at 20% duty and 50% reduction in levy.

(g) Frozen Beef for processing
— Quota A 30,000 tonnes per annum } 20% duty and levy
— Quota B 30,000 tonnes per annum } reduced by 55%.

(h) GATT Quota for frozen beef
— 50,000 tonnes per annum at 20% duty; levy free.

(i) Canned Beef
Bound in GATT at 26% duty with no quantitative restrictions and levy free.

The quantities and the levies are subject to review. Actual quantities imported under these agreements are in practice less than those specified.

6. **Scheme of Premiums for maintaining Suckler Cows (EEC Regulation 1357/80)**

(a) Aim of this scheme is the maintenance of suckler cows for meat production.

(b) Full time farmers are eligible for this scheme.

(c) Farmers must have ceased commercial milk production and agree not to engage in such production for 12 months after application.
(d) Cows must be recognised as belonging to a beef breed.
(e) The applicant must maintain for six months the number of suckler cows approved.
(f) The premium for 1982/83 is worth 35 ECU (£24.00 approx.) per eligible animal.
(g) Recoupment from EEC . . . . 100 per cent.
(h) Expenditure on the scheme for 1981/82 was £9.08 m (approx.) while expenditure for 1982/83 is estimated at £8.5 m.

7. **Calf Premium Scheme (EEC Regulation 1201/82)**

(a) Calves born on or after the 20 May 1982 in the marketing year 1982/83 are eligible for the premium.
(b) From the 1st January 1983 farmers will tag their own calves and will be required to record full details of each calf (particularly the date of birth) in a simple calf register. If the calf is sold the certificate of birth is passed on to the new owner.
(c) Imported calves are not eligible for the premium.
(d) The premium is worth 32 ECU (£22 approx.) and is payable when the calf is six months old.
(e) Total cost of the scheme . . . . . £37 million.
(f) Recoupment from the EEC . . . . . 100 per cent.

8. **Guidance Premiums for Beef/Sheepmeat Production (EEC Directive 159)**

(a) Guidance premiums are available only to development farmers under the Farm Modernisation Scheme.

(b) They are payable where the farm development plan indicates that the planned gross margins for the beef/sheepmeat enterprise will be at least 50% of the total planned gross margin by the end of the farm plan.

(c) In addition the farm plan must indicate that there will be at least a 20% increase in the number of livestock units to be devoted to beef/sheepmeat production.

(d) The amount of premium payable is related to the acreage to be devoted to beef/sheepmeat production.

(e) Premiums are payable where there is evidence of orientation towards beef/sheepmeat production.

(f) Guidance premium rates are as follows (subject to exchange rates)
1st year £15.70 per acre subject to limit of £3,880 per farm.
2nd year £10.65 per acre subject to limit of £2,630 per farm.
3rd year £5.40 per acre subject to limit of £1,340 per farm.

(g) Development farmers under the Farm Modernisation Scheme are also eligible for the following, which assist in the development of beef cattle systems

Land improvement	50% capital grant or equivalent interest subsidy for a period of up to 15 years on amount borrowed.
Fixed assets	30% capital grant or equivalent interest subsidy for a period of up to 15 years.
Initial purchase of extra stock	10% capital grant or equivalent interest subsidy for a period of up to 5 years.
Mobile equipment	10% capital grant or equivalent interest subsidy for a period of up to 5 years.

(Development farmers are also entitled to a grant in respect of keeping farm accounts and having priority access to land released under the Retirement Scheme).

(h) Expenditure under the Farm Modernisation Scheme

		Reimbursement from EEC
	£(m)	£(m)
1979	32.0	2.9
1980	52.0	4.3
1981	44.3	9.2

Recoupment rate : Western Region 50% on capital grants

Recoupment rate :

Western Region	50%	on capital grants paid to
Remainder of Country	25%	Development Farmers only.

(i) Expenditure on Guidance Premia (included in above figures).

		Reimbursement from EEC
	£(m)	£(m)
1979	0.358	0.090
1980	0.455	0.089
1981	0.525	0.154

Recoupment rate : Western Region 50%, Remainder of Country 25%.

9. **Calf to Beef Interest Subsidy under the Programme for Western Development (EEC Regulation 1820/80)**

(a) This scheme is **part** of a special programme for the stimulation of agricultural development in the West of Ireland, is open to all farmers in Western counties who are eligible under the conditions of the scheme.

(b) Farmers following improvement plans orientating cattle production towards an integrated calf to beef system can qualify for an interest subsidy not exceeding 16% on a loan of up to £100 per animal for 2 years on each calf entering the system in the first and second year of the plan and will be additional to the capital grants available for buildings (40%) and fixed equipment (30%). (For farmers who undertake to follow a farm improvement plan with emphasis on the expansion of cattle and sheep numbers and

keep simplified accounts in a prescribed form from the start of the plan will receive 40% grant for farm buildings and 30% grant for fixed equipment. The amount of grant aid towards investment provided for in the improvement plan will not apply to investment in excess of £12,000 per farm).

(c) Recoupement from the EEC . . . . . 50%.

(d) No payment in respect of the Calf to Beef Interest Subsidy have been made to date.

(e) State expenditure for the Calf to Beef Interest Subsidy is estimated at £8 million (approx.) over a 10 year period.

10. **EEC Programme for Development of Beef Catte Production in Ireland (EEC Council Regulation 1054/81 and Commission Regulation 1410/81)**

(a) This is a two year programme for the development of beef cattle production in Ireland (forms part of the Programme of Special Measures for Ireland).

(b) The element of this programme which has an immediate effect on the improvement of livestock is a scheme aimed at promoting an increase in the use of artificial insemination (AI) by reducing the cost of the service.

— a subsidy of £5 (approx.) is payable on first inseminations of suitable breeds.

— provision in the 1982 estimates for expenditure on this scheme is £5.9m approx.

(c) Under this programme aid is also provided for genetic improvement in breeding stock (bulls) by the following

— Extension of on farm recording scheme of pedigree beef herds

— Expansion of performance testing

— Expansion of progeny testing

— Meat quality research project

— Provision in the 1982 estimates for expenditure in this area is £1.25 m approx.

(d) Recoupment from the EEC . . . . 50%.

11. **Scheme of Assistance for the Expansion of the Cattle Breeding Herd — 1982**

(a) This is a national scheme (funded entirely by the State Exchequer) and approved by the EEC Commission, which is aimed at assisting an expansion of the cattle breeding herd.

(b) Applications were accepted up to July 30th 1982.

(c) All first calved heifers being considered for grant must be present at inspection and be additional to the number of cows computed for the basic herd, i.e. in the herd on June 30th 1981 and still present at the time of inspection.

(d) Each additional first calved heifer must :

(i) Have calved in the calendar year 1982. If a heifer has not calved by inspection time, she must calve by December 31st 1982.

(ii) Be of good quality and type and suited to the production of good quality cattle.
(iii) Have been inseminated by a licenced or AI bull.
(iv) Have not more than six permanent incisor teeth.
(v) Have incurred an outlay of £500 to the applicant (comprising certified borrowings plus inputs) in order to quality for the grant of £70, subject to a maximum of 40 heifers per applicant.

(e) In the 1982 estimates provision is made for expenditure of £5.5m on this scheme.

12. **Headage Schemes**

(A) **Cattle headage payments in severely handicapped areas (EEC Directive 75/268)**

(a) This scheme applies only in the areas designated as severely handicapped.
(b) Payments are based on the number of L.U.S. declared to be in applicants ownership of 30th June 1982 and which are present at a subsequent inspection.
(c) Rates of payment

First 8 L.U.	—	£32/L.U.
9th to 30th L.U.	—	£20/L.U.

i.e. to a maximum of £872.00.

(d) Recoupement from the EEC . . . . . 50%.

(B) **Beef Cow Scheme**

Disadvantaged areas (EEC Directive 75/268)

(a) This scheme applies in less severely handicapped regions within the Disadvantaged Areas, e.g. East Galway, South Roscommon, North Kerry, etc.
(b) The scheme is confined to applicants who do not engage wholly or partly in commercial milk production.
(c) Rates of payment

First 10 beef cows	—	£32/cow
11th to 28th cow	—	£28/cow

i.e. to a maximum of £824.00.

(d) Recoupment from the EEC . . . . 50%.

13. **European Agricultural Guidance and Guarantee Fund (FEOGA) (EEC Regulation 355/77)**

Grant aid received from FEOGA (Guidance) for the improvement of processing and marketing in the beef sector is as follows.

	£(m)
1980	2.5
1981	2.7
1982 (June)	1.7

14. **EEC Interest Subsidy Scheme (EEC Council Decision 81/598)**

(a) This scheme was introduced on 1 September 1981 and allows a two year subsidy of 5% per annum on loans taken out to finance Development Plans under the Farm Modernisation Scheme.

(b) The Scheme applies only to farmers classified as Development under the Farm Modernisation Scheme.

(c) To date almost 10,000 applications have been received under the scheme and 7,000 farmers have been paid subsidies totalling £3.7m.

(d) Recoupment from the EEC — in Disadvantaged areas: 50%
Recoupment from the EEC — in Other areas: 25%

15. **National Interest Subsidy Scheme**

(a) The National Interest Subsidy Scheme introduced on 1 December 1981 allows a two year subsidy of 5% per annum to non-Development farmers under the Farm Modernisation Scheme.

(b) The subsidy is paid on loans arranged between 1 January 1976 to 31 December 1980 to finance grant-aided investment.

(c) To date 8,000 applications have been received under the scheme and 4,600 of these have been paid subsidies amounting to £1.4m.

16. **Reduced Interest Scheme for Farmers in severe financial difficulty**

(a) This Scheme was introduced on 1 April 1982 with the aim of aiding full-time farmers who are in financial difficulty.

(b) The Scheme allows a subsidy up to $8\frac{3}{4}$% for 3 years on loans arranged for general agricultural purposes between 1 January 1976 and 31 December 1980.

(c) It is expected that about 7,000 farmers will benefit under the Scheme.

A Guide to Export Markets for Steer Beef

P. J. MOORE

CBF — Irish Liverstock and Meat Board, Dublin.

The Irish cattle and beef industry is unique in its export dependence. Overall 85% of total production is exported. In the case of steer beef, there is no domestic market—our entire output is exported. This year a total of about 40 markets will buy Irish steers in one form or another. Many of these markets are looking for different beef types especially when it comes to specifications on weight and there is probably no single animal that is just right for all markets.

Steer Disposals from Farms

The Irish farmer has two outlets open to him for the disposal of his steer production—meat plants and the live export trade. Table 1 shows the pattern of steer sales from farms to both of those marketing channels. As can be seen the meat plants have gradually increased their importance during the 1970's rising from 51% shortly after EEC membership to 73% at the end of the decade. In the opposite direction the proportion of live exports declined. A reversal has taken place since 1980 with the upsurge in the live trade to newer Third Country markets.

Table 1

Distribution of steer sales to meat plants and for live exports

	Meat plants	Live exports
1973	51%	49%
1974	60%	40%
1975	59%	41%
1976	68%	32%
1977	68%	32%
1978	67%	33%
1979	73%	27%
1980	67%	33%
1981	56%	44%

Live Exports

The distribution of live steer exports as sold to each of the four principal destinations is shown in Table 2. The most striking feature of this trade is the decline in the importance of Great Britain and to a lesser extent Northern Ireland alongside the development in trade to Third Countries. The number of steers exported to Third Countries in 1981 probably reached their peak at 278,000 head. In 1982 exports to Third Countries have decreased by almost 20%. The two main factors which have led to the growth in this trade are the increased demand from the North Africa/Middle East countries coupled with the changed emphasis in EEC policy whereby disposal of cattle and beef directly onto Third Country markets was seen as a more cost-effective budgetary measure to the use of the Intervention system. The current refunds on live steers to North Africa, at IR£55.28/100 kg, amount to about half the cost of the cattle at auction marts.

Table 2

Destination of live steer exports (%) : proportion exported to

	Northern Ireland	Great Britain	Continental EEC	Third Countries
1973	29%	52%	16%	3%
1974	35%	56%	3%	6%
1975	42%	48%	5%	5%
1976	32%	41%	8%	19%
1977	36%	44%	7%	13%
1978	41%	39%	7%	13%
1979	24%	34%	6%	36%
1980	21%	22%	4%	53%
1981	20%	12%	2%	66%

Slaughterings at Meat Export Plants

Animals sold to meat plants have two ultimate destinations, namely commercial export markets and Intervention (Table 3). Since the commencement of Intervention buying in late 1973, the proportion of steer throughput sold commercially for export has ranged from a low of 50% in 1974 up to the present position of about 68%. Correspondingly, the proportion sold into Intervention has tended downwards and now accounts for about one-third of throughput.

Table 3

Distribution of steer slaughterings sold for commercial exports and into Intervention (%)

Year	Commercial markets	Intervention
1973	100%	—
1974	51%	49%
1975	55%	45%
1976	62%	38%
1977	63%	37%
1978	59%	41%
1979	57%	43%
1980	56%	44%
1981	68%	32%

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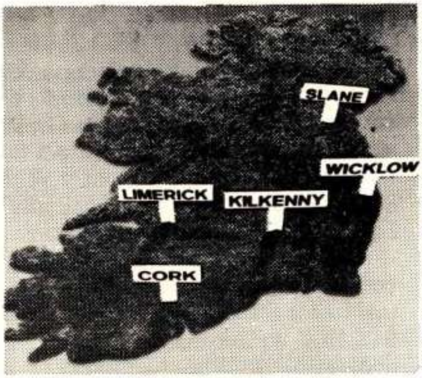

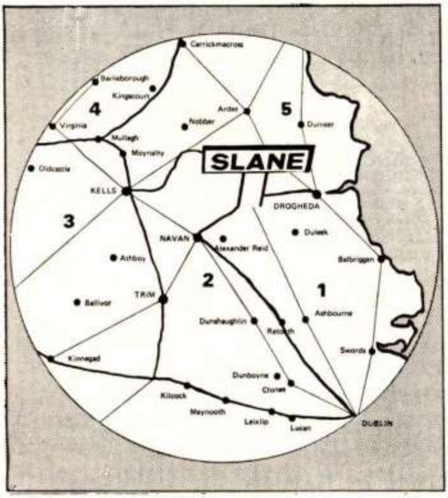

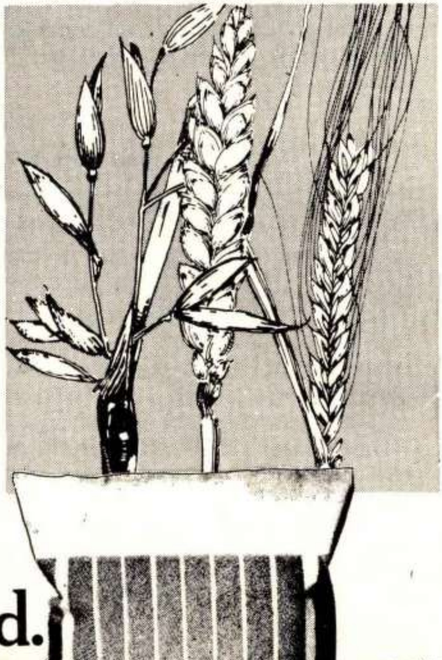

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Export Markets for Beef

More than half of beef exports are to Great Britain and this has been a consistent pattern since 1973 (Table 4). Prior to EEC entry the share of beef exports consigned to Great Britain was of the order of 70%. The overall importance of Continental EEC markets has tended to decline from about 44% in the early years of EEC membership down to about 33% in 1982. The principal market for Irish beef on the Continent is France, followed by West Germany, Belgium and the Netherlands. Only small quantities of Irish beef are exported to Italy and Greece. A number of explanations can be put forward as to why exports to the Continent have not developed but part of the reason must lie in the fact that we have not made the required transition to the type of beef demanded by the Continental trade. A further reason is increased attractiveness of Third Country markets, particularly in the past year brought about by increased demand from countries of the North African/ Middle East region coupled with the increased importance of export refunds.

Table 4

Export markets for chilled beef (%)

Period	U.K.	Continental EEC	Third Countries
1973	42%	52%	6%
1974	69%	30%	1%
1975	45%	51%	4%
1976	51%	37%	12%
1977	50%	43%	7%
1978	58%	39%	3%
1979	61%	36%	3%
1980	57%	36%	7%
1981	55%	35%	10%

Great Britain

The total volume of beef imported into Great Britain has been declining but the tonnage from Ireland has been on a general upward trend (Table 5). Since the entry of the UK into the Community, traditional suppliers like Argentina, Australia and New Zealand have been replaced by EEC suppliers. Ireland's share of total imports is currently 55%. Domestic beef production in the UK has been increasing and this is illustrated in the fact that the degree of self-sufficiency has grown from 60% in the mid-1960s to 85% in 1981 with a forecast of a slight fall to 83% by 1985. Given this outlook, it is likely that Great Britain will continue to be an important market for Ireland.

Table 5

UK beef imports

Year	Total imports 000 tonnes	Ireland's share
1965	286	10%
1970	265	39%
1975	196	49%
1980	233	68%
1981	195	55%

The British market for steer beef can be divided into three main segments:
- — Wholesale markets
- — Depot type markets
- — Supermarkets

Supermarkets pay the highest prices for beef. It has been shown that the level of premium paid by supermarkets over wholesale outlets was of the order of 4p/lb carcase weight in 1979/80. That differential is still broadly the same. Data collected by CBF's London Office on exports to date in 1982 shows supermarkets have paid 2p/lb on average over returns from sales to depots and 4p/lb over the returns from Smithfield.

Supermarkets pay these higher prices for a specified quality, consistently supplied. In practice their first priority is for quality coupled with uniformity from one order to the next. They mostly buy to formal and fairly strict specifications. Their requirements are for relatively light carcases, weighing between 270 and 325 kgs, having a good conformation and with a medium covering of fat. On the new EUROP Classification system, supplies would be selected from carcases having an R conformation score and with fatness scores of 3 and low 4. The approximate live equilavent is for an animal weighing between 500 kg and 600 kg.

About 15% of Irish steer beef exports to Great Britain are currently sold to supermarkets. This compares with about 8% in 1981 and is a very desirable development.

Continental EEC

Total beef imports into Continental EEC countries amount to about 800,000 tonnes annually. Ireland's share of this import volume is less than 10%. The Continental EEC markets for steers can be broadly divided into two segments:
1) Retail Butchers
2) Large Supermarkets

The requirements of the Butcher trade are best illustrated in the buying patterns on the Rungis Wholesale market in Paris. Conformation is a characteristic highly valued in this market. Over and above its effect on yield of meat, conformation is sought as a measure of the thickness of muscle. On the Continent muscles are dissected individually and completely defatted before being sectioned for sale as steaks. Good conformation effectively increases the yield of high priced cuts. Muscles which in a less well fleshed carcase would not be thick enough, but in a well conformed carcase they can be dissected individually, sectioned and sold as steaks.

At the present time, the differential on steer carcases on the Rungis market ranges between 5 and 7 IRP/LB for each change in conformation score.

Carcae weight and low fat levels are equally important for this market. Carcases in excess of 350 kg with low fat levels are ideal. Large overfat carcase with good conformation can only be supplied following trimming of excess fat. On the new EUROP scale, carcases with a conformation score of U are very suitable.

As far as Ireland is concerned the supermarket trade to the Continent mainly applies to West Germany. Supermarkets in Germany almost exclusively buy vacuum-packed beef which has been de-boned from carcases weighing between 320 kg and 340 kg with light covering of fat. Selection for this trade is made from the carcases having an R3 score on the new EUROP scale.

Carcase Quality in Ireland

Operation of the Beef Classification Scheme has given an opportunity to collect data not only on levels of fatness and conformation but also on breed type. The following data was prepared by the Carcase Classification Unit in the Department of Agriculture based on a sample of 10,000 steer carcases slaughtered in 1981. The study was carried out during the operation of the IRELAND system and to avoid confusion I have assumed that the new EUROP system compares with the IRELAND system as outlined in Table 6.

Table 6

Distribution of breeds by conformation class

Conformation Classes %								
	I E	R U	E R	L O	A P	N	D	% of Total slaughterings
Friesians	0	1	37	55	7			54
Hereford X's	0	2	61	33	3			34
Charolais	0	24	61	14	1			9
Overall average	0	3	47	44	6			97

Source : D. Coleman and P. O. Ryan, Department of Agriculture.

Table 6 shows the classification by conformation class of the three main breed types. Friesians have the worst conformation with 55% in class 'O' and only 37% in 'R' category on the new EUROP system. The reverse is true for Hereford Crosses—61% graded 'R' or better and 33% graded 'O'. There are more Friesian carcases also in the very poor class, 7% graded 'P'. Charolais graded superior to the other breeds, most noticeably in the number of 'U's — 24% of all Charolais graded 'U'. Similar type results could be expected from Simmental, Limousin and the Blond d'Aquitaine had sufficient members being available for identification in the survey by the Department of Agriculture.

The influence of Friesians on the breed structure of steers is apparent in the "Overall Average" data. Charolais and Hereford Crosses graded reasonably well for conformation but because Friesians constitute more than 50% of the steer kill the overall average conformation scores were low. The introduction of the Holstein strain into the dairy cow herd will further militate against improved conformation of Friesians.

Summary

The premium priced market segment in Great Britain is for a carcase weighing from 270 to 300 kgs with good conformation and a light to medium fat cover. In terms of a live animal this is a steer weighing from 500 to 550 kgs with good conformation and with no excess fat.

The premium Continental market is for large excellently conformed carcases with very low fat covering weighing upwards of 350 kgs which in liveweight terms is upwards of 650 kgs.

Continental supermarkets, especially in West Germany, demand meat from carcases of good conformation weighing from 320 to 340 kgs (590-630 kgs liveweight).

Silage for Dairy Cows — Conservation and Method of Feeding

J. J. MURPHY

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Introduction

It is now widely accepted that silage is the most reliable method of conserving winter forage on a dairy farm. Especially in our climate where weather is unpredictable, silage conservation is far less at risk than hay making. A total of 2.59 million acres were conserved as silage and hay in 1980 (Farm Management Department, An Foras Taluntais) and the area devoted to hay has been declining with a corresponding increase in the area and quantity of grass silage.

Thomas (1981) in this Journal covered a number of factors in relation to quality silage and milk production. This paper will deal with four aspects of silage for dairy cows : (a) the importance of silage digestibility and preservation quality, (b) the influence of wilting on silage intake and cow performance, (c) the use of sulphuric acid as a silage additive and (d) self and easy feeding of silages.

Silage digestibility and preservation quality

The stage of growth at which herbage is cut is the prime determinent of its digestibility and for a well preserved silage, digestibility is the major factor influencing its feed value. With dairy cows the effect of digestibility on silage intake and milk yield has been well illustrated in a number of experiments (Table 1). Delaying cutting from 42 to 63 days

Table 1

The effect of silage digestibility on silage intake and cow performance

	Cutting time	In-vitro DMD(%)	Silage DMI (% Lw)	Milk yield (kg/d)
Butler 1972	42 days	76.0	1.64	14.3
	63 days	63.0	1.55	11.7
	84 days	59.0	1.30	11.2
Butler 1977	May 25	75.2	1.91	19.5
	June 14	68.0	1.54	16.7
Steen and Gordon 1980	Cutting time	In-vitro DMD(%)	Silage (kg)	Milk yield (kg)
Supplement of 7.6 kg concentrates per day	36 days	72.1	726	1942
	65 days	68.3	651	1731
Supplement of 11.2 kg concentrates per day	36 days	72.1	614	1979
	65 days	68.3	553	1830

reduced DMD by 13 units, silage dry matter intake by 5.5% and milk yield by 18% when 3.6 kg of concentrates were fed per cow per day and performance was further reduced when silage cut after 84 days of growth was fed (Butler 1972). In a later experiment (Butler 1977) where 5.5 kg of concentrates per cow per day was fed a 68 DMD silage gave a 19% lower intake and 14.3% less milk compared to a 75.2 DMD silage. Steen and Gordon (1980) fed two silages of different digestibility to spring calving cows with a moderate and high level of concentrate during the indoor feeding period (approximately 70 days). Even with the high level of concentrate supplementation (11.2 kg/cow/day) earlier cut material (73.6 DMD produced 12% more milk compared to a later cut silage (68.3 DMD).

As well as obtaining high digestibility it is also important that the silage be well preserved. Poor preservation results in high pH values and ammonia levels with subsequent reduction in intake. A number of experiments have been carried out at Moorepark which clearly illustrate the negative effects of poor preservation on silage intake and milk production. Two of these are summarised in Table 2 and in both experiments the well preserved silages were treated with 85% formic acid. In experiment 1, the poor preservation resulted in a 15.6% reduction in intake and an 11.4% decrease in milk yield compared to a well preserved silage. Intake and milk yield were decreased by 4.4 and 6.5% respectively as a result of poor preservation in experiment 2. In both experiments the DMD was lower in the poorly preserved silages.

Table 2

The effects of poor preservation on silage dry matter intake and milk production

	Quality of Preservation	
	Poor	Good
Experiment 1		
DM %	19.20	20.60
pH	4.71	3.98
In-vitro DMD%	65.60	73.20
Silage DM intake (% Lw)	1.51	1.79
Milk yield (kg/d)	17.10	19.30
Experiment 2		
DM%	19.30	22.40
pH	4.76	3.91
VN — % TN	24.70	9.70
In-vitro DMD%	68.00	69.00
Silage DM intake (% Lw)	1.72	1.80
Milk yield (kg/d)	17.30	18.50

In both experiments silage was supplemented with 5.0 kg of concentrate per cow per day.

Field wilting of grass for silage

Good preservation can be achieved without using an additive by raising the dry matter content of the grass before ensiling by field wilting. This concentrates the soluble carbohydrates in the grass thereby improving the growth conditions for Lactobacilli and inhibiting the undesirable clostridial bacteria due to increased osmotic pressure. Experiments on wilting have shown that it consistently gives good preservation and increase silage dry matter intake but does not always improve cow performance (Butler, Gleeson and Murphy, 1979). Seven experiments on wilting carried out in Moorepark are summarised in Table 3. In five experiments unwilted silage without additive was compared with silage made from similar grass wilted for 24 to 36 hours before ensiling. Silage dry matter intake increased by approximately 26% due to wilting but milk yield increased by less than 2%. Where wilted silage was compared to an unwilted silage treated with 85% formic acid, intake was increased by 20% but milk yield was slightly less. No consistent differences in milk composition between cows on unwilted and wilted silages were evident in these experiments. Similar results have been obtained with dairy cows in Northern Ireland and England in comparisons of unwilted and wilted silage (Gordon 1980, Thomas 1981). Overall, the results suggest that wilted sillage has no nutritional advantage over a well preserved unwilted silage.

Table 3

The effect of wilting on silage intake and milk yield when compared with (a) unwilted silage without additive (5 expts.) and (b) unwilted silage treated with 85% formic acid (2 expts.)

	Unwilted	Wilted	Percentage effect due to wilting
(a)			
DM%	18.50	27.80	
pH	4.38	4.53	
Intake (% Lw)	1.55	1.95	+ 25.80
Milk yield (kg/d)	18.00	18.30	+ 1.70
(b)			
DM%	20.60	29.00	
pH	3.85	4.33	
Intake (% Lw)	1.72	2.07	+ 20.30
Milk yield (kg/d)	18.60	18.30	− 1.60

Sulphuric acid as a silage additive

The most frequently used silage additives in Ireltnd have been 85% formic acid and molasses and both have been shown to be effective in a number of trials. Within the last few years 40-45% sulphuric acid has

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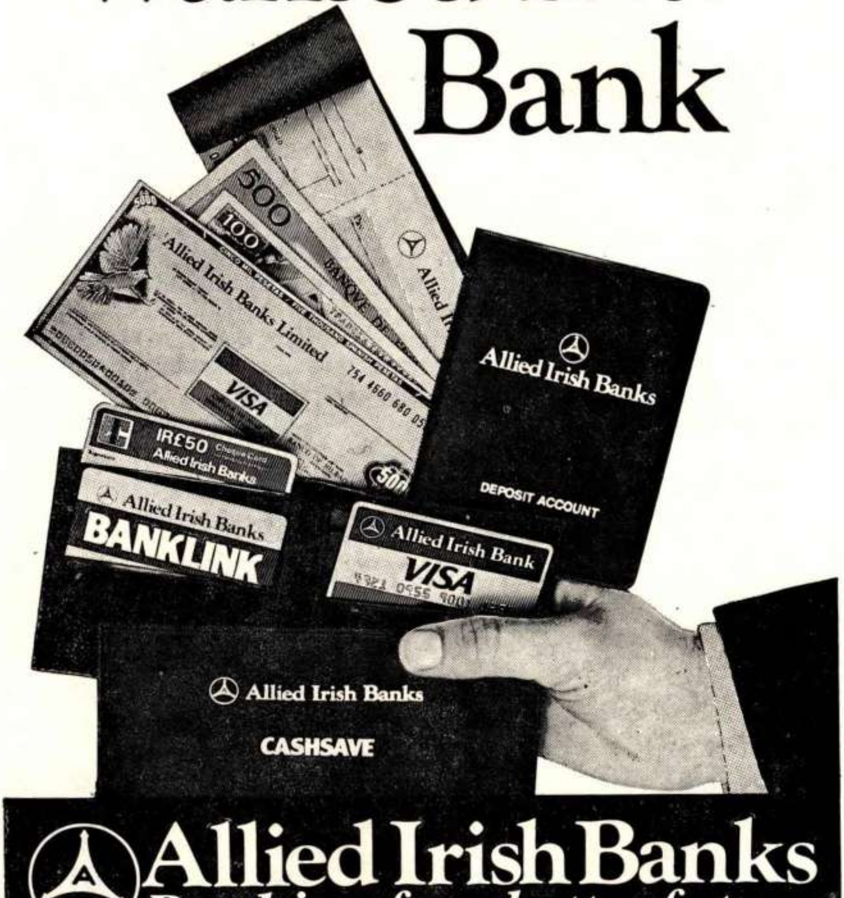

been made commercially available as a silage additive and this has been compared with 85% formic acid in a trial in Moorepark. Three portions of primary growth herbage (approximately 2 ha. each) were mown and harvested with a precision chop harvester with the following treatments:

1. Unwilted plus 85% formic acid (approx. 2.3 l/t)
2. Unwilted plus Sulphuric acid A (approx. 2.3 l/t)
3. Unwilted plus Sulphuric acid B (approx. 2.3 l/t)

Both Sulphuric acid A and B are commercially available silage additives. The silages were evaluated in a 52 day randomised block feeding experiment with spring calving cows in early lactation (ten cows per treatment) The silages were fed *ad-libitum* and were supplemented with 5.0 kg per day of barley-soyabean meal concentrate. Six cows on each treatment were housed in a metabolism house for 10 day periods where diet digestibility and mineral intake and excretion were measured. Blood samples were taken in the 6th and 7th week of the trial and analysed for calcium, magnesium, phosphorus and copper.

The chemical composition of the 3 silages is shown in Table 4. All were well preserved and highly digestible. The use of the sulphuric acid additives increased the sulphur content to 0.40 and 0.34% from 0.24% on the 85% formic acid treated silage. Animal performance and diet digestibilities on the silages are shown in Table 5. Yields of milk and milk constituents were not significantly different between treatments. Silage dry matter intake was significantly lower on the sulphuric acid A treatment compared to the 85% formic acid treatment. Other intake differences were not significant and the level of silage intake at over 2.0% of liveweight was high on all treatments. The digestibility of dietary dry matter and organic matter was higher on both sulphuric acid treatments

Table 4
The chemical composition of the different additive treated silages

	Silage Additive		
	85% Formic acid	Sulphuric acid A	Sulphuric acid B
Dry matter %	23.30	22.20	23.60
pH	4.02	4.02	4.02
Crude protein (% DM)	15.40	16.00	15.60
NPN — % TN	44.40	43.20	44.40
VN % TN	7.20	7.30	10.60
MADF (% DM)	38.10	38.20	37.90
Ash (% DM)	8.60	8.40	7.70
Sulphur (% DM)	0.24	0.40	0.34
In-vitro DMD (%)	69.50	70.20	70.80
Acetic acid (% DM)	1.71	3.21	1.82
Propionic acid (% DM)	0.08	0.35	0.14
Butyric acid (% DM)	0.15	0.22	0.16

compared to the formic acid treatment. There were no significant differences between treatments in calcium and magnesium excretion or in the blood levels of calcium, magnesium, phosphorus and copper (Table 6). Overall these results indicate that 40-45% sulphuric acid at levels of approximately 2.3 l/t is a suitable additive for use on silage for dairy cows.

Table 5

Cow performance on the different additive treated silages

	Silage additive		
	85% Formic acid	Sulphuric acid A	Sulphuric acid B
Milk yield (kg/d)	20.5	21.0	20.9
Fat yield (kg/d)	0.702	0.695	0.705
Protein yield (kg/d)	0.592	0.576	0.585
Lactose yield (kg/d)	0.925	0.931	0.939
Silage DM intake (% Lw)	2.20	2.00	2.06
(kg/d)	11.09	9.93	10.49
Liveweight change (kg/d)	—0.33	—0.54	—0.28
In-vivo digestibility of dietary:			
Dry matter	71.3	73.0	74.3
Organic matter	72.6	74.3	75.2

Table 6

Levels of calcium and magnesium excretion (as a % of intake) and blood levels of calcium, magnesium, phosphorus and copper on the different silages

	Silage additive		
	85% Formic acid	Sulphuric acid A	Sulphuric acid B
Mineral excretion			
Calcium	108.1	99.8	94.8
Magnesium	72.4	80.7	73.9
Blood levels			
1st Sampling			
Calcium (mg/100 ml)	10.50	10.60	11.10
Magnesium (mg/100 ml)	2.13	2.18	2.16
Phosphorus (mg/100 ml)	2.01	1.73	1.75
Copper (μg/ml)	1.40	0.99	1.42
2nd Sampling			
Calcium (mg/100 ml)	12.10	13.50	12.70
Magnesium (mg/100 ml)	2.11	2.17	2.19
Phosphorus (mg/100 ml)	1.65	1.48	1.45
Copper (μg/ml)	1.43	1.61	1.56

Method of feeding silage

Self feeding of silage has been the practice on many dairy farms for a number of years but recently more farmers are considering changing over to an easy feeding system. The debate as to which feeding system is superior often hinges on nutritional aspects. There is a possibility of an interaction between method of feeding and silage chop length and from data reported in the literature the position is not clear. For this reason a number of experiments were undertaken comparing forage wagon and precision chop silage both self and easy fed.

Two experiments were carried out where the silages were fed both pre- and post-calving. The treatments were as follows :

1. Forage wagon silage self-fed
2. Forage wagon silage easy-fed
3. Precision chop silage self-fed
4. Precision chop silage easy fed.

There were 15 and 34 cows per treatment in experiments 1 and 2 respectively. Pre-calving only heifers and second calvers were supplemented with 1.8 kg of concentrates per day; post-calving, all animals received 7.25 kg of concentrates per day. On the easy feeding treatments there was a feeding space of 24″ per cow and on the self feeding treatments feeding spaces of 12″ and 7″ per cow in experiments 1 and 2 respectively. In a third experiment forage wagon and precision chop silages were self-fed in a post-calving period only, with a feed space of 13″ per cow being allowed. From a preliminary investigation the results suggest that the following average chop lengths were achieved by the different harvesters : precision chop 5.2 cm, forage wagon 23.1 cm, and courier wagon (expt. 3) 21.3 cm. The cow performance on the three experiments is shown in Table 7. In experiment 1, the silages were poorly preserved with the wagon silage having a slightly higher pH (4.88) than the precision chop (4.51). The pre-calving period was short and although cow liveweight before calving was not significantly different between treatments the lowest liveweight was recorded in the wagon silage self-fed. This group also had the lowest milk yields post-calving being 7.4, 5.9 and 4.4% lower than the yield of the cows on wagon silage easy-fed, precision chop silage self-fed and precision chop silage easy-fed.

In experiment 2, both the wagon and precision chop silages were well preserved and of good digestibility (wagon silage — pH 4.19, DMD% 72.3 : precision chop silage — pH 3.86, DMD% 70.7). Pre-calving liveweight gains on the wagon silage self-fed were significantly lower than on the other 3 treatments. Silage dry matter intake which was measured on 10 cows from each treatment using the chromic oxide dosing technique was also low on the treatment. Post-calving the wagon, silage self-fed group had the lowest liveweight loss and the lowest milk yield (10.8, 12.9 and 9.6% lower than the wagon silage easy-fed, precision chop silage self-fed and the precision chop silage easy-fed groups respectively).

In the third experiment courier wagon and precision chop silage were self-fed to autumn calving cows for 56 days. Cows were introduced to

Table 7

Performance of cows on forage wagon and precision chop silage both self and easy-fed

Experiment 1	Forage Wagon		Precision Chop	
	Self-fed	Easy-fed	Self-fed	Easy-fed
Pre-calving				
Period (days)	24.0	22.0	22.0	32.0
Weight before calving (kg)	524.6	551.1	541.1	535.1
Post-calving				
Period (days)	51.0	49.0	53.0	46.0
Milk yield (kg)	17.5	18.9	18.6	18.3
Experiment 2	Forage Wagon		Precision Chop	
	Self-fed	Easy-fed	Self-fed	Easy-fed
Pre-calving				
Period (days)	78.0	78.0	77.0	76.0
Weight gain (kg/d)	0.29	0.61	0.62	0.70
Silage DM intake (% Lw)	1.20	1.74	1.86	1.73
(kg/d)	6.6	9.8	10.8	9.8
Post-calving				
Period (days)	24.0	24.0	24.0	24.0
Weight loss (kg/d)	0.30	0.82	0.62	0.70
Milk yield (kg/d)	18.9	21.2	21.7	20.9
Experiment 3	Courier Wagon Self-fed		Precision Chop Self-fed	
Milk yield (kg/d)	16.5		16.9	
Liveweight in final week (kg)	517.8		524.3	

the silages approximately 113 days after calving. Both silages were poorly preserved and were of poor to moderate digestibility (wagon silage —pH5.04, DMD% 62.5 : precision chop silage — pH4.62, DMD% 64.5). Milk yields were similar on both silages. In all three experiments there were no significant differences in milk composition between treatments.

The results of these experiments show that there is no difference in performance between cows on precision chop silage either self or easy fed or on wagon silage easy-fed. The cows on wagon silage self-fed tended to perform poorly and their intakes of silage were low pre-calving. Their milk yields post-calving were also low which was probably a reflection on the poor liveweight gain achieved pre-calving. When cows of similar condition were put on self or easy feeding wagon silage post-calving only (receiving 7.25 kg of concentrates per day), the type of silage had little effect on their performance (experiment 3).

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Irish Agricultural Museum

Trace Element Deficiencies in the Dairy Herd

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In an earlier paper (Irish Grassland and Animal Production Journal, 17: 21-25, 1982) the importance of the mineral components af the animal's diet was outlined both in relation to physical structure of the animal and the physiological function. The usual requirements for the important essential elements and the amounts which Irish pasture grass could be expected to supply were also detailed. The present paper deals therefore with the abnormal, as it arises in trace mineral deficiencies or toxicity. It includes calves, yearling cattle as dairy replacements and the dairy cow. Despite the importance of the dairy cow in the Irish farming economy, the amount of good research-based information on trace element problems is small. The reasons for this include the absence of milk recording on farms and the multiplicity of factors affecting milk yield and reproductive performance. Considerable efforts have been made to study trace element problems on dairy farms and while we have obtained some information, it is not fully adequate. This paper is divided into two broad sections, firstly, the factors which lead to trace element problems and secondly the clinical manifestations and the prevention of these problems. It will be confined to four trace elements, copper, cobalt, selenium and iodine, because I have no evidence that other trace elements, albeit essential for animals, are actually limiting in any circumstances in Ireland.

Background to the problem

Copper is essential for animal health and production, being involved in a wide variety of enzyme and biochemical functions throughout the body. The amount of copper normally absorbed from the food by the ruminant is small — certainly less than 10%. It appears to be lower from fresh grass or silage than from hay or from concentrates.. Moreover, its absorption is subject to interference by a number of other dietary components. The most important of these are molybdenum and sulphur, which appear to be partly interdependent but also to be able to function separately. Other minerals which depress copper absorption are zinc, iron and cadmium; there is no evidence as to whether these operate under Irish farm conditions. Another important factor which can be involved is dietary soil. It is known that grazing animals can ingest soil up to 10% of the dry matter intake, even higher at times, and this can reduce copper availability by 50% or more. This may be an explanation for the adverse effects of higher stocking rates on animal copper status.

Molybdenum occurs in anomalous levels in some Irish soils, largely restricted to certain shale soils. These occur in various parts of the country, sometimes extensively and in other parts quite restricted in area. Many cut-over peat soils are also high in molybdenum and the over-generous use of lime on any of these soils (but particularly on the peat soils) releases more molybdenum for plant uptake. These shale-derived soils tend to be heavy and to offer satisfactory supplies of sulphur for pasture growth and thus to have relatively high pasture sulphur levels.

Recent research findings from Johnstown Castle identifying sulphur deficiency affecting pastures on certain soils indicate the value of sulphur fertilisation in such cases. Fortunately, these are the free-draining light texture soils which are generally low in molybdenum, so the increase in pasture sulphur resulting from the proper use of sulphur-containing fertilizers should be confined to the low molybdenum situations. It is not fully known what the effect of this will be on bovine copper status; but research findings so far do not indicate any serious problems. It is recommended, however, that sulphur-containing fertilizers should only be used where there is a need for them and not on a generalised basis. In a similar way the use of sulphuric acid as a silage additive increases the sulphur content of the feed. In this case we have considerable research experience, particularly with beef cattle and the results show a definite but small depressing effect on copper status. This effect is not serious but on a farm where copper deficiency is known to occur, a suitable increase in the level of copper supplementation should be made if sulphuric acid is being used as a silage additive.

The results of surveys undertaken on blood copper levels in cows in various parts of Ireland suggest that a high proportion of cows are at a sub-optimal copper status. The nutritional or economic significance of this is still under study but at present we believe that in many areas, the finding is not of immediate importance and no measurable improvement in health or production will result from copper supplementation. On the other hand, in a considerable number of farms where blood copper levels are especially low, clinical symptoms or depressed growth or yields do occur and will respond satisfactority to adequate supplementation. The assessment therefore of the presence of "copper deficiency" must be based primarily on the clinical examination of the herd and its health and production data, supported by blood or liver copper analyses.

These low status herds obviously predominated in areas of high molybdenum. However, for a variety of reasons, pasture copper levels in Ireland appear to be falling in recent years. More and more, the combined effect of a sub-optimal or even low pasture copper aggravated by marginally elevated molybdenum and/or sulphur levels results in copper deficiency. In many cases, the factors involved here are plant physiological factors such as, pasture species, stage and rate of growth, effect of fertilizers, etc., rather than an inherently low soil copper. It is therefore unlikely that responses to soil application of copper will be observed under these conditions.

Let us now consider two other trace elements—cobalt and selenium—which may be of considerable importance. Both appear to be uncomplicated deficiencies in animals, although interactions with other trace elements may occur.

Cobalt deficiency occurs under two types of soil conditions. The first occurs where soil cobalt levels are very low (soils derived from granite, from sandstones and from calcareous sands and peat soils). In these cases, pasture values may be very low, particularly in shallow rooting swards and under conditions of high soil pH. In such cases there is usually a good response to the use of cobalt as a soil dressing. Secondly, on soils where elevated manganese levels restrict the uptake of cobalt to the extent that levels in the sward will be inadequate for ruminant livestock. In these cases soil dressings are of little value.

It is clear, therefore, that the mapping of cobalt deficiency on a soil basis ought to be possible and this has been done. One must, however, make due allowance for local variations in soil type and animal management.

Selenium in Ireland has long been regarded as a toxic element, from its occurrence in very high levels in certain glacial lake bed soils in Co. Limerick. It also occurs in an area in Co. Tipperary and in parts of Co. Meath and Co. Dublin. The classical symptoms of selenium toxicity—lameness, shedding of hooves and the hair of main and tail—can still be seen in certain cases. However, with the availability of a reliable and rapid blood enzyme test (glutathione peroxidase) to assess selenium status, it has become possible to survey animal blood selenium status in many parts of Ireland. This has shown that, in varying degrees, many of our herds are low, or even very low, in selenium and the toxic areas are indeed very localised. This finding is amply supported by Dr. Fleming's work in Johnstown Castle on soil and geological rock selenium levels.

Clinical manifestations and prevention

In the case of copper deficiency, the most commonly seen clinical signs occur in the young animal during its first grazing season, with the suckler calf being somewhat more sensitive than the bucket-fed animal. The early signs are dry, unhealthy coats and a tendency to stiffness. These progress to more pronounced bone lesions causing swelling above the fetlocks (front and rear), stiffness of gait and unnaturally straight stance probably resulting from lesions in the tendons. Coat colour changes (black to grey, red to dun) are less clear-cut and obvious in the Friesians than they are in the Aberdeen Angus or the Dairy Shorthorn. Diarrhoea or scouring may occur, at times profusely, but it is not a consistent feature. The effect on performance is about 40 kg liveweight during the first grazing season.

In the second year the animal is more resistant, although the effects of the first year's problem may well persist. Otherwise, poor coat texture, scouring and reduced weight gain (in the order of 25 kg of liveweight) may occur. In heifers, anoestrus (failure to come in heat), sometimes in animals in apparently first-class condition, may be associated with copper deficiency and will respond rapidly to treatment.

In adult cows, the situation is less clear. Herds have been observed where scouring and poor condition in cows have been associated with reduced milk yields (particularly in the latter part of the season) and have responded in controlled trials to copper supplementation. In many other trials, no productive response has been seen despite low or very low copper status and despite very clear increases in blood and liver copper values following treatment.

On the other hand, clinical (but uncontrolled) evidence from veterinary surgeons, agriculturalists and farmers supports the view that some problems of infertility (reduced conceptions) and even some abortion outbreaks do respond to copper and therefore may be a manifestation of copper deficiency. Our advice in such cases is that where the obvious alternative causes do not obtain or have been eliminated and where copper status is very low, treatment should be implemented in the knowledge that its value is subject to question. Similarly, neonatal vitality with mortality may be affected in calves born from copper-deficient mothers. This has been seen in lambs and we believe, although without conclusive research evidence, that this holds for calves also.

As has already been indicated, most of the serious copper deficiency is induced by molybdenum and sulphur. Therefore, any copper given as a feed supplement or in some other oral form will be similarly antagonised and its value reduced. For this reason particularly, the use of copper injections have been considered desirable and our research — supported by international evidence — has generally confirmed this view. Particularly in the young calf, up to about eight months of age, I would recommend no other route. Again, on the farm where the problem is under investigation, I would always start with parenteral treatment. In this way, one can with confidence assess the response to treatment or the lack of it and thereby confirm the diagnosis. Thereafter, if the herd owner wishes to use oral copper in some form, i.e. feed additive, mineral block or water medication, it may be found to be of supportive assistance or indeed to be adequate treatment. This will largely depend on the severity and the cause of the problem. My personal preference is to avoid any dubiety and to give each animal its precise dose by subcutaneous injection. My routine for the problem farm would be to treat the calves, first in May, to re-treat them in July and possibly again in October, using 100 mg of copper as the standard dose. The yearlings would be treated at turnout in the spring and in severe situations, and especially for dairy replacements, again in July or August. I would treat cows about 6 to 8 weeks before calving, this being largely aimed at the calf, and I would repeat this as soon as possible after calving. In cases where the deficiency is severe, the dose for cows could be increased to

200 mg. I would not re-treat cows during the summer unless I saw a clinical need for doing so.

We are carrying out research on a new method of copper supplementation in which a largely insoluble crystaline form of copper is given by mouth and is retained in the rumen to be absorbed over a long period of time. This could be very useful and could reduce the treatment of copper deficiency to one oral capsule per year.

Cattle are much less sensitive to cobalt deficiency than sheep, so on many farms where lambs may pine severely due to cobalt shortage, cattle may remain healthy. The clinical signs of cobalt deficiency are very similar to those of under-feeding. Calves during the summer at pasture may show poor growth rate, unhealthy coats and even some loss of coat colour. Much of this is the result of inappetence; one of the most regular and early features of cobalt depletion is a reduced appetite. As the condition progresses, severe muscular wasting leads on to emaciation and while this is unlikely to occur in Irish dairy cows, it could occur in calves at pasture.

Cobalt is required as a component of vitamin B_{12}. In the ruminant, the microflora of the rumen synthesises vitamin B_{12} so that, unlike the monogastric animal, the ruminant can utilise elemental cobalt in the synthesis of the vitamin. Vitamin B_{12} is a necessary component of the metabolic pathway for proprionate; this is one of the principle energy sources of the ruminant. This may be the explanation for the relationship between low cobalt status and acetonaemia in cows which has sometimes been described. Vitamin B_{12} is also involved in methionine metabolism and in this way affects wool and hair growth. In addition, vitamin B_{12} is important in the prevention of anaemia and therefore the cobalt-deficient animal is often very anaemic.

Apart from its effects on appetite and liveweight, it has been suggested that cobalt deficiency may affect fertility. I believe this to be a secondary effect and it is unlikely except as a sequel to the other effects as described.

The prevention of cobalt deficiency depends on increasing dietary cobalt intake. The use of cobalt by injection is of no value; the injection of vitamin B_{12} gives an obvious but transient response and is not of long-term practical value. Cobalt as a soil dressing, on the low cobalt/low manganese soils, can be very satisfactory but costs must be considered and this method may not be economical. The usual dressing is about 2 kg cobalt sulphate per hectare applied every third or fourth year. Cobalt can obviously be given in concentrate feeds but at pasture (apart from regular drenching which is seldom of a practical proposition), the supplement can be given in drinking water, in mineral mixes or blocks or as cobalt bullets. These latter remain in the rumen and release cobalt over extended periods. They appear to be more liable to regurgation in cattle, especially cows, than in sheep but they still offer a satisfactory remedy in some cases.

Research on selenium deficiency is in progress and no firm conclusions can yet be made. From research and field experience in other countries, it is known that selenium is required as a component of the enzyme glutathione peroxidase and that this enzyme is crucial in the protective removal of peroxides which form in the tissues during normal metabolic oxidation. Complementary to this function is the role of vitamin E which is that of an anti-oxident. The failure of these processes results in tissue damage in the bovine leading to muscular dystrophy which can affect skeletal muscle resulting in lameness and muscular wasting. It also affects cardiac muscle resulting in heart failure. Neither of these conditions occurs widely in Ireland, although muscular dystrophy is reported in Northern Ireland. Selenium and vitamin E shortage are also associated with some outbreaks of retained placenta and this has been observed as a response to treatment in a number of outbreaks in this country

There have also been reports from New Zealand and Australia of ill-thrift in both beef and dairy cattle responding to selenium therapy. I only know of one such case seen as a field observation in Ireland. Selenium deficiency is associated with reproduction disorders in both sexes and in a number of species. Poor hatchability and high chick mortality in poultry and quail, poor conception in pigs, embryonic mortality in ewes all have been reported. Again, however, there is little convincing research information in the case of the cow. However, treatment of cows in some problem farms appears to have given satisfactory responses in improving fertility. Problems of calf neonatal mortality and poor vitality associated with selenium deficiency have been reported in other countries.

With this background information, the fact that so many Irish herds are very low in selenium makes one wonder why we have not had many more problems. The true value of supplementary selenium requires further study.

At present, most selenium deficiency cases are treated by injection and we are at present assessing the value of a long-acting injection which could have a protective effect for up to a year. On the other hand, selenium supplementation, as in cobalt deficiency, may be given in the drinking water, in mineral blocks or mixes or as a soil dressing.

Iodine

Lastly, I want to refer to iodine deficiency about which we have little background data. It is clear, both from the work in Moorepark undertaken by Dr. H. Greene and also from observations made by colleagues in Regional Veterinary Laboratories that quite a high proportion of still-born calves or neonatal mortalities and at least some late abortion foetuses have enlarged hyperplastic thyroid glands. This would indicate either a shortage of dietary iodine or the presence of a goitrogenic substance in the feed. Where this has occurred in outbreaks, the use of supplementary iodine given to the cow during late pregnancy appears to control the condition. We are hoping to undertake further research on this as it appears to be an increasing problem.

Conclusion

In conclusion, one must offer some words of caution. Firstly, all these trace elements are poisons if given in excess. The safety margins and the nature of the toxic processes vary but all have to be treated with respect. A correct supplementation can give great benefit; wrongly used treatments can cause disaster.

Secondly, the factors influencing deficiencies vary considerably between soil types, animal types and farmer types. It is difficult to give generalised answers to specific situations and each farm represents a specific situation. So the assistance and advice from a veterinary surgeon and an agricultural adviser should be sought in relation to any particular farm situation.

Lastly, although trace elements are most important and can be the cause of serious loss, some farmers are, aided and abeted by commercial and advertising interests, resorting to trace elements as substitutes for good stock, good feeding and good management.

Grassland and Dairy Farming in the Netherlands

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Forage production in the Netherlands is based mainly on grassland. Almost 85% of the total roughage comes from the 3 million acres of grassland, most of it permanent.

The only important fodder crop is silage maize, which occupies an area of 360,000 acres, being the second largest crop in the country.

The Dutch climate is temperate and maritime with an average precipitation of 31 inches.

It is interesting to compare some data for Ireland and the Netherlands (Table 1). There is considerable contrast between the two countries when comparing the prices of inputs and output : Nitrogen and concentrates are more expensive in Ireland, while the Irish farmer gets less for his milk. Labour costs are much higher in the Netherlands than they are in Ireland. To meet the labour costs for a year the Dutch farmer has to produce 25,000 gallons of milk, whereas it requires only 12,000 gallons in Ireland.

Table 1
General data

	IRL	NL
Agricultural area, million acres	14.1	5.0
% grassland	92	66
Dairy cows, million	1.45	2.37
Dairy cows/herd	15	36
Milk, gal/cow	710	1120
Milk, % BF	3.5	4.0
N in CAN, p/lb	20	16
Concentrates, £/cwt	8.7	7.3
Milk, 3.7 BF, 3.4 Prot. p/lb BF	176	221

During the past 20 years farmers were confronted with sharp rises in costs of wages and other costs while the rise in prices of agricultural products was much smaller. In order to maintain their income farmers had to intensify and increase labour productivity. In 1965 2¼ gallons milk paid for 1 hour labour, while in 1982 9 gallons milk paid for 1 hour labour.

Intensification means more cows per man and per acre and consequently more production is required per acre and therefore more nitrogen is necessary (Table 2). This table clearly shows how nitrogen usage increased in the Netherlands.

Table 2

Nitrogen usage in the Netherlands in lb/acre grassland

1950	45
1960	85
1970	180
1981	250

Herbage production

Nitrogen is the key to increased grassland production. The Dutch philosophy is: Nitrogen accelerates the growth of grass, thus less days are required for a set yield (Figure 1) It is not yield per cut that is

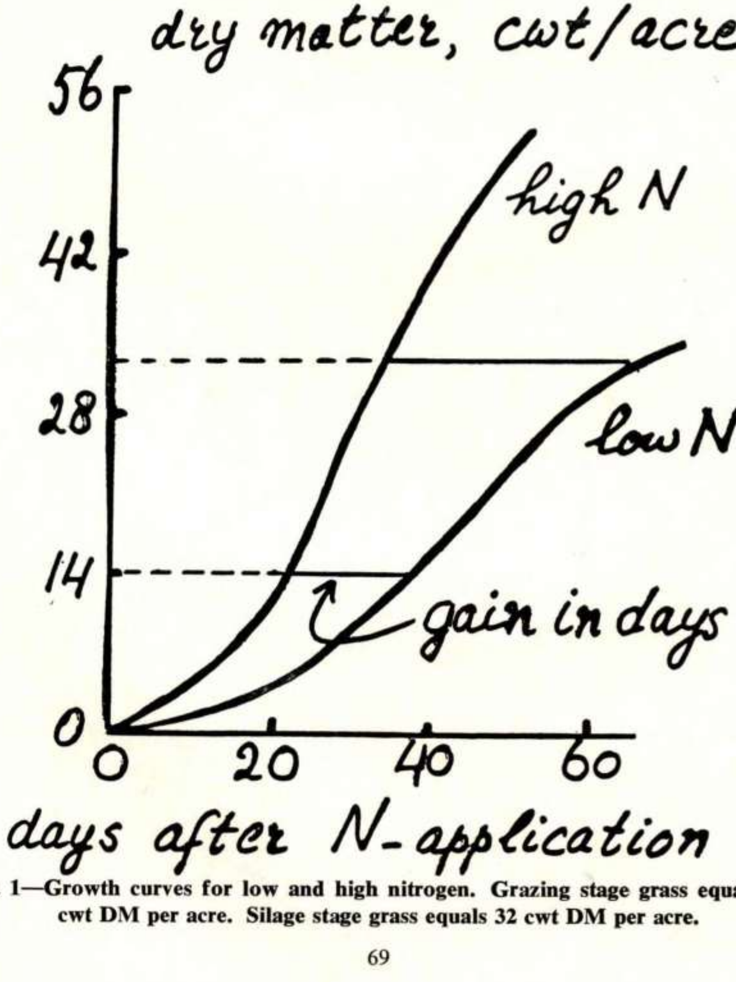

Fig. 1—Growth curves for low and high nitrogen. Grazing stage grass equals 14 cwt DM per acre. Silage stage grass equals 32 cwt DM per acre.

important, but number of cuts per year. Nitrogen increases the scale of operation and decreases the dependency on outside feed resources. Herbage production is roughly proportional to the input of fertilizer nitrogen up to rates of 300-350 lb N per acre.

It is obvious that the response to nitrogen is variable because of variations in environmental factors such as weather conditions, soil type, legumes, time of application, type of nitrogen fertilizer.

Nitrogen fertilizer

The common fertilizer in the Netherlands is calcium ammonium nitrate 26% N. This fertilizer has an acidifying effect on the soil. However, this acidifying effect is much smaller than in the case of ammonium nitrate and urea. Under acid conditions the better grasses may be replaced by poorer species, while an increase in soil acidity may ultimately lead to lower responses to nitrogen and to lower herbage yields.

In Dutch experiments the response to N at pH 3.8 was some 20% lower than at pH values ranging from 4.5 to 5.4 The grassland farmer should be concerned about the dangers of allowing the pH to drop too low.

The results obtained in grassland studies have led in the Netherlands to general recommendations for nitrogen (Table 3). The recommended annual rate of nitrogen using these amounts are 360-400 lb N per acre for sandy and clay soils and 250 lb N on peaty soils.

Table 3

ADAS advise in the Netherlands for sand, clay and peat soils* : N, lb/acre per "cut"

"cut"	Grazing	Mowing
1	55 - 70	70 - 110
2, 3	70	90
4, 5	55	70
later	35	—

* On well-drained peat soils 15 units/acre less after cut 1

Grassland utilization

Grazing

Between 60 to 70% of the total grass yield is used as fresh grass, mainly by grazing (95%). Grazing is the cheapest way of harvesting grass and feeding cattle. Moreover the feeding value of fresh grass is much higher than that of conserved products, while the average daily intake of dry matter is also much higher. Therefore top priority in the total utilization of grassland should be given to providing the grazing cow with high quality grass.

In the Netherlands there is a strong integration between grazing and forage conservation. Conservation must serve grazing; in other words the time of mowing depends more on the time at which regrowth is again required for grazing than on yield as such.

Most fertilizer studies have been primarily concerned with herbage production but as the ultimate use of herbage is animal production, fertilizer experiments should involve animal performance. Only a small number of such experiments have been carried out in Western Europe, mainly in the UK and Ireland. The data on responses are shown in Table 4. In general, they indicate a high potential for increased milk production from nitrogen fertilization.

Table 4

Nitrogen responses

N-range lb/acre	Milk gallon/lb N
0 - 135	2.0
180 - 360	1.4
270 - 630	0.5 - 1.0

Grazing methods have been much improved since the early fifties. At that time the traditional extensive, low stocking rate set-stocking system was the usual practice and in the case of rotational grazing, a grazing time of 10-14 days per plot was common.

Rotational grazing is still the most common system. However, the grazing period has been reduced to 5 or less days per plot. Paddock grazing is mainly a system of day and night grazing. In the Netherlands a modified paddock system is in operation as a result of the introduction of cubicle housing namely, day grazing and night housing. This system, particularly popular on intensive farms, reduces the problem of fouling and thus enables a better utilization of grass. Treading and poaching can be kept to acceptable levels. The disadvantage is that to make up for the shorter grazing time, fresh grass, silage or concentrates must be fed at night.

In the Netherlands zero-grazing and the modern intensive set-stocking (continuous grazing) system are only practised on a very limited scale.

Concentrates at pasture

Obviously, grass has potential as a production feed but too many farmers seem to regard it as maintenance feed. In recent years the trend on many modern dairy farms throughout Western Europe is to use liberal amounts of concentrates at pasture. The Netherlands is no exception (Table 5).

Table 5

Use of concentrates, cwt/dairy cow

	1965	1980
Total	13.8	35.0
At pasture	2.0	16.7

This widespread practice of supplying too much supplementary feed to grazing cows at pasture is surprising, alarming and difficult to justify on nutritional grounds since good quality herbage can provide enough energy to produce 5 gallons milk in May, June, July, dropping to 3.5 gallons in September. To the grassland enthusiasist this appears to be self evident. However the provision of supplementary feed may simplify farm operations, give a sense of security in periods of poor growth and increase the size of the herd.

On highly stocked farms one sees rather often that extra concentrates are fed to save grass for conservation. With ensiling, losses (during wilting and storage) will be higher than with grazing. Moreover there seems to be no point in taking a product capable of maintaining a cow plus 5 gallons milk and converting it into silage which will give only maintenance + 2-2.5 gallons.

Conservation

Conservation of forage is vital in livestock farming not only for providing winter feed but also as a tool in grassland management; mowing must serve grazing.

Farmers in the Netherlands have changed from hay to silage. Of the total mown area in the country at present 85% is for silage and only 15% for hay. The larger and modern farms produce almost exclusively silage, while the smaller, more traditional farms still produce hay.

The main feature of silage making in the Netherlands is the commitment to heavy wilting; 90% of all silage made is wilted to above at least 35% dry matter (Table 6). Forage harvesters are almost non-existent, the crop is cut by a drum mower in most cases. For wilting 3-4 days dry weather are necessary, as well as frequent tedding. If weather

Table 6

Silage survey in the Netherlands 1975-1980

% dry matter	51.5
% DCP	12.0
% crude fibre	25.4
ME, MJ/kg DM	9.5

conditions are unfavourable it takes more days and losses during the field period may become rather high. One should aim for a maximum field period of 5 days.

Why is high dry matter silage so popular in the Netherlands ? Firstly, there is strong integration between grazing and fodder conservation. cutting starts rather early in May, 7 to 8 days after grazing has commenced, and regrowth is available at the end of May. Therefore yields per cut are rather low; they are hardly higher than 25-30 cwt dry matter per acre. On the so called nitrogen pilot farms the silage cuts average only 22 cwt dry matter per acre. Furthermore, silage cuts are taken throughout the season. Secondly, our grass is fertilized heavily with nitrogen, cut when young and leafy, and rich in protein and low in sugars. Ensiling such a crop directly is difficult; even if fermented well it would result in a rather sticky product without much texture and animals would not like it. Generally a higher dry matter content will make the silage more palatable, which means faster and higher intake.

Other advantages of high dry matter silage are : no effluent problems; no additives needed; easy to handle, less weight; lower fermentation losses; no bad smell even if fermentation is not quite good.

Naturally there are disadvantages : weather during field period is very important; the field period means a delay in regrowth. A wilted crop is more difficult to ensile. The key to success is airtight sealing. One could almost say that the best silage additive is polythene sheeting.

Finally, let us consider the quality - quantity controversy. Animal performance depends to a large extent on the quality of the fodder which is particularly important when cutting grass for winter feed. A cow given high quality silage will consume more of that silage than of a lower quality product. A higher intake together with a higher nutritional value results in a much higher milk or meat production potential from forage and therefore less dependency on supplementary feeding stuffs (Table 7).

Table 7

Silage quality and milk output (after Fred Gordon)

Item	Silage quality		
	Medium	Medium	High
Concentrates, lb/day	12.5	8.4	8.4
Total DM intake			
cwt concentrates	7.0	4.7	4.7
cwt silage	13.6	14.2	16.4
Milk, gallons	353	333	360

A common criticism against early cut, high quality silage is that it will lead to lower forage production per acre, and would thus require more forage acres. Without doubt early and more frequent cutting for better nutritive value reduces the yield per cut. However, too often it is forgotten that an increase in rate of nitrogen, and consequently in number of cuts, can more than compensate for the lower yield per cut.

To obtain the same total dry matter yield per acre more nitrogen is required as the cutting frequency increases (Table 8). Even in the present economic climate fertilizer nitrogen application makes good sense and it would be false economy to reduce fertilizer use. However, an increase in nitrogen should go hand in hand with an increase in stocking rate and with an improvement in management.

Table 8

Cutting frequency : N necessary for 120 cwt dry matter per acre

Number of cuts	N lb/acre	ME MJ/kg DM
3	215	9.2
4	290	9.7
6	400	10.3
8	470	11.0

ABSTRACTS

THE YEAR AVERAGE OF WEATHER AT GRANGE

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To establish a baseline for weather at Grange 10 years daily recordings for air temperature (max. min and mean), soil temperature (at 50, 100 and 200 mm), rainfall (mm day^{-1} and sunshine (hr day^{-1}) were assembled in a Hewlett-Packard 1000/45 computer. Using specifically written programmes the data were sorted, the average for each day for 10 years calculated and the data smoothened by taking a 5 day running average. All temperature showed a bell-shaped distribution, soil temperature at 100 mm rose above 7°C about mid-April and returned below it in early November. Rainfall was fairly uniformly spread throughout the year but April, May and June were slightly drier than other months. Only about 27.2% of the potential sunshine was received due to cloud cover which was uniform throughout the year.

THE MEASUREMENT OF DRY MATTER PRODUCTION IN GRAZING TRIALS

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In grazing trials it is conventional practice to measure dry matter production as the change in yield cut to ground level between the end of each grazing and the beginning of the following grazing. This practice will include any changes that occur in the ungrazed stubble in the estimate of production. This paper presents data on the seasonal changes in yield in the ungrazed stubble and makes a comparison between total dry matter production measured from ground level cuts and the production of available herbage above the stubble height. Stubble yields increased substantially (at constant stubble height) from April to July and then decreased. As a result the production measured from ground level-sampling was significantly greater than the level of production of available herbage in the April-July period and was significantly less than available herbage in the July-October period.

AN ATTEMPT TO MAXIMISE GRASS YIELDS IN THE FIELD IN N. IRELAND

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Four 0.25 ha swards of Barlenna perennial and three 0.25 ha swards of RvP Italian ryegrass were grown for five years at four centres in Northern Ireland. An attempt was made to maximise yield by providing non-limiting amounts of nutrients and preventing weeds, pests and diseases. Up to 22.9 t D.M. ha^{-1} was obtained and at one site perennial ryegrass produced an average yield of 19.0 t ha^{-1} $year^{-1}$ over 5 years. Such yields compared well with those obtainable in experiments.

At two sites, yields were much lower than in the other sites. Differences in yield could not be attributed to climate, pests, diseases, ingress of weeds or lack of nutrients. They are thought to be due to soil physical problems.

Italian ryegrass outyielded perennial in the first year after seeding, but its yield declined markedly in subsequent years and it gave less total yield over 5 years even though it had been reseeded after 2 years. The digestibility of its herbage was also lower.

THE BALANCE BETWEEN GROWTH AND SENESCENCE IN A GRAZED SWARD

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One of the main characteristics of a grass sward is its rapid turnover of tissue. Throughout the year leaf growth and leaf senescence occur simultaneously so that at any given time the average ryegrass tiller will have a more or less constant number (± 3) of green leaves per tiller. There is a net accumulation of green material in the sward when the average length of the leaves appearing is longer than the older leaves senescing. Management exerts its influence on the productivity of swards by determining the amount of senescence in so far as green leaf removed by grazing or cutting will not be lost to death and decay. It also influences the amount of growth through its effects on what is left on the tiller post-grazing or cutting which will determine regrowth. Management also has an effect on tiller numbers. In rotational cattle grazing systems tiller numbers are approximately 10,000/m^2 whereas in continuous grazing systems numbers of up to 25,000/m^2 have been reported.

Data from Johnstown Castle have shown that as grazing severity is increased, total DM production will be reduced but total leaf DM will be increased by virtue of greater tiller numbers in the severe grazed sward. The implications for the grazing manager are not yet clear because as grazing severity is increased the tillers become smaller and the extra leaf production may be so near the ground that they are inaccessible to grazing cattle. Reports in the literature also suggest that forcing cattle to graze below 5 cm results in significant reductions in performance.

EVALUATION OF PICK-UP-WAGON SILAGE

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In 1979 and 1980 respectively three and four cuts of silage were made, each comparing the pick-up-wagon and double-chop harvester. All silage was unwilted and treated with 2.3 l/t of 85% formic acid. Mean DM%, pH, NH_3-N, % N and DMD% values of 18.2 and 19.3, 4.40 and 4.22, 11.1 and 9.6 and 72.5 and 72.2 were obtained for six paired comparisons of silages made using the pick-up-wagon and double-chop harvesters respectively. Three animal production trials were conducted with these silages. In trial I sixteen Friesian steers (initial liveweight 297 kg) were allocated to each silage type which was fed *ad libitum* for 221 days. All cattle were offered 1.84 kg concentrates/day. Final carcase weights for the animals on the wagon and double-chop silages were 269.9 and 278.7 kg respectively. In trial II sixteen Friesian bulls (initial liveweight 102.7 kg) were fed on each silage for 413 days. All cattle were offered an average of 2.06 kg concentrates/day. Final carcase weights were 283.6 and 280.7 kg for the animals on the wagon and double-chop silages respectively. Trial III was the same as trial II except that initial liveweight was 124.6 kg, the trial duration was 409 days, concentrate input was 2.2 kg/day and final carcase weights were 276.5 kg and 272.8 kg for the wagon and double chop silages respectively. The carcase weight averages of the three trials for the animals on the wagon and double-chop silages were 276.7 and 277.4 kg respectively.

Grass was harvested for trial IV without wilting on May 28-30, 1981 using either a double-chop harvester, a precision chop harvester or a pick-up-wagon. Each was treated with 2.3 l/t of 85% formic acid at ensiling. Eight Hereford x steers (initial weight 461 kg) were allocated to each of the silages and a further group of eight was given the silage ensiled using the pick-up-wagon but passed through the precision chop harvester immediately prior to feeding. 2 kg concentrates per day was fed to all groups. After adjusting the growth rates for some badly preserved silage which was fed during the first month of the feeding trial, the daily liveweight gains for the steers on the wagon, wagon/precision, precision and double-chop silages were 1.22, 1.29, 1.17 and 1.24 kg/day respectively over a period of 64 days.

Three successive cuts of unwilted silage were harvested for trial V on 22 May, July 1 and August 27, 1981. Within each cut grass was ensiled using the pick-up-wagon, set to give a theoretical chop length of either 5 cm or 10 cm. Mean DM%, pH, NH_3-N, % N and DMD% values were similar for both silages. Sixteen Hereford x heifers were allocated to each treatment and within each of these first, second and third cut silages were fed in sequence. Silage was the sole feed and was offered *ad libitum* for 135 days. Final carcase weights were similar for both silages.

Grass for trial VI was mown with a rotary mower on 30 September, 1982 and harvested using a double chop harvester or a pick-up-wagon. Within each of these harvester treatments approximately 4.5 tonnes of grass was ensiled either without preservative treatment or after the addition of 2.3 l/t of 85% formic acid. Mean DM%, pH, NH_3-N, %N and DMD% values for the wagon silage, without and with preservative and the double-chop without and with preservative were 13.8, 15.4, 14.0 and 15.0; 4.20, 3.96, 4.16 and 3.76; 10.1, 5.8, 12.8 and 6.0 and 73.8, 74.0, 71.6 and 74.8 respectively. Five Friesian steers (approximately 283 kg) were allocated to each silage type and offered silage **ad libitum** and unsupplemented for 10 days. Mean DM intakes for the four silages were 2.23, 2.35, 2.01 and 2.27% of body weight respectively.

It is concluded that the pick-up-wagon can be used to consistently produce silage similar in feed value to silage made using conventional harvesters. It is essential to achieve anaerobiosis quickly and maintain it. It is essential to avoid contamination and to use effective preservative treatment when necessary.

EVALUATION OF A FORMIC ACID/FORMALDEHYDE MIXTURE AS A SILAGE PRESERVATIVE

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Formaldehyde has been included in some silage preservatives on the assumption that its inclusion in silage will protect the forage protein from excessive microbial degradation in the rumen. In the three experiments reported here, one such preservative (Silaform : 55% formic acid + 14% formaldehyde) was evaluated as a silage preservative and its 'protein sparing' effect determined in terms of carcase production by intensively reared beef cattle.

Between 1980 and 1982 eight cuts of silage were taken. Each cut was treated at harvesting with either 2.3 l/t of 85% formic acid or 2.8 l/t of the formic acid/formaldehyde mixture preservative. Male Friesian cattle were offered either silage type *ad libitum* and within each silage type eight animals were supplemented with a low crude protein (10% CP) concentrate and eight with a high crude protein (16% CP) concentrate. Animals were group penned on slatted floor accommodation.

The chemical composition of both silage types from each of the eight cuts was similar. Mean DM %, pH, CP % and DMD % values of 18.9 and 19.4, 4.01 and 3.99, 15.6 and 15.6 and 70.1 and 70.4 were obtained for seven paired comparisons of formic/formaldehyde and formic acid treated silage respectively.

In Experiment 1 steers (mean initial liveweight 439 kg) were fed silage for 105 days, supplemented with 3.0 kg concentrates/head/day. Final mean hot carcase weights of 298.5 and 304.0 kg were obtained for the steers fed the silages preserved with and without formaldehyde respectively. No carcase weight response was obtained to increasing the crude protein content of the supplement fed with either silage type.

Experiment 2 involved the production of beef using bulls, which were reared on the appropriate treatments from 125 kg initial liveweight for 411 days. The mean daily input of concentrates was 2.41 kg/day. Final hot carcase weights averaged at 276.4 and 276.8 kg respectively for animals reared on the silages preserved using the formic + formaldehyde mixture and the formic acid. Intake of both silage types was similar. Increasing the protein content of the concentrates tended to increase the hot carcase weight (+ 7.9 kg) but this response was not significant ($P < 0.05$).

Experiment 3 differed from 2 above in that steers with an initial liveweight of 135.4 kg were used and that the trial lasted for 373 days. The silages treated with the mixture and with the straight acid resulted in mean final carcase weights of 256.5 and 264.4 kg respectively. Increasing the protein content of the supplement increased the mean carcase weight from 254.1 to 266.7 kg.

The formic acid + formaldehyde mixture being evaluated (Silaform) when applied at 2.8 l/t was as effective a silage preservative as 85% formic acid applied at 2.3 l/t. No positive response to the presence of formaldehyde was noted in terms of carcase production, or in the efficiency of its production. With finishing steers no response to increasing the CP content of the supplement from 10% to 16% was obtained but a 7.9 and 12.6 kg carcase response was noted with weanling to beef produced bulls and steers respectively. No significant interaction between silage preservative type and concentrate protein content was found.

EVALUATION OF ACID INSOLUBLE ASH (AIA) AS AN INDICATOR OF IN VIVO DIGESTIBILITY WITH RUMINANTS

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The scientific literature shows that acid insoluble ash (A.I.A.) (SiO_2) is widely distributed in plant material and passes through the digestive tract essentially unchanged. The ratio of the relative concentrations of A.I.A. in the feed and faeces can be used to estimate digestibility with various species including cattle, sheep, pigs, horses and poultry.

A preliminary study was conducted to determine the size of feed sample to be analysed to minimize variability in the results. It was found that a 10 g sample was adequate with little or no reduction in the coefficient of variation when larger samples were used.

Feeds and faeces samples from a digestion trial conducted at Grange (8 feeds x 4 replications, steers) and from a Canadian digestion trial (15 feeds x 4 replications, sheep) were the basis of this study. A.I.A. was determined by the 2N HCl method.

Digestibility estimated by A.I.A. correlated well with total collection method when the means of 3 or 4 animals were used for each feed, and gave r values of 0.93 and 0.96 for the Grange and Canadian data respectively. The A.I.A. values were superior to those estimated from MADF (r = 0.74) but slightly inferior to *in vitro* DMD (r = 0.98) in the Grange data.

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COMPUDOSE 365 AS A GROWTH PROMOTER FOR BEEF CATTLE

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Compudose 365 is an ear implant which contains 45 mg oestradiol 17 β for growth promotion in beef cattle. It consists of an inert silicone rubber core surrounded by a silicone rubber matrix containing the oestradiol 17 β. The implant which is large (3 cms x 4.8 mm) cannot be crushed and retains its original size and shape after insertion. Consequently it can be readily seen and felt under the skin on the back of the ear. Treatment with Compudose 365 causes a negligible increase in tissue oestrogen levels and oestradiol 17 β is a naturally occurring oestrogen which is present in the tissues of all animals and man.

The animal production response to Compudose 365 was measured in a number of trials. For a period up up to 6 months after implantation the responses to Compudose 365 and repeated Ralgro implantation were similar. Afterwards the response to Compudose 365 tended to decline relative to the repeated Ralgro response. There was an additional response from the use of Finaplix with Compudose 365 and Compudose 365 + Finaplix gave similar performance to Ralgro + Finaplix and Synovex-S + Finaplix. There was no response to Compudose 365 in young bulls implanted at about 11 months of age but there was a response in calves which was similar to that for Ralgro. The duration of effectiveness of Compudose 365 could not be clearly determined from the data. In one trial there was a response of 37 kg liveweight and 23 kg carcass weight over 414 days and in another the response was 38 kg liveweight and 19 kg carcass weight over 346 days. The corresponding response to 4 Ralgro implants over the same period was 49 kg liveweight and 26 kg carcass weight.

There were a number of instances of temporary sexual behaviour and 9% of implants were lost shortly after implantation.

RESULTS OF TWENTY YEARS SELECTION FOR INCREASED LITTER SIZE IN IRISH SHEEP

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The number of lambs reared per ewe joined with the ram is a major component of variation in income per ewe. Results from breed comparison trials indicate that the low level of lamb output for Irish lowland flocks is largely attributable to an inherently low litter size.

In 1963 two experimental programmes were initiated to select for increased litter size. The first involved selection within the Galway breed and the other involved the purchase of ewes which had extremely high litter size records. There were no breed restrictions and both purebred and crossbred ewes were purchased. This flock, called High Fertility, was closed in 1965 with subsequent within-flock selection for high litter size.

Selection within the Galway breed has yielded an annual improvement of 0.019 ± 0.0049 in litter size averaged for 2, 3 and 4-year old ewes and measured as a deviation from an unselected control population. Analysis of the response at each age shows a greater apparent total response at two years of age (0.35 ± 0.09) than at four years old (0.19 ± 0.08). In recent years selection line ewes were about 2 kg heavier than control ewes. Data on ovulation rate at 18 months of age shows that the litter size response could be attributed to increased ovulation rate.

The litter size of foundation ewes (prior to their purchase) for the High Fertility flock averaged 3.17 and the post-purchase records on these ewes showed a mean litter size of 2.14. For ewes born in this flock between 1977 and 1980 the average litter sizes were 1.59, 2.03, 2.37 and 2.21 at 1, 2, 3 and 4 years of age, respectively. Analysis of the breed composition of this flock showed the following percentage contributions: Galway 22%, Cheviot 20%, Suffolk 14%, Border Leicester 8%, Finn 6% and 30% could not be determined. Ovluation rate of mature High Fertility ewes average 2.84 which indicates that the high litter size can be attributed to ovulation rate with no evidence for increased embryo survival in this population.

INTAKE AND DIGESTIBILITY OF HERBAGE BY DAIRY COWS

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A series of experiments were conducted in Moorepark in '81/'82 to investigate the effects of the following parameters on the intake characteristics and digestibility of herbage by stall-tied cows; season, cow physiological status, supplementary feeding, level of intake and cutting strategy. Advancing season had a small but significant ($P<0.001$) effect on digestibility. Intakes of lactating cows increased as season progressed reaching a maximum in August while dry pregnant cows increased in intake up to June and subsequently declined. Level of herbage intake did not effect digestibility.

Concentrate supplementation (3.7 kgs OMI/day) reduced herbage intake ($P<0.01$) but did not significantly increase total OMI intake. Digestibility of herbage only was 80.4% OMD and herbage plus supplement 81.1% OMD. They were not significantly different.

A growth interval of 4 weeks versus 6 weeks over the whole growing season showed that the younger grass had a 2 unit advantage aver the older grass (81% OMD vs 79.3% OMD) ($P<0.001$). In April this difference (pre-cut) was 83.5 vs 79.7 while in July it was 82.9 vs 79.1. In August the difference was 78.7 vs 78.6.

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BODY CONDITION SCORE AT CALVING AND REPRODUCTIVE PERFORMANCE OF DAIRY COWS

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Energy intake has been found to affect reproductive performance in beef and dairy cows. Research showing this relationship has depended upon the use of body weight measurements and analysis of food and blood. This study investigated the relationship between body condition score at calving and the subsequent reproductive performance of 110 spring calving dairy cows. The resumption of oestrous cycles was determined by measuring milk progesterone levels in milk samples taken three days each week and oestrus detection was carried out twice daily with the aid of tail paint. Service commenced in April so that some early calving cows would not have been served for up to 90 days post-calving.

The intervals to first ovulation, oestrus and service for cows which calved in poor body condition (body score 1.5 or less) were 36.0, 65.1 and 86.8 days. Cows with a body score of 2 at calving had intervals of 25.3, 45.5 and 93.4 days and those with a higher body score at calving had intervals of 23.1, 45.5 and 78.3 days respectively. The effects of body condition score at calving on the interval to first ovulation, and first observed oestrus were significant. The effect of body condition on the interval to service was not significant, probably because service was delayed until April in all early calving cows.

The implications of these results are that the level of feeding prior to calving, and hence the body condition score at calving, affects the interval from calving to the resumption of oestrous cycles. This is most important in late calving cows in order to serve them and get them pregnant as soon as possible, and so advance their calving date the following year. Body condition scoring is easily carried out, requires no equipment and is a valuable aid to good herd management.

THE DEVELOPMENT AND IMPLEMENTATION OF A COMPUTERISED MANAGEMENT INFORMATION SYSTEM FOR DAIRY FARMERS (DAIRYMIS II)

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For cost effective dairy farming optimisation of inputs and outputs is essential. On intensive dairy farms strategic decisions require accurate and current information on farm events. The physical volume of farm events makes manual processing of data difficult. Computerised systems can process data efficiently and fulfill a vital role in farm management.

Detailed management and production data are being collected from 35 dairy farmers in the Fermoy area for the purpose of developing a computerised management information system. Dairymis II is an integrated recording scheme which provides essential information for establishing and maintaining a productive and profitable dairy farm. The system is recorder based. The recorder visits each farm on a monthly basis in order to collect stock and production data. The recorder then codes the data for computer input. Each month the farmer receives a number of reports which relate to his own farm and reports from which he can compare his own herd performance with other members of his group. The reports which the farmer receives contain information on milk yield per cow and per acre, concentrate use, fertiliser use, grassland management, silage quantity and quality, stocking rate, calvings, fertility control, stock control, culling and mortality rates. Economic measures of efficiency per cow and per acre are also included.

IN VITRO FERTILIZATION OF THE MAMMALIAN EGG

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Although *in vitro* fertilization has been reported for at least 14 mammalian species, live births have been recorded in only the rabbit, mouse, rat, human and the cow. The process of sperm capacitation, which normally occurs in the female reproductive tract and which can take from 2- to 12-hours has been a major technological barrier. The process of *in vitro* fertilization would render the whole process of embryo transfer more feasible, because it would ensure a reliable and predictable supply of embryos for transfer.

In the present experiment oocytes were provided following the hormonal induction of superovulation following PMSG and prostaglandin. At the time of first detection of heat, donors received 2,000 i.u. hCG and oocytes were recovered 25 hours later. Sperm capacitation was attempted *in vitro* using a high ionic strength (H.I.S.) medium with an osmolality of 380 m Osm/kg. Oocytes were recovered using HAM'S F-10 medium supplemented with 5% heat treated steer serum and antibiotics. Oocytes and sperm were incubated in microdrops under oil with a gas phase of 5% CO_2; 8% O_2, and 87% N_2. After 24 hour culture, oocytes were fixed and stained for evidence of fertilization. Overall 24% (5/21) of tubal oocytes were fertilized, but none of the follicular oocytes were fertilized on staining.

A REVIEW OF ANTIBIOTIC RESIDUES AND THEIR SOURCES IN IRISH MILK SUPPLIES

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The incidence of antibiotic residues in some Irish milk supplies has varied considerably during the last 15 years. In most cases, however, only trace amounts of antibiotic were detected and these were most unlikely to be harmful to consumers or cause problems in the manufacture of dairy products.

The primary source of residues results from the use of intramammary antibiotics in the treatment and prophylaxis of mastitis. Failure to withhold the milk from a treated cow could contaminate over 20,000 gallons of milk. Low levels of antibiotic are transferred to untreated quarters for up to two milkings after treatment. Residues can be detected on the milking equipment used to milk treated cows and this could contaminate several hundred gallons of milk. Treated cows should be clearly identified and milked last. Natural inhibitors present in milk are unlikely to interfere with the microbiological test methods used to detect residues.

EFFECT OF PELLET SIZE AND PELLET QUALITY ON PIG PERFORMANCE

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An experiment involving 1360 growing finishing pigs was undertaken to examine the effect of pellet size and pellet quality as measured by the Holmen pellet durability test on pig performance. A barley-soyabean meal diet was used and pellets were of 2 diameter sizes 5 mm and 10 mm x 2 qualities. Pellet quality was varied by steam conditioning and screening procedure during the pelleting process. The mean difference obtained in pellet durability was 11%.

Pig performance was not affected either by pellet size or pellet quality ($P>0.05$). There were small non-significant trends in favour of the smaller pellets and the low quality pellets. These trends of the order of 1% or less followed the same pattern as the dry matter content of the diets fed. The smaller diameter pellets were more efficiently dried in the cooling process and the low durability pellets had less steam added during the manufacturing process which was reflected in the finished diets.

THE RESPONSE OF PIGLETS WEANED AT 21 DAYS TO MILK PRODUCT CONTENT OF THE POST-WEANING DIET GIVEN *AD LIBITUM*

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In three experiments alternative starter diets containing graded levels of skimmed milk powder (SMP) were each formulated to contain the same amount of energy and lysine as the control, while in a fourth experiment the energy content of the diet increased with increasing content of SMP and the lysine ; energy ratio was maintained as a constant. The experimental animals were penned individually in experiments 1 and 2 while in experiments 3 and 4 they were penned in groups of six.

In the first experiment when SMP was included in the post-weaning diet at from zero to 300 g kg^{-1} (replacing soya bean meal and tallow) the rates of growth over the first seven days post-weaning and from weaning to 30 kg liveweight both increased linearly with increasing dietary inclusions of SMP. In the second experiment, when SMP was included at 100, 300 or 500 g kg^{-1} in diets given from weaning to 10 kg liveweight the rates of liveweight gain were 210, 246 and 260 $\pm$ 8.9 g d^{-1} respectively and in the same order the feed : gain ratios were 1.11, 0.97 and 0.98 $\pm$ 0.026.

In the third experiment groups of animals were given starter diets which included zero, 62.5, 125, 187.5 or 250 g SMP per kg of diet. The SMP replaced fish meal and soya bean meal and the ratio between these last two ingredients was kept constant. There was a significant linear ($P<0.001$) positive response to SMP in growth rate and in the efficiency of feed use. In the fourth experimtnt (pigs weaned at 15 d), when pigs were given pelleted diets containing SMP at high (360 g kg^{-1}), medium (250 g kg^{-1}) or low (0 g kg^{-1}) rates of inclusion from weaning to 9 kg liveweight, rates of liveweight gain were 240, 233 and 183 $\pm$ 4.4 g d^{-1} respectively while the corresponding conversions of digestible energy to liveweight were 18.2, 18.4 and 22.4 MJ kg^{-1}.

It is concluded that a dietary content of SMP of around 250 g kg^{-1} is likely to maximise the rate of growth, but that the selection of an optimum dietary content of SMP will depend upon the economic criteria used in the assessment.

CASSAVA (TAPIOCA) IN FINISHING PIG DIETS

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A series of experiments has been carried out using cassava which had originated in Thailand and which had been transported to U.K. in the pelleted form. The pellets were then ground before being included in meal diets based upon barley and dehulled soya bean meals. The diets were fed wet from troughs. Pigs of about 35 kg initial liveweight housed in groups of 10 were used throughout and slaughtered at around 85 kg liveweight.

The first experiment was a factorial design combining 4 levels of dietary cassava (from 0 to 450 kg/tonne) with 3 levels of tallow (from 0 to 100 kg/tonne). There was a significant interaction on growth rate with tallow preventing the decline in growth rate of about 60 g/day which occurred at the high levels of inclusion of cassava. The second experiment compared four levels of cassava (from 0 to 715 kg/tonne). The diet with the highest level of cassava contained no barley. As in the first experiment growth rate significantly declined with increasing cassava content but there was no effect on feed conversion ratio. In both experiments a digestible energy (DE) value of 14.2 MJ/kg has been assumed for cassava and, on this assumption, diets were restricted in order to produce isocaloric daily intakes. The results suggested that a lower DE value for cassava would be more appropriate.

Diets in both of these experiments were supplemented with synthetic methionine so that the sulphur amino acids content in each case was the same as that in the control diet. In the third experiment graded levels of supplementary methionine were compared using the diet containing 715 kg cassava/tonne. Growth rate, feed conversion and backfat thickness all deteriorated as the total content of methionine plus cystine fell below 5.4 g/kg.

These and other experimental data support the conclusions that the appropriate DE value to use in diet formulation for this type of cassava is about 12.5 MJ/kg, and that supplementary methionine may be required in diets containing moderate to high inclusions of cassava.

THE USE OF A WATER TABLE IN THE VISUALIZATION OF AIR FLOW PATTERNS IN NATURALLY VENTILATED LIVESTOCK HOUSES

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The need for high ventilation rates for housed cattle and sheep has been established. In naturally ventilated livestock houses wind is the predominant ventilating force. At low wind speeds a good air flow pattern ensures efficient ventilation while at high wind speeds a good air flow pattern ensures the absence of draughts. Draughts may cause discomfort to man and animals and may result in chilling of susceptible livestock. The water table is a means of studying the effect of the design, location and orientation of a livestock building on air flow patterns.

The water table consists of a table 1m wide with 0.2m high sides along which a mass of water 0.07 - 0.17m deep flows slowly. This water is used to simulate wind movement over open countryside. Scale models of naturally ventilated animal houses are submersed in the water and the pattern of movement of the water is visualised using soluble dyes. The flow patterns seen may be recorded using still photography, video film or by manual sketching. Models of houses are made from perspex or plastic card and are easily assembled.

Air flowing within and around buildings behaves as an incompressible fluid and therefore may be accurately simulated using water. While the speed of air flow within a naturally ventilated house varies directly in proportion to the external wind speed the air flow pattern does not change for sharp edged buildings. The water table may be used to predict air flow patterns due to wind only; no account is taken of air flow patterns arising from the stack effect.

Applications of the water table to date by the authors include : (a) the study of airflow in design variations of Patterson and Monopitch type houses, (b) a programme for optimising the use of gable end doors in a Kennel type calf house has been established from airflow studies in the water table—this programme maximises ventilation rate while reducing the risk of draughts under variable conditions of wind speeds and directions, (c) the effect of roof slope on air flow pattern in Pitched Roof houses has been studied, (d) the effect of wind barriers, solid and semi solid, has been studied on air flow patterns in sheep houses in relation to the distance which must separate the house and barrier so that normal air flow patterns occur and (e) models of complete sites and farm yards have been used to study the interaction of buildings and trees on flow pattern—this has been useful in the study of ventilation problems in climatic calf houses.

It is concluded that the water table is a useful means of studying the air flow patterns created by wind within and around climatic houses and has applications in the improvement of climatic house design and in the solution of complex ventilation problems in climatic houses.

FACTORS ASSOCIATED WITH VARIATION IN BIRTH WEIGHT OF PIGS

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Records from 2730 sows farrowed at Moorepark over a 5 year period were analysed. Pigs in 1066 litters were weighed individually and for these within litter variation is expressed by the within litter coefficient of variation (CV%). Average weight at birth (gm) was expressed by the following equations :

(1) $Y = \underset{\pm 148}{1231} - \underset{\pm 4}{24X_1} + 3X_2$ (r = 0.33) for gilts and

(2) $Y = \underset{\pm 13}{1544} - \underset{\pm 2}{45X_1} + \underset{\pm 3}{7X_2} - \underset{\pm 3}{15X_3}$ (r = 0.57 for older sows

CV% was expressed by the equations

(1) $Y = \underset{\pm 0.2}{22.7} + \underset{\pm 0.16}{0.16X_1} - \underset{\pm 0.03}{0.12X_2}$ (r = 0.31) for gilts and

(2) $Y = \underset{\pm 0.2}{5.51} + \underset{\pm 0.07}{0.95X_1} - \underset{\pm 0.013}{0.007X_2} + \underset{\pm 0.13}{0.41X_3}$ (r = 0.47) for older sows

In all equations X_1 = no. in litter, X_2 = service wt. Kg, X_3 = parity. The effect of pregnancy weight gain and gestation length was negligible.

THE INDUCTION OF PREMATURE PARTURITION IN THE COW USING LONG AND SHORT-ACTING CORTICOSTEROIDS

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A practical method of inducing premature parturition in cows thereby restricting calf growth rate *in utero* would allow for greater use of the larger beef breeds as terminal crossing sires both in the dairy and beef herds.

Two groups of cows (total 44) were presented for induction. Both groups were bred to continental sire breeds and a high incidence of dystocia would be expected following a normal term. The objective was to induce parturition 5-7 days prior to the normal expected calving date. The induction regime consisted of a primary treatment with a long-acting glucocorticoid; 20 mg betamethasone alcohol s.c. 10-14 days prior to expected calving date. This was followed 5 days later, if parturition had not occurred, by a secondary treatment consisting of a short acting glucocorticoid; 30 mg betamethasone phosphate s.c. Results for both groups were similar and a summary for both groups combined is presented.

Calving responses following the primary and secondary treatment were 16% and 77% respectively. Seven percent of the cows failed to respond within 72 hours of the secondary treatment and they calved at full term. Mean $\pm$ S.D. interval from the secondary treatment to calving was 43 $\pm$ 6.6 hours. Mean $\pm$ S.D. ease of calving score was 1.25 $\pm$ 0.30. Twenty-five percent of the cows retained the placenta for more than 48 hours and these cows had a longer interval ($P < 0.01$) from the secondary treatment to parturition than the cows that expelled their membranes within 48 hours of parturition. This longer interval suggests that these cows were relatively more premature at time of parturition. Calf birth weight was strongly correlated with gestation day at parturition ($r=0.59$). Regression analysis gave an estimate of calf growth rate *in utero* of b $\pm$ S.E. = 0.78 $\pm$ 0.23 kg per day ($P < 0.05$). This induction regime resulted in good relaxation and dilatation of the birth canal in 43 of 44 cows. Udder development was assessed to be normal in 42 of 44 cows; calf survival and vigour were not adversely affected.

This combination of a primary treatment with a long-acting glucocorticoid which seems to prepare the dam for parturition, followed by secondary treatment consisting of a short-acting glucocorticoid which triggers the onset of parturition, would seem to mimic quite closely the events of normal parturition.

THE USE OF ENZYME IMMUNOASSAY PROCEDURES FOR THE MEASUREMENT OF PROGESTERONE IN MILK OR BLOOD

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Because of its role in the maintenance of cyclicity and in the establishment and maintenance of pregnancy, progesterone is an important reproductive hormone. Progesterone level can be used to monitor corpus luteum function and, therefore, reproductive status in various situations. Until recently, progesterone determination was carried out by radioimmunoassay (RIA). But the use of this technique has been confined to specialised laboratories, due to high costs and the problems associated with the use and disposal of radioisotopes. Enzyme immunoassay now, however, provides an alternative method. The use of an enzyme label allows the assay to be colorimetrically based and hence dramatically reduces the capital cost of this assay. As there are no specialised requirements, the running costs of the assay are also reduced.

The progesterone assay (EIA) described is that developed by Cleere, W. and reported in J. Reprod. Fert. 62, 173-180. The performance of the assay at Belclare showed that the extraction efficiency was high (98.9%) and the standard deviation was low (± 1.9%) thus indicating a consistent procedure. The high correlation ($r = 0.94$) between the RIA and EIA methods was established over the complete oestrous cycle and therefore over a range of progesterone values. The co-efficients of variation both within and between assay runs were low and well within the ranges reported in the literature.

Using microtitration plates (8 x 12 matrix) instead of tubes, the optical density of the solution in the wells can be read *in situ* and commercially available plate readers now allow 96 well plates to be read in less than one minute. The output from the microtitre plate reader can be interfaced with a microcomputer and the results printed in terms of progesterone per ml of plasma or milk—thus allowing assay completion within one day.