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Season's Greetings

Agriculture • Forestry • Environment • Amenity

The IAgrE Scottish Branch Conference 1997

Wednesday, 19 February 1997, 10.00 - 4.30 Isle of Skye Hotel, Perth

Fast Tractors

Until recently, it was accepted that tractors were slow moving machines - at home in the fields and a mobile traffic jam on the road!

Now things are changing. A new generation of tractors, some of which are capable of speeds of up to 70 km/h, is having a major effect on the role of the tractor in farming.

Not only are faster tractors available, but also more versatile prime movers - system vehicles - are changing the definition

CONFERENCE PROGRAMME

Future of the fast tractor

The speaker from JCB gives his views on the likely trends for this new farm machine.

What are the constraints if any which might limit their use? Is the lack of a range of fast equipment going to hold the new tractor back?

Versatile system vehicles

In the past, not only were tractors slow, but also the driver was often facing the wrong way! Now a range of versatile system vehicles which enable the driver to be in the optimum position to control and observe implements, behind and in front, is now available.

The speaker from Claas in Germany discusses the range of functions and applications of this type of machine.

How do they perform?

The fast tractor from the users standpoint.

A farmer describes his experiences with fast tractors - what are the gains?

The law on the fast track

What are the latest UK and EC regulations covering tractors and how are they being applied?

A speaker experienced in the application of the law covers current and possible future regulations in pipeline.

Fast tractors in forestry - are they out of the wood yet ?

A Forestry Commission engineer describes the operation of fast tractors in forestry and their limitations.

Will they become part of the woodland scene?

Hard on the heels

Following hard on the heels of a fast tractor may be a fast trailer.

A leading trailer manufacturer (Wootton) describes the design work behind the high speed bailer which was specifically developed to match the performance of a fast tractor.

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Landwards

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Front cover: *Harvesting a young crop of Norway Spruce for Christmas (photo: Forest Life Picture Library)*

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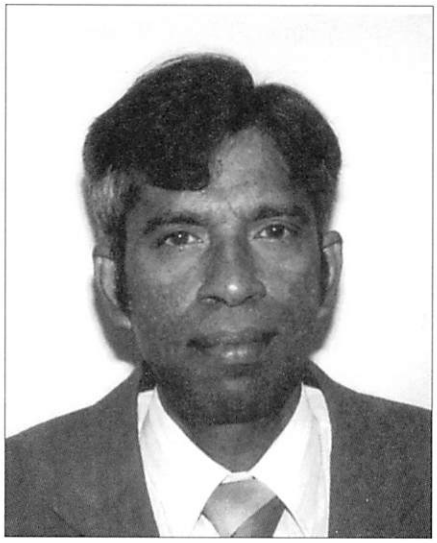

Paint systems for steel slurry tanks

V. Gopal Sangarapillai

Five paint systems that are potentially suitable to inhibit further corrosion in steel slurry tank panels were investigated by exposing test samples to livestock slurry. It was found that epoxy coatings gave the best protection followed by urethane coating, a combination of epoxy and urethane coating and glass reinforced rust stabiliser coating, in that order. It was concluded that epoxy coatings and, with further validation tests, urethane coatings could be used for treating corroded steel panels. The likely performance of corroded steel with the application of the paint systems compared to that of proprietary steel tanks is also discussed. Based on the current and previous findings, it was concluded that none of the paint systems is likely to give as good protection as vitreous enamel or glass coating or a combination of galvanising plus epoxy paint coating used in newer corrugated steel tanks.

Table 1 Paint systems used.

Treatment	Number of coats	Description
EP1	2	High performance single component epoxy primer and epoxy top coat (recommended for industrial applications).
EP2	2	Two-component epoxy primer coat and epoxy top coat (recommended for marine applications).
GRCR	4	Two coats of glass reinforced rust stabiliser as undercoat and two coats of unmodified chlorinated rubber reinforced finish as top coat (recommended for fast repair and localised corrosion damage).
EPUR	2	Two-component epoxy primer coat (as in EP2) and two-component urethane top coat (as in UR).
UR	2	Two-component urethane used both as undercoat and top coat (recommended for long term protection of external pipework).
CTRL	None	Untreated control samples.

1. Introduction

Steel panels of above ground slurry tanks are coated with vitreous enamel or glass coating and a mastic sealant is used at bolted joints during construction. However, corrosion is likely to take place if either the coating is damaged or the mastic sealant begins to harden with age. This damage may not immediately be apparent and only become evident when panel joints corrode. The use of paint systems can help prevent corrosion by rust stabilisation and inhibition of corrosion. Rust stabilisers penetrate corroded substrates and stabilise rust. Corrosion inhibitors form a protective surface film to stop the ingress of oxygen and moisture, and hence the propagation of corrosion is prevented. Thus, good paint systems can be used to maintain steel slurry tanks.

2. Materials and methods

2.1 Steel and treatments

Two types of steel, HR3 and HSLA, used in steel panels of slurry tanks were tested. The two types refer to different manufacturing processes and are detailed in BS 1449: Part 1 (BSI, 1983). Steel thicknesses of 2.0 mm for HR3 and 3.4 mm for HSLA steel were chosen.

Five paint systems, which are readily available on the market, were also

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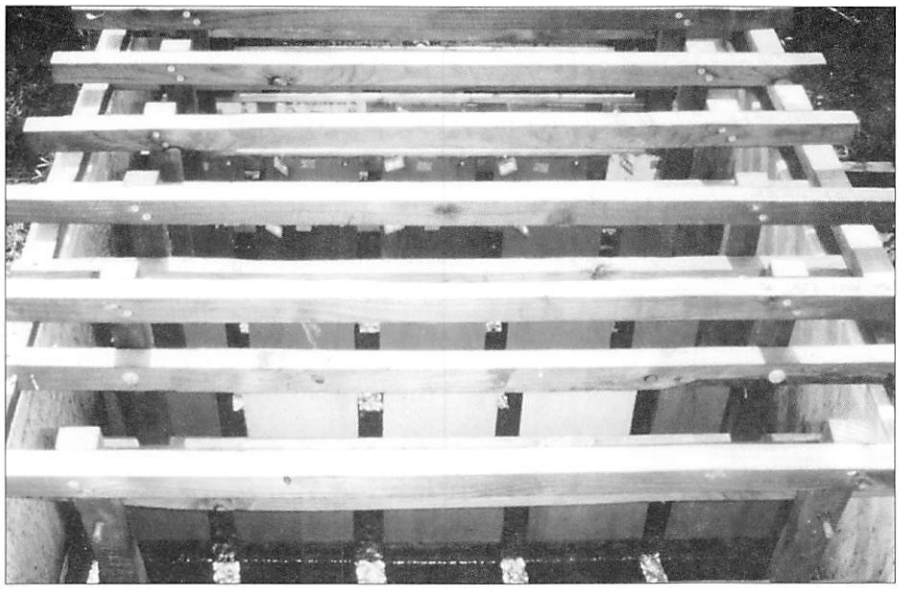

Fig. 1 Test samples at Checkendon.

selected. They are two epoxy, one urethane, a combination of epoxy and urethane and one glass reinforced chlorinated rubber based paint systems, respectively.

Samples which were 145 mm by 300 mm in size were cut from new, standard height panel sheets. Three replicates were used for each steel grade/thickness (2), treatment (6) and exposure condition (4). Thus, a total of 144 test samples (3 x 2 x 6 x 4) were prepared. They were divided into six equal batches and five batches were treated, one batch for each paint system, and the sixth batch used for (untreated) control samples.

The treatments applied, their description and recommended use are given in *Table 1*.

2.2 Sites and exposure conditions

Three site locations and four exposure conditions that were chosen are described below:

1. *Centre for Dairy Research (CEDAR), University of Reading, Aborfield, Berkshire* - cattle slurry of two different dry matter contents, obtained by mixing neat slurry with that from a slurry lagoon;
2. *Institute of Animal Health (IAH), Compton, Berkshire* - cattle slurry of a variable dry matter content, which was collected from a cattle housing, screed and stored in a small circular steel tank of three days' storage capacity;
3. *Pig Breeders' Supply Company's farm in Checkendon, Oxfordshire* - pig slurry screened and stored in a settlement lagoon.

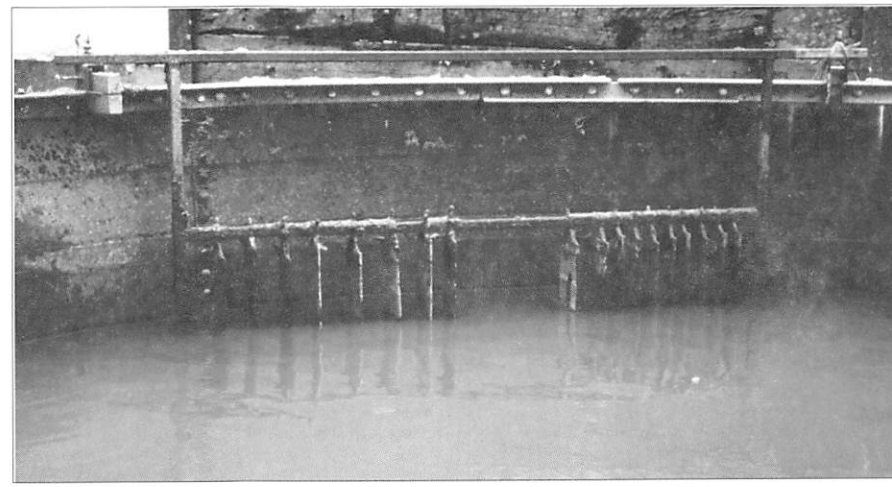

Fig. 2 Test samples at IAH.

Table 2 Exposure conditions.

Site	Slurry type & dry matter content (DM)	Exposure
CEDAR	CS1 (cattle slurry lower DM)	Partially immersed
CEDAR	CS2 (cattle slurry higher DM)	Partially immersed
IAH	CS3 (cattle variable DM)*	Air-only to fully immersed
Checkendon	PS1 (pig slurry)	Partially immersed

*Note: At IAH, the exposure conditions varied from air-only to fully immersed in slurry with the dry matter content fluctuating due to the cleaning procedure adopted in the cattle housing.

2.3 Test methods

2.3.1 Exposure test

The samples were sequentially numbered, two holes were drilled in one end and then they were placed in rows, by suspending them from nails on timber battens (CEDAR and Checkendon) and from wires tied a steel beam (IAH) that rested on top of the small slurry tank *(Figures 1 & 2)*. The exposure conditions are given in *Table 2*.

2.3.2 Monitoring of weight change

Samples were inspected and weighed prior to the exposure test in August '95. The exposure test was divided into Phase 1 of five months and Phase 2 of six months duration. The samples were weighed at the end of each phase, in December '95 and June '96, respectively. At the end of Phase 1, the samples were taken from their respective tanks, soaked in water, carefully cleaned without abrasion to ensure that sample surfaces were not damaged and weighed. Thereafter, the samples were put back in their respective locations and Phase 2 of the exposure test commenced. At the end of Phase 2, the samples were removed, cleaned and weighed as described above.

2.3.3 Monitoring of slurry

During the exposure test, periodic measurements of pH were carried out. At the same time, slurry samples were taken

Table 3 Visual inspection of the test samples prior to and after the exposure test.

Treatment	Colour prior to exposure	Colour after exposure		
		Upper portion exposed to air*	Middle portion exposed to slurry and air*	Bottom portion exposed to slurry*
EP1	Dark grey	No marked change in colour	No marked change in colour	No marked change in colour
EP2	Medium grey	Dark brown	Colour is intermediate between top & bottom	Medium grey
GRCR	White	White: some loss of paint	White: marked loss of paint	White: some loss of paint
EPUR	Light grey	Light brown	Light grey: blistering & exposure of undercoat	Light grey: Blistering of paint
UR	Light grey	Light brown	Marginal change in colour	Light grey
CTRL	Black	Rusty brown	Colour is intermediate	Metal black

* Notes:
1. At IAH, since the slurry level in the tank varied from empty to full, for samples treated with a paint system the distinction between top, middle and bottom parts was less marked. Consequently, the top part only showed a slight deposit of brown coloured layer for EP1, EP2, EPUR and UR Treatments. In the control CTRL samples, rust formation was evident over the entire surface area. Similarly, the loss of paint in GRCR Treatment and the blistering of paint in EPUR Treatment were observed over the entire surface area.
2. At Checkendon, for samples treated with a paint system, the middle part of their surfaces was less affected compared to those at CEDAR and IAH.
3. In the case of control CTRL samples, rust flakes peeled off the samples that were exposed, in particular, at IAH and Checkendon at the end of Phase 2. This resulted in bare metal being exposed in place of rust flakes.

for subsequent determination of the dry matter contents by the oven-drying method.

In addition at CEDAR, slurry levels in the two tanks were checked and, if necessary, were topped up to the original levels. The dry matter contents were also adjusted, to try to bring them closer to their initial values.

3. Results

3.1 Visual inspection

The results of the visual inspections prior to and after the exposure test are summarised in *Table 3*. Although the appearance of the test samples did not vary markedly either between the sites or at end of Phases 1 and 2, there were some differences and they are described as notes, after the table.

The six treatments of samples from CEDAR (CS1 slurry) after Phase 1 of the exposure test are shown in *Figure 3*. The reflection of camera flash in some of the test samples should be disregarded.

3.2 Weight changes in the test samples

The weight changes at the end of Phases 1 and 2 of the exposure test are summarised in *Tables 4A and 4B*, respectively. They contain the average values of the three replicates used for each steel grade/thickness, treatment and exposure condition. *Table 5* shows the average values of the weight changes in the test samples extracted from Tables 4A and 4B. They are categorised under the two steel grades/thicknesses and six treatments for each phase of the exposure test.

3. 3 Slurry properties

The average values of the dry matter content and pH of the cattle and pig slurries obtained during the exposure test are shown in *Table 6*.

4. Discussion

4.1 Phase 1 of the exposure test

From *Table 4A*, all but two of the replicate sets of the test samples increased in weight at the end of Phase 1 of the exposure test. This may be attributed to the initial build up of a surface layer due to oxidation the paint systems and rusting of bare steel.

4.2 Phase 2 of the exposure test

From *Table 4B*, the majority of the test samples have lost weight as a result of partial loss of the oxidation layer and due to rust flakes peeling off the control

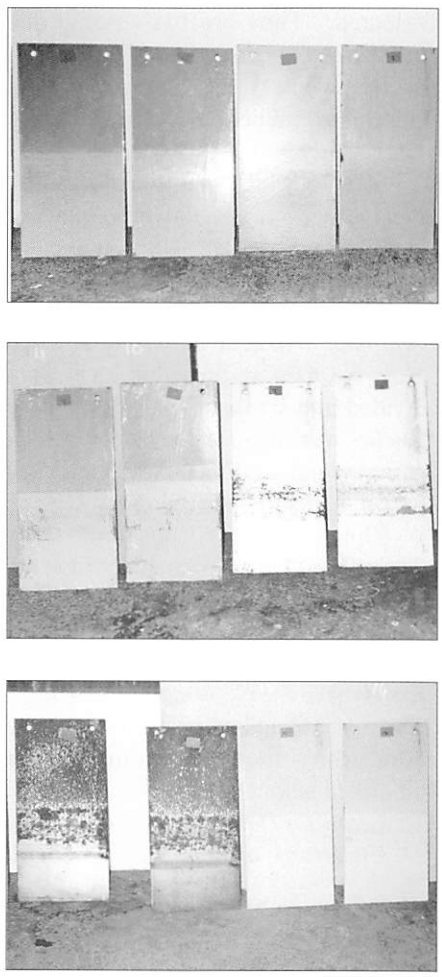

Fig. 3 Replicated samples after Phase 1 of the exposure test: TOP - the two epoxy treatments, EP2 *(left)* and EP1; MIDDLE - combined epoxy/ urethane (EPUR) *(left)*, and glass reinforced chlorinated rubber (GRCR) treatments; BOTTOM - the control (CTRL) *(left)* and urethane (UR) treatments.

Table 4A Average weight change in the test sample replicate sets at the end of Phase 1 of the exposure test.

Steel/ treatment reference	Weight change, g			
	CEDAR		I A H	Check-endon
	CS1	CS2	CS3	PS1
HR3				
EP1	+0.1	+0.2	-0.2	+0.3
EP2	+0.8	+0.5	+0.1	+0.5
GRCR	+0.1	+0.5	+0.7	+0.8
EPUR	+1.1	+2.0	+0.3	+0.5
UR	+0.8	+0.4	+0.7	+0.4
CTRL	+2.3	-0.1	+30.6	+2.7
HSLA				
EP1	+0.6	+0.3	+0.5	+0.7
EP2	+1.0	+0.5	+0.6	+0.7
GRCR	+0.2	+0.4	+0.2	+2.0
EPUR	+1.0	+2.4	+0.6	+0.7
UR	+0.7	+0.8	+0.6	+0.7
CTRL	+2.3	+0.2	+28.5	+0.7

Table 4B Average weight change in the test sample replicate sets at the end of Phase 2 of the exposure test.

Steel/ treatment reference	Weight change, g			
	CEDAR		I A H	Check-endon
	CS1	CS2	CS3	PS1
HR3				
EP1	-0.4	+0.0	-1.1	-1.7
EP2	+0.2	+0.3	-0.8	-1.2
GRCR	-1.1	-0.1	-1.0	-1.2
EPUR	+1.2	+1.4	-1.9	-0.7
UR	+0.4	+0.4	-0.8	-1.2
CTRL	-1.2	-1.4	+22.8	-16.4
HSLA				
EP1	+0.4	+0.0	-0.3	-1.4
EP2	+1.0	+0.6	-0.5	-1.7
GRCR	-0.7	-0.7	-1.3	-0.2
EPUR	+1.2	+2.8	-1.3	-0.7
UR	+0.6	+0.9	-0.7	-0.8
CTRL	-2.8	-1.4	-2.0	-13.8

samples. For the two epoxy EP1 and EP2 samples located at CEDAR, the weight changes were mixed with some of them were still showing an increase - but less pronounced than that was observed at the end of Phase 1 - and the others were showing a decrease under the same exposure conditions (cattle slurries CS1 and CS2). For samples treated with a paint system, those exposed at IAH and Checkendon had lost more weight than those exposed at CEDAR. This indicates that the atmosphere/slurry interface is critical because exposure conditions at IAH varied from air-only to full exposure in slurry, and that pig slurry is more corrosive than cattle slurry, which can be attributed to the types of livestock feed consumed.

4.3 Relative performance of the paint systems

From *Table 3*, it is evident from visual inspection that the GRCR (glass reinforced chlorinated rubber) treatment because of the loss of paint and the EPUR (combination of epoxy and urethane) treatment because of the blistering of paint are unlikely to perform satisfactorily over a longer period of time.

From *Table 5*, it can be seen that out of the other three treatments, the epoxy EP1 samples have gained less weight than the epoxy EP2 and the urethane UR samples during Phase 1. During Phase 2, however, they lost more weight than those treated with the other two treatments. Also, the visual comparison at the end of Phase 2 indicates that not only the adhesion of paint to the substrate of the EP1 samples is better than that observed in the UR samples but also they have exhibited less change in colour than those treated with EP2 and UR treatments. Using both the weight loss and visual degradation as the criteria to rank the performance of the paint systems, the EP1 and EP2 paint systems are recommended for treating corroded steel panels.

With regard to the UR paint system, although it seems to have performed less well than the EP1 and EP2 paint systems, a longer period of exposure is necessary to establish its potential for use in slurry tanks.

4.4 Exposure conditions

The procedure of periodic checks rather than controlling the dry matter content

Table 5 Average weight change in the test samples based on steel grades and treatments at the end of both phases of the exposure test.

Steel reference	Weight change, g					
	EP1	EP2	GRCR	EPUR	UR	CTRL
Phase 1						
HR3	0.10	0.48	0.53	0.98	0.58	8.88
HSLA	0.53	0.70	0.70	1.20	0.70	7.93
Average	0.32	0.59	0.62	1.09	0.64	8.41
Phase 2						
HR3	-0.80	-0.38	-0.85	+0.00	-0.30	+0.95
HSLA	-0.38	-0.15	-0.73	+0.50	+0.00	-5.00
Average	-0.59	-0.27	-0.79	+0.25	-0.15	-2.03

Table 6 Dry matter contents and pH values of cattle and pig slurries during the exposure test.

Location	Slurry sample	DM content, %		pH	
		Phase 1	Phase 2	Phase 1	Phase 2
CEDAR	CS1	0.9	0.8	7.5	7.7
	CS2	1.3	2.8	7.1	6.9
IAH	CS3	0.9	0.6	7.2	6.8
Checkendon	PS1	0.8	0.4	8.3	7.6

and pH value was adopted. This approach mirrors more closely what usually happens under field conditions, as they vary from day to day over the storage period. From *Table 6*, it appears that, within experimental limits, pig slurry was slightly alkaline.

5. Practical implications

The Control of Pollution Regulations require that above ground slurry tanks should have a design and durability life of 20 years with minimum maintenance (HMSO, 1991). During a pilot survey of proprietary vitreous enamel or glass coated steel slurry stores, it was found that some of the panels of tanks of over 20 years old were in good condition (ADAS, 1994). Although the paint systems would not be a substitute for protecting steel, they could enhance the protection offered by overcoming the drawbacks due the production process of and workmanship during erection of vitreous enamel or glass coated steel tanks. It is likely, however, that the paint systems investigated would require periodic renewal over the 20-year period, with the two epoxy systems EP1 and EP2 requiring less frequent renewal than the others. Therefore, repainted steel is not as good as steel protected with vitreous enamel/glass coating in pristine condition.

Table 7 Effect of acid deposition on rate of corrosion of pure zinc.

Acid deposition value (from map)	Unweighted annual corrosion rate for pure zinc, g/m²
1	7.4-11.2
2	11.2-14.9
3	14.9-18.6
4	18.6-22.3
5	22.3-26.1
6	26.1-29.8
7	29.8-33.5

Work by ADAS on the compilation of an acid deposition map covering the United Kingdom indicates that galvanising would have a calculable life as indicated in *Table 7* (ADAS, 1992). Thus, a galvanising layer of 250 g/m+ would last between 8 and 30 years under air-only exposure conditions at locations with the highest and lowest deposition levels, respectively. With immersion in slurry/exposure to air, galvanising could last a similar or shorter period, depending on the pH of the slurry.

With regards to proprietary galvanised/epoxy coated corrugated steel tanks, it would appear that its durability is dependent on the type of epoxy used. However, none of these stores has been in use long enough to ascertain practical long term performance of this coating method.

6. Conclusions

1. The epoxy generic paint system gave the best performance. The two-component EP2 paint system of primer and top coat was marginally better than the corresponding single component EP1 paint system.
2. The urethane paint system, UR, also offers good protection.
3. The combined epoxy/urethane paint system, EPUR, had little potential to offer proper protection. This is because the top coat would blister and eventually peel off.
4. The paint system of glass reinforced chlorinated rubber, GRCR, is not suitable to protect steel exposed to livestock slurry.
5. In comparing the paint systems with other proprietary systems, it is concluded that:
   a) none of the paint systems is likely to give as good protection as conventional vitreous enamel or glass coating gives to steel;
   b) the combination of galvanising plus epoxy paint coating used on some newer corrugated steel buildings has the potential to offer good corrosion protection but the system has not been in use long enough to make an assessment of their long term performance.

Acknowledgements

This work was funded by the Environmental Protection Division of the Ministry of Agriculture, Fisheries and Food.

I thank CEDAR, IAH and the Pig Breeders' Supply Company for giving permission to use their sites, and my former colleagues, David Powell and Mike Spooner (University of Reading) and John Dumelow (Rover International Ltd) for their assistance.

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Leading the way in safer tractor operation

Case IH is giving its total support to an enterprising safety initiative under which 13 to 16 year old boys and girls in Northern Ireland are being taught the necessary skills to drive tractors safely.

Established last year by Greenmount College of Agriculture and Horticulture in consultation with the Health and Safety Inspectorate of the Province's Department of Agriculture, the two-day courses are aimed at providing youngsters with a knowledge of safe driving techniques with or without implements, and simple maintenance.

The scheme recognises the fact that in Northern Ireland there are more accidents involving agricultural tractors and their implements than with any other machinery on the farm. Most of these accidents are caused by tractors overturning or passengers falling from moving machines.

Graham Black, Case United Kingdom's communications manager, said: "As one of the world's leading tractor manufacturers, we are committed to ensuring our machines are built to operate safely and to comply fully with all legislation governing safety. Despite comprehensive instruction manuals, certain situations outside our control - such as poor operating practices and inadequate maintenance - are all too often the cause of serious accidents. Hence our wholehearted support for a scheme which could well be the only one of its type in the world."

The Health and Safety Inspectorate's statistics show that over a nine year period between 1985 and 1994, 48 people were fatally injured as a result of tractor related accidents in Northern Ireland. Regrettably, young people are frequently among the victims. In the four years up to 1994, 18 young people under the age of 17 were involved in tractor related accidents. Six of these were fatal.

Although it is not unusual for young people with farming backgrounds to be able to drive a tractor from a tender age, they are unlikely to be given proper instruction or training in safe operating practice and will therefore be unaware of potential dangers. Besides, it is illegal for anyone under the age of 13 to drive a tractor 'off the road'.

It was this situation, coupled with the number of fatalities among the farming community's young people that prompted Terry Chambers from the Health and Safety Inspectorate, together with Derek McKinstry and George Mathers, senior lecturers at Greenmount, to devise a structured tractor driving course aimed at reducing the risk of accidents. Following discussions on tractor requirements for the course, Case IH, through local dealer Norman Erwin & Company, supplied three 4WD tractor models from its popular 32/4200 Series — a 4210LP, a 4240XL and a 4240LP.

"Response from the farming community was tremendous when we announced the scheme last year," says George Mathers. "We were surprised and delighted by the number of youngsters who applied and, as result, we had no alternative but to adopt a first come first served approach. Building on this success and with the continuing support of Case IH who supplied five tractors (four from the 4200 Series and a Maxxum 5120), we have been able to double the number attending each two day course this year."

The courses, open to young people of either sex who are closely associated with a farm or a horticultural unit, take place at Greenmount College near Antrim and its sister college in Enniskillen during the July and August school holidays. Each course is designed to cover the NVQ level one unit: "transport mechanically". Assessment for this qualification can be arranged by the College at a later date but is not compulsory. Although the courses are free, there is a charge of £44.85 for NVQ registration and certification if required.

At the start of a course, the 16 participants are divided into groups of four, each under the supervision of an instructor. A pool of instructors, comprising college staff, retired safety officers and working farmers, operate on a rota basis. All have been selected because of their experience in teaching young people.

The first day begins with an introduction to the course, followed by a review of tractor and farm safety in general. Instructors then take their charges through the tractor's controls and their respective functions. After lunch, hands-on driving commences as well as further instruction on safety and drawbar changing. The day ends with revision of safety procedures and the various activities performed during each session.

Driving and manoeuvring with a trailer take up most of the second day which includes instruction on implement attachment. This is followed by tractor servicing and maintenance with an emphasis on pre-start checks. The final session includes a safety video and summary.

During the Summer around 270 teenagers, (110 in 1995) participated in this year's courses at the Colleges in Antrim and Enniskillen. George Mathers and the team of instructors are confident that all will have gone away with a better understanding of safe driving techniques and tractor safety in general.

Errata

Compounds aggressive to concrete floors in pig houses *by* N De Belie, B De Blaere & R Verschoore

Two data line symbols were transposed in, and the right hand scale omitted from, the graph in Figure 2, page 25 of *Landwards*, Autumn issue. The correct graph is published here, with apologies for the editorial oversight.

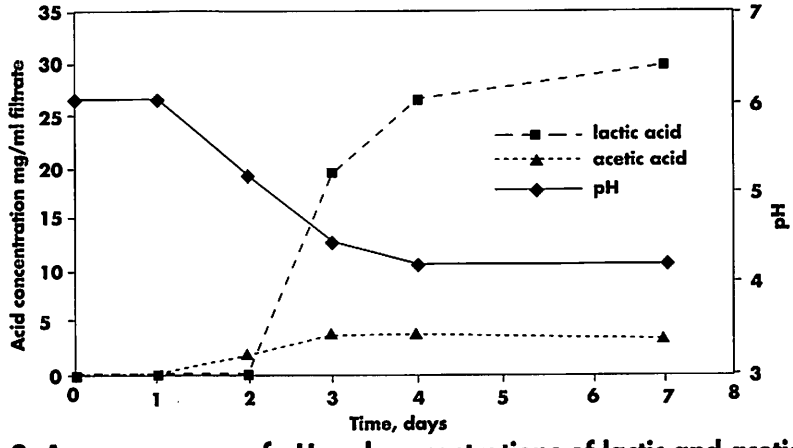
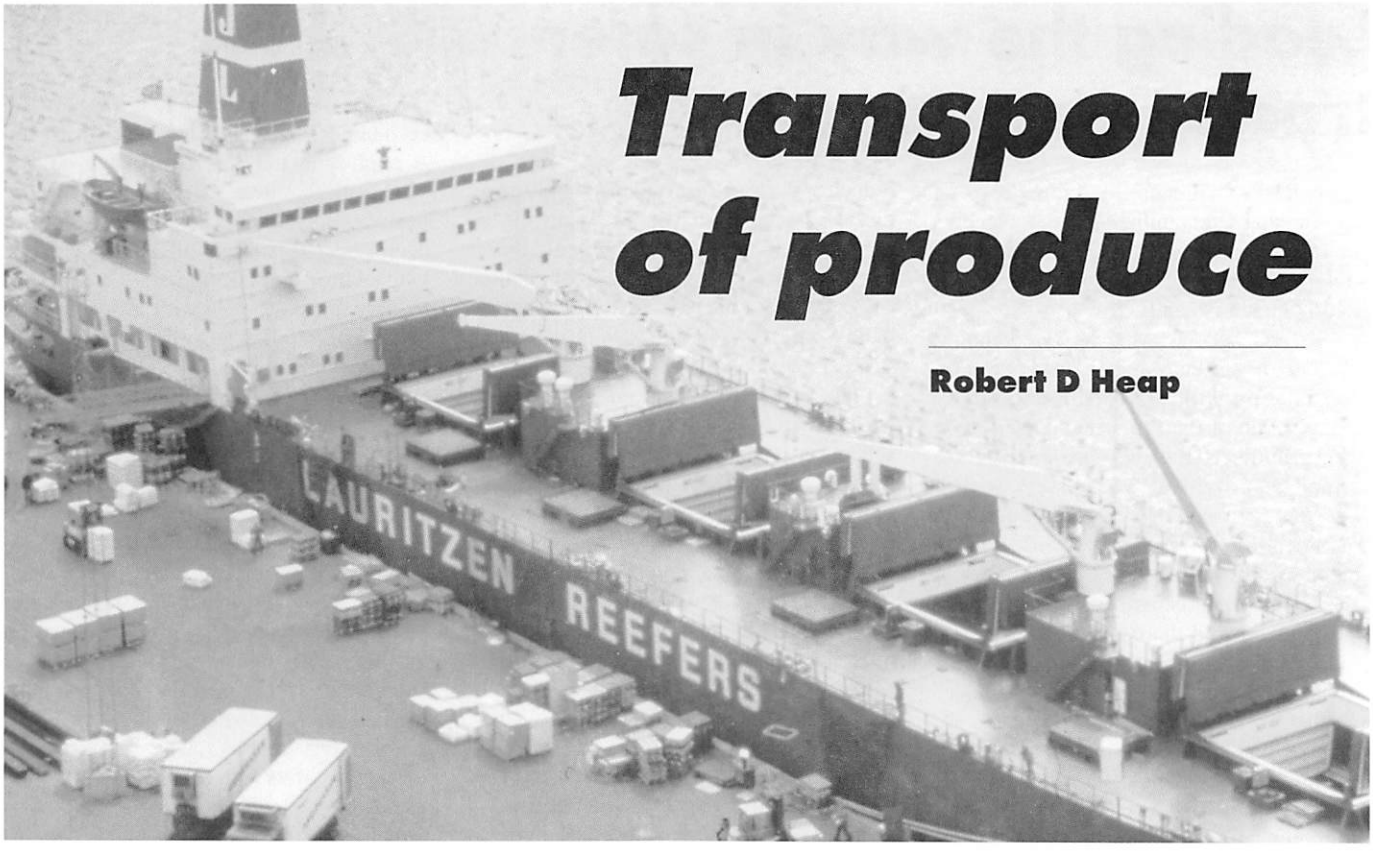


Fig. 2 Average course of pH and concentrations of lactic and acetic acid in meal/water mixtures.



Transport of produce

Robert D Heap

Introduction

Refrigerated transport of produce must be seen as a total operation involving the movement of goods from one fixed storage area to another. The operation involves a 'chain' of events of which the actual movement of goods in a road vehicle, intermodal freight container, rail wagon, ship or aircraft is only a part. Temperature maintenance through the chain is essential for success, and the finest transport equipment cannot compensate for poor handling at loading, wrong packaging and stowage, or inadequate product cooling.

The term 'refrigerated transport' may itself be misleading, in that frequently it should be 'temperature-controlled transport'. In cold winter conditions it may be necessary to heat chilled foods in order to prevent freezing damage, and for many fresh tropical fruits quite moderate temperatures can produce irreversible chilling damage. For example, bananas should not be allowed to cool below about 13°C. In areas of the world having severe winter conditions, heating requirements can be considerable. The distinction between 'refrigeration' and temperature control is important for equipment users, who may not appreciate that a wrong temperature-setting on transport equipment may lead to foodstuffs being heated, whereas in many static stores it would only lead to lack of refrigeration.

If the produce is to be worth transporting, it must be of good quality, properly prepared and selected.

If the produce is to be worth transporting, it must be of good quality, properly prepared and selected. Success is about selling the best to a market at a premium price, not about finding someone to pay for an unwanted surplus.

It follows that is essential to know the product's needs in terms of packaging, temperature and ventilation if it is to be maintained in good condition. As the detailed requirements may vary with variety, growing area, and season, this may not always be easy.

If possible problems are to be anticipated and avoided, it is necessary to understand the complexity of and the possible interactions between the various factors which have to be right to ensure success. Long distance transport of produce can be, and generally is, worth while and effective, but it should not be attempted without proper thought and study, as it can be full of traps for the unwary.

Long distance transport can be by land, sea, air or any combination of these. The choice of transport mode depends on the distance, the time available, the quantity and value of the goods, and on what is accessible locally. Generally, the more valuable and the more perishable the produce, the better the justification for the higher costs of air freight, though market conditions (eg the pre-Christmas trade) can alter the equation.

For longer distances, if time allows, sea transport is the most economical and is well established for consignments from about 25 cubic metres in a single refrigerated container to several thousand tonnes in a refrigerated ship. The choice between containerised shipment and the use of palletised loads in a conventional ship will depend on the particular journey

This paper was presented at the IAgrE Annual conference entitled: "Crop Quality - Post harvest" and held at Writtle College, Chelmsford on 2nd April 1996. Robert Heap is Technical Director at Cambridge Refrigeration Technology, 140 Newmarket Road, Cambridge, CB5 8HE.

being considered, and on whether the load is a 'one off' or part of a continuing regular trade.

In general, transport equipment is designed to maintain temperature, and not to provide cooling. Whilst goods can be cooled to some extent during transport, this is a slow and non-uniform method of attempting to cool, and it should not be depended upon. Pre-cooled produce should be loaded under temperature-controlled conditions wherever possible.

Transport equipment

The range of transport refrigeration equipment is wide, as are the needs for transport. At its simplest, it could be an insulated box containing water ice. At its most complex, it might be an intermodal freight container with integral refrigeration machinery capable of maintaining either frozen or chilled goods at any selected temperature between -25°C and +30°C in ambient temperatures from -20°C to +50°C. Most frequently it will be a road vehicle designed either for local deliveries or for long distance or bulk distribution.

The temperature control requirements for chilled goods are more difficult to achieve than those for frozen goods. Typically, it may be necessary to maintain produce between 0°C and 5°C, and for many items closer tolerances are required, whereas with frozen foods there will be an upper limit temperature, perhaps -18°C, but no lower limit. To ensure temperature uniformity in a load of chilled goods, relatively high rates of continuous air circulation and high levels of temperature control are necessary, and careful stowage within the vehicle may be needed to achieve this.

Road vehicles

Refrigerated road vehicles fall into two basic categories. Firstly, there are large semi-trailers, with refrigeration units which can be run independently of the tractor unit. Secondly, there are rigid-bodied vehicles of various sizes, which may have independent refrigeration units, or may have units driven from the vehicle engine or axles, or may depend on eutectic storage media.

Semi-trailers are used for long distance or bulk movements, generally with only one or a few destinations. Journey times may vary from two hours for supermarket distribution to several days for fresh produce transportation. Whilst most such vehicles use diesel engine drives with optional electric alternatives, some use total-loss refrigerant tanks (liquid nitrogen or carbon dioxide) to reduce both capital cost and noise levels in sensitive areas.

In most developed countries, semi-trailers are designed for use in ambient temperatures of 30°C or above, with thermal insulation with overall value of 0.7 W/m^{2}K or better. If frozen goods may also be carried, insulation of less than 0.4 W/m^{2}K would be used. Increasingly, multi-purpose multi-compartment vehicles are being produced, capable of carrying frozen, chilled and fresh produce simultaneously in different compartments.

Rigid-bodied vehicles vary from large vehicles very similar in use to the semi-trailers to small delivery vehicles for multiple deliveries of chilled foods to corner shops. Refrigeration units may be driven by diesel or electric motors, or by hydraulic drive from the vehicle chassis, or may be based on either total-loss or eutectic systems. The latter two are more often used for frozen food transport, being relatively difficult to control at chilled temperatures. Delivery vehicles may require walk-in access for order selection from fixed shelving, and may have to operate with large numbers of daily door openings. Recent legislation such as the UK food safety regulations has provided the impetus for much development of vehicle design to meet increasingly stringent temperature requirements.

Generally, refrigerated vehicles control the temperature of the air supplied to the cargo space, and monitor the temperature of the air returning to the refrigeration units with an external gauge or display or, increasingly, a display within the vehicle cab. Some older vehicles primarily designed for frozen foods may only control the temperature of air returning to the refrigeration unit, with the risk of freezing chilled goods that are loaded too warm. Some multi-compartment vehicles depend on the thermostatic operation of bulkhead fans to maintain chilled temperatures by circulation of air from a frozen food compartment.

Intermodal freight containers.

Intermodal freight containers

Intermodal freight containers ('ISO' containers) with integral refrigeration machinery are widely used for the long distance transport of fresh fruit and vegetables and chilled meat. Because of journey times of up to 6 weeks, they have highly developed refrigeration and control systems, and they are capable of operating over a wide range of conditions. They are normally only used for point-to-point international transport involving a substantial sea journey though there are

occasions on which the lease of such a container can be a very convenient way of providing a temporary facility. Standard sizes are either 6 m or 12 m length with capacities of about 28 or 60 m^3, and refrigeration units are electrically driven from three-phase supplies from either mains or a diesel generator. They differ from most road vehicles in that air is supplied to the load space from a 'T' section floor grating.

Containers, which are widely used for fruit carriage, are available as either insulated or refrigerated units. They have all the advantages of general cargo containers (especially, minimum handling of produce, and security) and can be operated on road and rail land links as well as at sea. Insulated containers require connection to an external controlled temperature air handling system, refrigerated containers incorporate their own refrigeration equipment and only need an electricity supply.

Modern refrigerated containers can control air temperatures very closely at any set point in a very wide range of ambient conditions, but are not designed to have sufficient refrigeration capacity to act as rapid coolers of warm produce. In fact, if fruit with a high rate of respiration (eg avocado, mango) is loaded too warm, the refrigeration machinery is unable to extract sufficient heat to prevent the fruit warming up. In this context, how warm is too warm is very dependent on packaging details, but an excess of 5°C could certainly give problems.

Other equipment

Modern refrigerated cargo ships are designed with powerful refrigeration equipment, and with a maximum air circulation rate equal to a change of the temperature of air in an empty hold every 40 seconds. Such ships can maintain close control of the temperature of air delivered to the cargo space, and are also used (especially in the banana trade) to cool fruit to carrying temperatures. However, such cooling requires a time of a few days rather than a few hours, and pre-cooling prior to shipment is essential for most produce.

For air transport, journey times are relatively short and no attempt is made to control temperatures in the way that is understood by marine operators with perhaps some solid CO_2 present to reduce the rate of warming, and cargo conditions at outturn depends on speed of handling. If problems occur, they are more likely to be on the ground than in the air, so it is important to use importers who are familiar with the handling and importation procedures in the receiving country.

Rail transport of temperature controlled produce is widespread in Eastern Europe and the former Soviet States, less so in the West. Fully refrigerated and insulated railcars are available, as are simpler units depending on ice bunkers. At present in the UK, road transport is predominant, but an increase in intermodalism could lead to further development of rail services into and from Europe.

Whatever the transport mode, it is important that the shipper understands the limitations of the equipment being used and issues instructions accordingly. For sea transport, distinction should be made between air delivery temperature, air return temperature, and carrying temperature, but for air transport, it is unlikely that any precise temperature specification can apply.

Handling cartons of apples in a ship's hold: note foot boards to avoid bruise damage.

Possible problem areas

The first problem experienced by any exporter is likely to be a lack of relevant information on storage life. It is necessary to know how long a commercially handled product can retain a useful shelf life at the carriage temperature, and this is not the same as the time to breakdown of a sample picked at ideal maturity and held under laboratory conditions. Intermediate scale static trials can provide useful information, without the costs of a full experimental shipment. Such trials must incorporate any desired pre-treatments (hot water, fungicide, etc) and should preferably include elements of the packaging system to be used.

The next requirement is careful handling. No amount of attention to temperature control can compensate for bruised produce, and no amount of pre-cooling can overcome the heating of cartons stacked in the sun before loading. The cartons or boxes must themselves be designed to protect adequately against all the rigors of transportation, including high humidity.

It is necessary to consider the possibilities of various forms of cross contamination. Foodstuffs containers should hold no odour from previous cargoes, but if different commodities are to be mixed, whether in a single shipping container or connected to a common air space, then odours can be transferred, as can ethylene produced by fruit.

Finally, there can be an accumulative loss of storage life margins through the various links of the transport chain. Although there may be some overall margin for error, this can only be used once. If all the margins are eroded by the exporter, for example by insufficient pre-cooling, then there is no margin for later delays, for example due to import customs delays.

New technologies

There are new or developing areas of

technology which could have a substantial impact on transport of produce. These include controlled atmosphere storage and transport, ethylene absorption, irradiation, and genetic engineering.

Controlled atmosphere (c.a.) is an addition to refrigeration, providing controlled reduced levels of oxygen and (generally) increased levels of carbon dioxide, with possible ethylene scrubbing and humidity control. Modern transport systems use either membrane or pressure swing absorption methods to generate nitrogen continuously. Equipment is available but is expensive, and c.a. chains could be difficult to establish. Nevertheless, the technique offers shelf life improvements and, if used properly, improved quality of outturns.

Ethylene acts as a ripening agent for some fruits in concentrations as low as 0.03 ppm, and its removal can play an important part in retaining fruit life. One-off absorbents may be used, or on a larger scale catalytic converters can oxidise ethylene to harmless gases. The efficiency and cost-effectiveness of such systems are subjects of on-going research.

Irradiation of fresh fruits, either to kill surface bacteria and moulds or to inhibit ripening, is a technique which is approved to some extent in some countries, and it would be reasonable to expect the number of approvals to increase. Dose control to avoid damage could be difficult for some fruits, and the cost-effectiveness of bringing fruit to a central irradiation source may be difficult to justify, but further development is possible.

Genetic engineering offers the possibility of some produce items being bred for longer storage life or greater temperature tolerance, and this could affect transport requirements for these products. Either the products themselves could be carried differently, or in some cases the transport need could be reduced by developing varieties to grow in the climate near the point of sale.

Conclusion

The methods available for the transport of produce are well suited to a wide range of commodities and journeys, and this transport is carried out successfully as long as the needs of the transport chain are understood. Technological developments will continue to meet the ever-increasing demands of the market place.

Branch Diary

Scottish Branch

Wednesday, 29 January at 19.30 h
Royal Hotel, Bridge of Allan
Members' night. Various members speaking on a selection of topics after a bar supper.

Wednesday, 19 February at 10.00 h
Isle of Skye Hotel, Perth
Fast tractors. Followed at 16.30 h by *AGM.*

Hon Sec: G M Owen Tel: 01968 675943

South East Midlands Branch

Monday 13 January at 19.30 h
Silsoe College
Research papers:
Behavioural responses of broiler chickens to transport conditions by Julia Behrends, Silsoe Research Institute;
The use of modified atmosphere packing techniques with Thompson grapes by Gwen Berry, Silsoe College;
Modelling air flows from orchard sprayers by Ross Cant, Silsoe Research Institute;
Aerobic treatment of pig slurry - reducing the nitrous oxide emission by Ole Pahl, Silsoe Research Institute;
Development of a date palm harvester by Mohsen Shamsi, Silsoe College;
Spray drift measurement by Paul Young, Silsoe College.

Monday 3 February at 19.00 h
Star & Garter, Silsoe
Presidential address by Dr Mike Dwyer.
Flood & coastal defences in East Anglia by Walter Massey, Assistant regional Engineer, MAFF, Cambridge.

Monday 3 March at 19.00 h
Silsoe Research Institute, Conference Room
AGM, followed by *Application of electronic noses in agriculture* by Julian Gardner, Department of Engineering, University of Warwick. (Joint meeting with IMechE &/or IEE.)

Hon Sec: D Pullen Tel: 01525 863038

West Midlands Branch

Monday, 13 January at 20.00 h
Evesham College
History of Deutz-Fahr Tractors. Andy Delaney of Watveare on the development of Deutz-Fahr Tractors, including the Agrotron series.

Monday, 10 February at 20.00 h
Oxstalls Farm, Evesham
Visit to Evenproducts Ltd. G Godber (Director) will provide a conducted tour and discuss the range of irrigation and other products developed and marketed by this long-established company.

Monday, 10 March at 19.15 h
Massey Ferguson, Banner Lane
AGM, followed at 20.15 h by: *Precision farming*. A presentation by Mark Moore of Massey Ferguson. This meeting will represent the West Midlands Branch contribution to the 'Year of Engineering Success' programme.

Hon Sec: M C Sheldon Tel: 01926 498900

GIS developments within Forest Enterprise

Jo O'Hara

Forest Enterprise is the part of the Forestry Commission responsible for the management of the publicly owned forest estate in Great Britain. In this role, it has to achieve targets set by government for:

- financial performance;
- timber production;
- landscape enhancement;
- recreation provision;
- environmental and archaeological conservation.

Managing forests for these multiple benefits is a complicated task, needing careful and detailed planning from the site to the national scale.

Over the last 5 years, Forest Enterprise (FE) has had to consult more widely on its activities, and has had to meet ever-tightening financial targets. In order to facilitate these changes, information handling systems have had an increasingly important role to play. These systems can vary from paper-based records to complicated databases, and the information held within them is used for numerous tasks, including consultation, budgeting, and production planning.

The major issues facing FE in the medium term will be:

- increasing production from UK plantation forests;
- greater competition from abroad in the market for British timber;
- certification;
- reduced financial support from central government;
- pressure to fulfil biodiversity and sustainability criteria;
- continuing public demand for recreation facilities;
- continuing pressure to minimise the impact of forestry in valued areas (like national parks).

All of these issues will force the organisation to be more 'on the ball' about its resources, so that it plans for change, rather than reacts to it.

Example 1

Clear-felling is becoming less acceptable to the general public in the US and continental Europe. In those areas where it is still carried out, maximum coupe sizes are sometimes enforced (often considerably smaller than the average in upland Britain). What impact would a maximum coupe size of 20 ha have on FE production?

This is the sort of question that the organisation needs to be asking itself. At present, it would be possible to come up with an answer of sorts. However, the amount of time and resources needed to investigate the impact on even one forest is such that this type of question often goes unanswered.

This paper was presented at the IAgrE conference entitled: "Computers in Forestry Production", organised by the Forestry Engineering Specialist Group and held at Newton Rigg College on 5th September 1996.
Jo O'Hara is GIS Development Officer at Forest Enterprise, 231 Corstorphine Rd, Edinburgh EH12 7AT.

As a business in a highly competitive timber market, FE also has to be continually looking to improve its performance. Our main product is timber and we need to be able to maximise our return from what we sell while still achieving our 'non-market' targets. To do this, we need to be continually improving our products, to optimise production so that we are maximising production of the right product at the right time, and to have confident marketing information for the short and long term.

2. Existing forest planning systems

FE currently has various systems for planning and managing the dynamics of the forest resource.

i. The core of forest information is the sub-compartment database (held on computer) and stock maps (digitally captured and distributed to Districts as paper copies). When used in conjunction, these represent a set of information about site and trees that is consistent across the whole country *(Table 1 and Figure 1)*.

ii. The production forecasting system consists of yield models and price-size curves held with a set of programmes on a central computer. This can calculate yields, assortments and revenues for any sub-compartment.

iii. Forest design plans are the central planning document, and give rise to the coupes used as input to the production forecast. These plans hold the background information for a given forest area (e.g. topography, archaeological sites, conservation sites, operational constraints, etc.), they put the information into context via a design concept, and then show the proposals for a given area in terms of felling and restocking.

iv. The landscape design package is used by landscape architects to model the impact of proposed coupes on sensitive landscapes as part of the forest design process. This computer-based system is held at regions and is used as a service by districts.

v. Small scale assessments of felling and planting decisions can be carried out locally using a computerised investment appraisal package. This contains various yield models and can be used to determine discounted

revenues for various courses of action as well as calculating optimum felling dates for individual stands and calculating volumes.

Example 2

A forest manager is being asked by her client to delay the felling of certain coupes in a design plan and she wants to know what impact this will have on her budget and harvesting commitments. There are no operational constraints but the area is being restructured, and delaying the felling of these coupes will have an impact on the timings of adjacent coupes.

This manager would currently have three courses of action open to her.
1.If there were only 2 or 3 coupes affected, and the crops in them were relatively uniform, she could use the investment appraisal package to calculate the likely volumes and revenues from each crop type, and use assortment tables to see the impact on product mix.
2.If more coupes were affected in a complex forest, it could be quicker to request a new production forecast run to be carried out centrally.
3.She could make an educated guess about the likely impact based on experience.
None of these options is ideal, the first two are time consuming (especially if some degree of sensitivity analysis is needed), and the third, while being the quickest, is not objective and would be difficult to back up if questioned.

3. The move to GIS

Over the past couple of years there have been several factors which have combined to make the move to GIS appropriate.

i. *Pressure from central government*
The National Audit Office report on the harvesting and marketing functions of FE in 1992 recommended that better information handling systems be installed to allow more extensive testing of options for harvesting plans. There is also political pressure for FE to minimise the opportunity cost associated with accommodating non-market benefits in its operations.

ii. *Increasing delegation to forest*

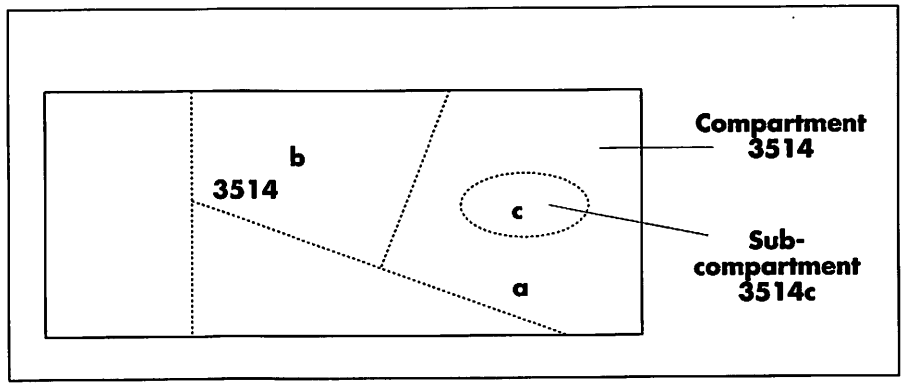


Fig. 1 Diagram showing the compartment and sub-compartment structure of stock maps.

Table 1 Description of sub-compartment database.

Field name	*Description*	*Use*
Cpmt	Compartment	Part of key
Scpt	Sub-compartment	Part of key
Comp	Component	Part of key, used to split two or more unmappable components of one sub-compartment
Land Use	Land use code	e.g. PHF = productive high forest
St	Storey	If a mixture of dominant and suppressed trees as different components, separates one from the other
Spp	Species	e.g. SS = Sitka Spruce
Orig	Origin	e.g. Queen Charlotte Island or Washington for SS (Provenance)
Prop	Propagation	Trees which have been produced by vegetative propagation
P.Year	Planting year	
YC	Yield class	Indicative of growth rate
Prod Area	Productive area	Area with a productive crop of trees on it
Unprod Area	Unproductive area	Unmappable areas of unproductive land within component
Rotn	Rotation	First or second rotation
Mixt	Mixture	
Legl	Legal status	e.g. Leasehold
Cnty	County	
Lndscpe	Landscape classification	e.g. AONB
For Park	Forest Park?	
Cons	Conservation classification	e.g. SSSI - used for statutory designations
FC Cons	Conservation classification	Not always used
AMAW	Ancient monument or Ancient woodland?	Is either present within the sub-compartment?
Soil	Soil type	Not always available
Alt	Altitude	Approximate (not derived from DTM)
Terr	Terrain classification	Indicative of roughness, slope and ground conditions
WHC	Windthrow hazard class	
PFTB	Production forecast block	Used in production forecasting
Loc 1	Local use 1	Use defined by District
Loc 2	Local use 2	Use defined by District
Loc 3	Local use 3	Use defined by District
Grid Ref		Not derived, an approximate centre point for the compartment
Surv Year	Date of last survey	

districts with shrinking staff numbers

As in many other sectors of government, there is a move away from centralisation, and towards flatter management structures. If forest managers are to be given more responsibility, then they need good support systems.

iii. *Increased accountability and more requests for information*

More open government means providing external parties with clear, comprehensible information within a reasonable time span. With the advent of design plans and consultation with external parties, the reasoning behind management decisions has to be more carefully explained and supported than was maybe the case previously.

iv. *Increasing use of information technology at all levels within the organisation*

As has been the case in all aspects of life, the use of computers has become far more widespread in recent years. There are probably two main reasons for this: the first is that the cost of hardware and software has fallen; and the second is that the various software packages have become much easier to use and more accessible to the non-expert. The biggest change in FE has been the provision of networked Personal Computers (PCs) to all districts, along with MS Office to use as they see fit. The result is that the level of computer literacy within the organisation has increased considerably.

v. *Advances in GIS and hardware performance*

Over the last two years, the number of PC and Windows based GIS has increased considerably. Up until quite recently, the systems that could be run on a PC only offered limited 'functionality'(i.e. they couldn't do very much!), and the more powerful systems could only operate on expensive mainframes and were difficult for non-expert users to learn and use.

In March 1995, a decision was made to set up a pilot study to see whether a GIS could be used to improve the production forecasting system for forest districts. If the pilot study was successful, then the organisation would plan to provide local GIS to all districts for managing their own database, maps and production forecasts.

4. Pilot study

The core brief of the project was to investigate the ability of a GIS to:

i. extract data from the sub-compartment database on the basis of a coupe drawn on the screen;

ii. run a production forecast for that coupe (or series of coupes) based on a felling date derived from the optimum fell date *or* input from the design plan.

In order to do this, the following aspects had to be investigated:

- importing stock map information to create a seamless stock map that could be viewed and edited on screen at any scale;
- handling the large tables of information associated with the SCDB and production forecasting system and allowing complex modelling functions to be carried out on those tables;
- creating a direct link between the stock map and the database to allow access from one to the other (e.g. showing all Sitka Spruce in a given Geographic Block, or updating the area associated with a compartment when the size of that compartment is changed on the map);
- allowing 'spatial querying' - e.g. extracting details of all sub-compartments, or parts of sub-compartments that fall within a given felling coupe;
- importing other information from diverse sources (such as aerial photos, the TJP Computer Aided Design (CAD) package, other databases, etc.);
- customising the appearance of the software to allow a wide range of abilities to use it.

By the end of the pilot study it was shown that the GIS package which had been used (called ReGIS) had the ability to carry out all of the above to a greater or lesser extent. Problems were encountered in the following areas:

- displaying the Ordnance Survey Raster backdrop (not investigated further because not crucial to the core brief);
- importing digital maps onto the GIS caused some problems because of the way the data had been digitised initially (i.e. for digital mapping purposes not GIS), as a result considerable 'cleaning' of the data was necessary;
- linking problems between the 'Access' database and a product, called ODBC, that acts as a translator resulted in the use of the internal GIS database which was not an ideal outcome and the whole issue needs to be investigated further;
- testing difficulties with the CAD abilities of the programme due to a lack of time and a user unfriendly manual.

5. The current situation

FE has decided, on the basis of the above, that it will develop GIS further, with the aim of having a system installed in forest districts next year. To this end, a full time GIS development officer has been appointed. Her role is to manage and direct the development of the GIS system. The development officer is advised and guided by a steering group drawn from different parts of the Forestry Commission (including foresters, information technology specialists and cartographers).

The work that has been carried out so far has included drawing up a proposed system specification that shows how the GIS will fit into the organisation, and what outputs may be expected from it *(Figure 2)*. GIS consultants have also been appointed to advise us on potential products and the procurement process. We now have a shortlist of four possible products and will be running benchmark tests over the next month. Once the tests have been completed we will choose a package (tendering if necessary) and start work on designing the system itself.

6. A vision of the future

If the system is going to be worth all of this development money, then it will have to provide real benefits in the management of the forest. Some of the ways it may achieve this are:

- optimising felling dates within design plans - hence potentially less revenue foregone;
- providing a more flexible production forecasting system available at the district;
- allowing on-screen updating of the database and stock maps as areas are felled and planted - hence a more up-to-date dataset and fewer errors due to there being a real link between the database and the map and a single entry system for updates;
- improving risk management through modelling of 'What If?' scenarios.

This list could be endless in reality, since once the system is in place new uses will continually be found for it.

A plan of the proposed system is included in *Figure 2*. This shows that the GIS cannot be considered in isolation from any of the other systems that support it. We are not intending to have one package that will handle *all* of our mapping, database and production forecasting needs: we currently have separate systems that are extremely good at these tasks. The role of the GIS will be to link different sources of information together, and to provide the forester with a single point of access, so it must be able to link to these other systems easily and invisibly.

Because the system is so dependent upon other information sources, there are other aspects of the organisation that need careful consideration before the benefits

(e.g. provision of stock maps within forest districts), then how this fits with other cartographic services within the organisation will have to be carefully considered.

- The current database and production forecasting systems are getting more and more out of date in terms of user requirements and structure. The GIS will only be as good as the underlying datasets, models and maps that we feed into it. The strategy for database and production forecast management needs to be considered in depth before the GIS is designed in any detail.
- The whole situation within the organisation regarding networking, hardware, operating systems and other software needs to be considered so that

may improve the *quality* of work coming from individuals, and it may allow more effective working; however, it will not replace the management and practical skills of trained personnel who know the forest and the geography of the area they are working in. A GIS will not reduce the amount of time needed to supervise sites, liaise with contractors or monitor establishment.

A GIS will not improve the quality of your data. Just because you can draw a line to less than 1 mm precision doesn't mean that the line is in the right place to start off with - that is dependent on your surveys. Equally, the GIS will not be able to magically predict production from stands that do not have yield data associated with them - the forecast will

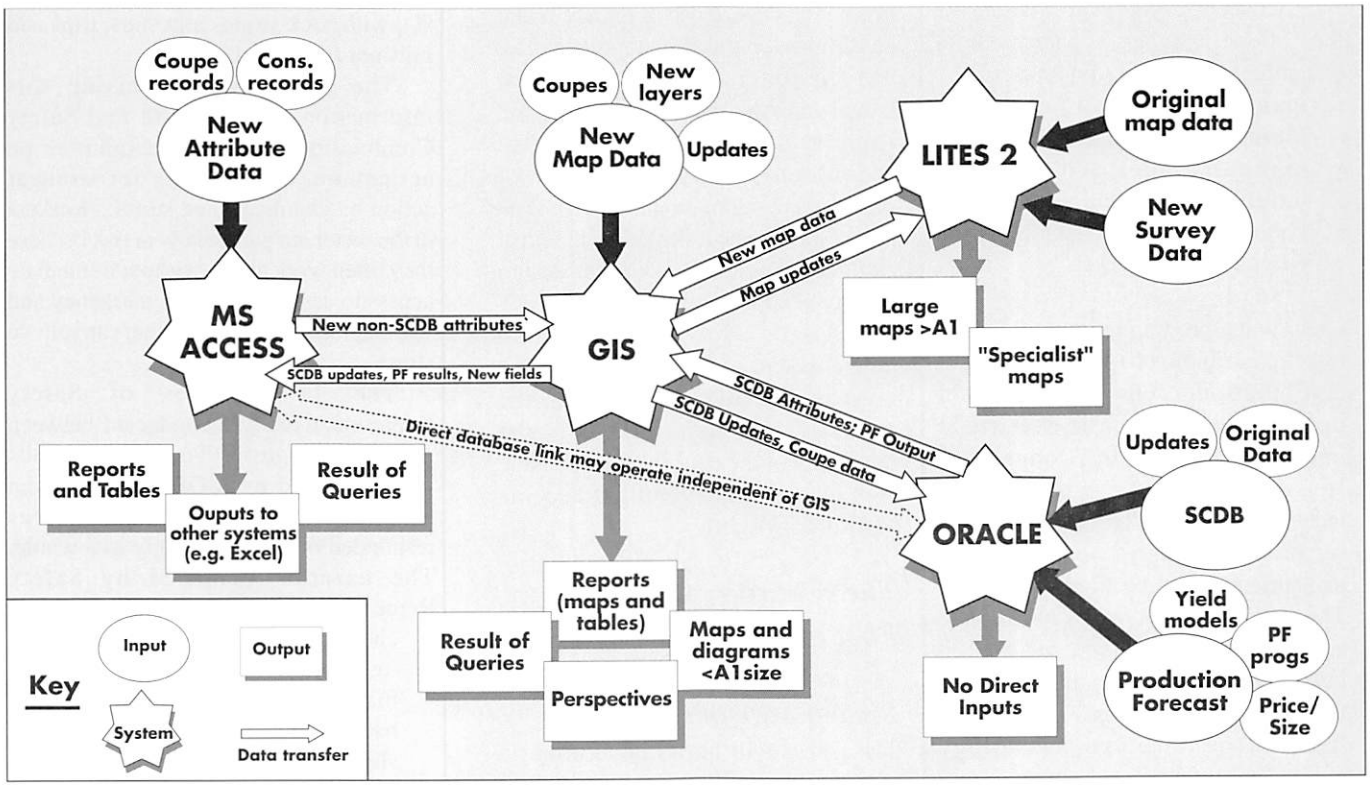


Fig. 2 Proposed structure of the Forest Enterprise GIS system.

of GIS can be fully realised.

- *Accurate* map and survey data will still be at the core of the system, and a way of maintaining the integrity of this dataset for the whole organisation needs to be decided. Forest Districts will need to believe in the system and recognise its benefits if they are to use it to its full potential. The current level of IT skills within the organisation may not be high enough for this to happen.
- If the GIS does end up being a 'front end' for some cartographic functions

any new investment in GIS fits comfortably into the FE information handling system.

7. What a GIS *won't* do!

It is easy to get swept along on the tide of enthusiasm that unseen new technology tends to carry with it. However, it is always a good idea to keep the limitations of the system in mind (especially when talking to salesmen!).

A GIS will not replace foresters. It only be as good as the underlying models and the accuracy of the crop information.

A GIS will not do a forest design plan. It will help by bringing all the information together in one place, and allowing you to produce neat maps. It may even do some 3D analysis, but the basic skills of designing coupes to fulfil multiple objectives still need to be provided by the operator.

The MART equipment challenge

The MART (Management of Appropriate Road Technology) Equipment Challenge is organised by the Construction Enterprise Unit (CEU) of Loughborough University, which was awarded a 3 year research contract by the Overseas Development Administration (ODA) in April 1995. The challenge is open to any individual interested in the appropriate technology sector who is able to draw on their experience and expertise to help with the development of specific items of equipment.

Concept designs are invited for the following types of intermediate technology, roadworks equipment:

- **manually operated one barrel bitumen heater distributor;**
- **manually operated concrete paver press & testing apparatus;**
- **(tractor) towed deadweight compaction roller.**

Small scale enterprises and community, programmes could have a major contribution to play in the future construction, rehabilitation and maintenance of roads in urban and rural areas of developing countries. However, the conventional technologies normally used in the road sector require high levels of capital investment operating funds and skills. This precludes their use by small scale enterprises and local communities. The initial objective of the challenge is to develop concept designs for specific items of intermediate technology equipment suitable for use by the target enterprises and communities. The concept designs must be feasible and explicit enough for development into detailed designs and prototypes to be tested in the field under the MART programme.

Requirements

The designs ultimately developed must be capable of being fabricated in a modest mechanical workshop in a developing country. They must be robust and capable of withstanding the hard in-service treatment expected. The equipment must be cheap to fabricate using commonly available materials and workshop equipment. Spares and maintenance requirements should be at an acceptable and manageable minimal level. The equipment must be capable of allowing work to be produced to appropriate and internationally acceptable standards. The requirements of each item of equipment are set out in their individual specification briefs.

Your role as concept designer

From your experience of the needs and conditions of the developing world, and your powers of creative and maybe lateral thinking, you will prepare and submit a concept design for consideration by a panel of independent international experts. You do not have to be a skilled mechanical engineer to prepare a concept design worthy of consideration by the MART Challenge. However, sufficient diagrams and supporting information must be provided to convince the evaluation panel regarding the feasibility of the concept design. Note that the designs submitted become MART copyright!

The reward

First prize of ***£500*** for the best overall design.

Second prize of ***£250***

The prizes will be awarded after an evaluation process by a panel of experts drawn from organisations including the UN International Labour Office (ILO) and ODA. Closing date is **31 March 1997**. Application forms and design briefs for each item of equipment are available from: **Derek Miles, Director, Institute of Development Engineering, Loughborough University, LE11 3TU, UK. Fax: + (0)1509 211079; or Robert Petts MIAgrE, MART Programme Manager, Intech Associates, 53 The Park, Great Bookham, Surrey KT23 3LN. Fax: 01372 458955.**

Chemical hazards are main worker concern in agriculture

A TUC survey of workplace Safety Representatives has shown that the main health and safety concern for agriculture and fishing sector workers is chemical hazards. Two thirds of Safety Representatives identified chemicals as a major concern to workers at their workplace (twice the proportion across the economy as a whole).

Other issues identified, particularly in agriculture and fishing, were overwork or stress (54 %) and machinery hazards (51 %), with back strains and slips, trips and falls not far behind.

The TUC will be raising this information at the Health and Safety Commission's advisory committee on agriculture, and pressing for stronger action on chemicals and stress. Workers in the sector are particularly at risk because they often work alone, without immediate access to assistance in an emergency and without the social support that can relieve stress

The TUC Survey of Safety Representatives was conducted between April and August 1996 and the results were analysed by MORI. Over seven thousand Safety Representatives responded over the economy as a whole. The hazards identified by Safety Representatives in the sector were:

chemicals (67 %);
overwork or stress (54 %);
machinery hazards (51 %);
back strains (41 %);
slips, trips and falls (41 %);
working alone (41 %);
noise (35 %);
dusts (34 %);
RSI (34 %);
infections (30 %).

The full report of the Survey will be published before Christmas. Further analysis of the data from agricultural Safety Representatives will be conducted during 1997 and the data made publicly available at a later date.

Contact: **Owen Tudor, TUC Health and Safety Officer, on 0171 467 1325.**

Membership Matters

Quarterly The Newsletter of the Institution of Agricultural Engineers Winter 1996

Benchmarking

Benchmarking has been practised in a formal way for some years by leading companies and informally by most of industry most of the time. Students at college compare their industrial employers one against another, design and development departments specify and test against the opposition, marketing departments produce advertisements showing data of competitors' or world leaders' machines and use this to sell their own product. These activities are all Benchmarking. Using a prominent position in the world to locate where we are is what the map makers do. This should provide one with the necessary reference points to guide one forward to a better future.

Benchmarking as a formal management tool has been used from before the early 1980's, but it is not until the 1990's that formal procedures and distinctive texts have become widely available. The premier industrial award of quality in the USA - the Malcohn Baldridge National Quality Award - expects entrants to have an element of Benchmarking in their quality process. A number of industrial world leaders now are Benchmarking as an important activity throughout their organisations to maintain their competitive position.

If world leaders are doing it, should more humble concerns set aside valuable time to rush off in yet another direction? The world leaders spend the money and have the staff capacity, agricultural engineers work in a different league. Don't they? Continuous improvement should mean that exercises such as Benchmarking are unnecessary, shouldn't it? The evidence is not very encouraging for British industry and a step change is required in many areas for most companies if they are to survive in a world market. Recent studies have shown how far behind some of UK industry has become when compared with world class average performance.

Suggested improvements needed in some sections of industry are massive and are shown below.

a. Productivity must be doubled.
b. Stock turn round must be doubled.
c. Defects for suppliers must be halved.
d. Defects in house must be halved.

We do need to do something if British Agricultural Engineering is to re-establish its world wide markets. The question is: will Benchmarking make any difference? If it seems a good idea and staff are told to do some Benchmarking, then it will be a waste of money. If it is seen as *part* of the total drive in competitive improvement, if it is *fully* supported by the MD and heads of division and departments, if it is built into the management process in a logical and systematic way and if the company has a culture willing to *seek change*, then it may provide data that will assist in achieving marked improvement in commercial performance.

For those interested in looking further into this management tool a good start is to read Michael Spendolini's book *'The Benchmarking Book'* published by AMACOM.

GFD Wakeham

William G Warr, AIAgrE

Bill Warr will be missed. I first became aware of Bill several years ago as a regular attender at Institution meetings, and although I never got to know him very well, his interest and enthusiasms coincided with mine.

We appreciated having a real farmer on the committee of the West Midlands Branch, someone who was enthusiastic about learning from technical meetings. He was always fascinated by developments and also took an interest in other activities. For instance, I would sometimes see him at meetings of the Coventry Branch of the Institution of Mechanical Engineers, with which we have an agreement to exchange details of meetings.

He had been our Branch Treasurer for several years undertaking the task in a steady and conscientious way. I think he was looking forward to his retirement to become more involved in the Institution at national level since he had recently been appointed to Council. Unfortunately, his health began to deteriorate about that time and he was able to attend only one Council meeting.

When the concept of the 'Pioneering Technology Specialist Group' was first mentioned in the West Midland Branch committee, he was an enthusiastic supporter. We could do with more members like Bill.

Bill Warr, born 3rd December 1927: died 1st October 1996.

William Waddilove

New Specialist Group - *Horticultural Engineering*

Perhaps the most outstanding feature of commercial horticulture lies in its sheer diversity of crops grown and cropping applications, vastly outstripping the other sectors of our agricultural industry. Another of horticulture's important features, only too well known to growers, is the fact that its whole spectrum of produce, from protected crops, top and soft fruit growing, right through to watercress production, has always been open to worldwide competition in all markets.

Because of the latter, successful growers have never failed to exploit new technology in order to keep themselves ahead-of-the-field, thus ensuring their competitiveness. A vital factor in helping them to improve produce quality, develop new out-of-season cropping techniques and cut production costs has been the application of forward-looking applied engineering technology. Dr Robin Szmidt's timely article, *Impact of computers on horticultural crop production* in this autumn's issue of *Landwards*, highlights specific examples of how growers have benefited from a number of such engineering applications.

Various members within our Institution have been involved, both directly and indirectly, in some of these developments and it is important that, in their future work, there should be a more formalised service available for them to take full advantage from the exchange of ideas and contact with other like-minded bodies. This is why our Institution has embarked on the course of forming a Specialist Horticultural Engineering Group which, providing it has full support from members committed to this particular branch of engineering, should be of benefit to them and the industry they serve.

John Weir

New President for European Engineers

Eur Ing Sir John Cullen, of London, has been elected President of FEANI, the European Federation of National Engineering Associations representing more than 1,500,000 engineers in 27 countries. Sir John, who succeeds Professor José Medem Sanjuan, of Spain, will serve for three years.

Sir John was chairman of the British Health and Safety Commission for ten years from 1983. Before that he worked in the chemical industry, finishing as European director for the Rohm and Haas Company responsible for engineering, regulatory affairs and health, safety and the environment.

He is a Fellow of the Royal Academy of Engineering, a Senator of the Engineering Council, President of the Pipeline Industries Guild and a former President of the Institution of Chemical Engineers.

Sir John said: "Great strides have been made by FEANI over recent years, especially in establishing the title of European Engineer (Eur Ing) as a recognised proof of competence and a passport for the mobility of engineers across 27 countries.

"Over the next few years we shall aim to promote the role of professional engineers and to strive for a single voice to represent the engineering profession in Europe. The planned move of our headquarters to Brussels will help us to raise the voice of engineers even more strongly with the European Union Institutions".

Partnership Programmes on *The Learning Zone* on BBC 2

The Learning Zone is the BBC's through-the-night education service. You may have seen the trails on daytime television. It starts just after midnight and goes out five nights a week, providing over 30 hours of education, training and information for targeted audiences. It was launched in October last year and is now attracting weekly viewing figures of over 2 million people.

There are programmes for people learning at home or at work, people in business, on training courses or in full-time education. Teachers, nurses, parents, lecturers and a wide range of individual home-based learners record programmes to learn new skills or become better informed.

One part of The Learning Zone - BBC Focus - offers an opportunity for non-profit organisations to work in partnership to make and broadcast their own programmes. These are voluntary or public sector organisations like the Department of Health, Scope, the National Council for Educational Technology or the Central Bureau for Educational Visits and Exchanges.

These organisations now use broadcast television to communicate a regular stream of information, education or professional development programmes which are scheduled alongside other BBC programmes on BBC 2.

If you are considering how to teach a particular audience, you might find it helpful to come and talk to us about your plans, and learn how broadcasting has proved a cost-effective and powerful way of disseminating training or information.

To arrange a briefing about working in partnership with BBC Focus to develop programmes, contact: **Louise Marriott on 0181 576 2775.**

Widening span of Building Design

SAC has created a new Building Design Department headed by **Dr Mike Kelly** at Auchincruive. It is a department primarily concerned with consultancy work, but also has a teaching and development role within SAC

The Building Design Department comprises three Building Design Units, one at each Centre. The Building Design Unit Manager at Auchincruive is George Campbell; at Edinburgh, the Manager is Lindsay Watson; and at Aberdeen, it is Alan Robertson.

SAC Building Design Units are fully equipped with the latest Computer-Aided-Design equipment and software to produce high quality drawings, speedily and efficiently. The expertise of staff extends to the full range of buildings required in the rural environment, including housing and domestic buildings, as well as structures for industrial, commercial, leisure, tourist and diversification projects. The staff have a strong tradition and knowledge of all types of agricultural buildings but, in addition, they have designed Farm Produce Shops, a Rural School Theatre, Holiday Accommodation, a Residential Training Centre, a Fish Smokery, a Snail Unit and the conversion of redundant farm buildings to residential use.

The creation of a co-ordinated Building Design Service across Scotland enables SAC to make the maximum use of resources. Networking of drawings and information will increase, giving SAC a solid platform from which to promote its UK wide Building Design Service. The demand for existing services remains high, with many opportunities now arising to expand our activities, in full co-operation with other sectors of SAC.

Professional Development Manager

The Engineering Council has recently released a software package known as the **Professional Development Manager**. It enables members to plan their careers by building up a snapshot of themselves from replies to questionnaires about their work, achievements, assets and objectives. It then helps them create a development plan using the answers to the questions and their own wishes and needs. Part of the development plan is concerned with CPD, and the Institution's CPD scheme can be used to feed into this section of the software. The outcome is a 'dynamic' portfolio about the member, including abilities and development needs. Various reports can be printed or exported for use in producing a CV, for example.

The Professional Development Manager is a systematic way for members to think about their own development and progress. It is applicable to all stages of their careers and will be useful when applying for jobs, preparing for appraisal, applying to upgrade their Institution membership, or rethinking their careers. It bears some similarity to the old Career Manager published by the Engineering Council, but it is much broader and more dynamic, being a piece of software rather than paper-based. It does **not** replace the Institution's CPD scheme, but uses the scheme as a source of information.

The software and manual are available through the Institution at the UK members' price of £32 (including p&p and VAT). The software is supplied on a 3.5in disc and runs on 286, 386, 486 and Pentium PCs. The prices for overseas members are £35 for Europe and £40 for the rest of the world.

For more details or to place an order, please contact the Secretariat.

Long service certificates

50 years

Name	*Grade*	*Date of Anniversary*
Derek Burtt **Hargreaves**	FIAgrE	1 Dec 1996
Stephen Michael **Hawes**	CEng FIAgrE	3 Dec 1996

35 years

Name	*Grade*	*Date of Anniversary*
William Odili **Achukwu**	IEng MIAgrE	24 Jan 1996

25 years

Name	*Grade*	*Date of Anniversary*
Michael Eder **Kershaw**	AIAgrE	28 Oct 1996
Brian **Montandon**	MIAgrE	28 Oct 1996
Christopher John **Gaunt**	AIAgrE	28 Oct 1996

An agenda for action

Mike Heath, Director General, Engineering Council

These are exciting times for the engineering profession, The Year of Engineering Success (YES) is 'revving' up towards the official launch at the beginning of next year. SET Week next year looks like being the biggest and best ever with a much enhanced engineering dimension. We can look forward to stronger links between the profession and Government, industry, academia and other bodies associated with engineers and engineering. And the General Election may bring rafts of new policy initiatives that affect us, whoever wins.

This year, for the first time ever, the Engineering Council was represented at all three political party conferences where party leaders and senior front bench spokesmen were lobbied on behalf of the interests of engineers.

Closer to home, the profession's new regional structure is now gathering momentum. Despite the good work of so many individuals in the old Engineering Council Regional Organisation (ECRO), it was soon clear that the new partnership with the Institutions called for arrangements that were much more participative and jointly owned. The 15 new regional bodies that will replace the ECROs will be called Professional Engineering Institutions or PEIs, as in 'North West PEI'. The Transition Project Group, consisting of Institution representatives, is driving progress with the aim of setting up all the PEIs by the end of March '97. Membership will consist of Institution local branch chairmen and activity will take the form of joint ventures with, fundamentally importantly, the backing of national headquarters. PEIs will need the support of engineers locally so please contemplate a personal contribution. Thanks to the effectiveness of our partnership, and the support the Council is now receiving from Institutions, the series of high profile events we staged in September turned out to be a great success. Although these three events were staged under the Engineering Council's banner, there were numerous examples of our colleagues throughout the profession making a valuable contribution.

First, was the Council's Annual Conference, which was combined with an exciting presentation to prelaunch YES. YES has the not inconsiderable task of beginning to turn around the public's Perception of the role of engineers: in short, to change the culture of the nation. I am confident that, with the strength of commitment of its supporters, it will be a significant force in influencing change. Engineers could not offer support to a more worthwhile cause.

The joint event served to demonstrate to an influential audience the forward-looking outlook of our profession. The Conference agenda gave us the opportunity to address key issues and highlight both the challenges and the opportunities that lie ahead. Delegates from Government, industry, academia, the profession and the media were enthused by two excellent presentations by the Presidents of ICE and IMechE respectively on two of the '20/20 Vision' Joint Venture Study Groups covering transport and energy issues.

Next, the Council's Environment Award ceremony was an opportunity to recognise the skills of engineers and technicians in responding to environmental issues. Four finalists had been selected from entries that were 60 % up on last year. Their project presentations showed an outstanding commitment to environmental concerns. My thanks go particularly to the sponsoring organisations, whose support has enabled us to establish the Award firmly as the premier accolade of its type in the UK.

Then, with barely a weekend to catch our breath, the national final of the Young Engineers for Britain competition was upon us and held, by courtesy of British Airways Engineering, in a specially fitted out hangar at Heathrow. The competition was, by common consent, the best ever, a superb feast of engineering creativity and invention from young people. Again, it is an event only possible because of the commitment of so many organisations with the vision to put real effort and resource into encouraging tomorrow's engineers.

These occasions, of course, are just the more visible, higher profile signs of the profession making things happen and a means of presenting a public face. Our role now is to build on this profile and demonstrate to the public the contribution that engineers make to everyday life.

I wonder how many of you have access to the World Wide Web and in particular the Engineering Council home page (http://www.engc.org.uk). Growing numbers of engineering Institutions now have their own Web pages and the Council pages offer hyperlink access to all of them. A recent innovation is the inclusion of role-model CVs to encourage young people who may have an interest in an engineering career but wonder what real engineers actually do. This project will grow into 'Career of the Week' next year and we hope it will help teachers to answer career questions. We also hope to show, with some real life examples, the enormous contribution some particular engineers have made to UK plc.

This ambition brings us full circle. Not only to the broad mission of the YES campaign, but to the prime purpose of the new Engineering Council, which is to enhance the standing and contribution of the engineering profession in the national interest and to the benefit of society.

It is a mission that I know has the support of the whole profession. I am pleased to report that the Government has given its recognition to our task in an official statement of support. This "acknowledges and endorses the essential role of the Engineering Council in representing its constituent members' collective commitment to maintaining the highest standards of engineering expertise for the benefit of the community."

The Government has also given general agreement to a potential Memorandum of Understanding (MOU) with the Council and drafting work is in hand. We hope this MOU will add even greater authority to the voice of the engineering profession.

The tasks that have been set will be no sinecure. But I am convinced that, with the goodwill and commitment we have throughout this profession, we will succeed.

Membership Movements

Mem No	*Name*	*From*	*To*
2660	R Alcock	Ireland	Staffordshire
6514	L Anota	Bedfordshire	Papua New Guinea
4371	T D Beaumont	Bedfordshire	Argyll
4885	R Bond	Sri Lanka	Cheshire
6519	C D Boreham	Bedfordshire	Nottinghamshire
4144	R J Butt-Evans	Scotland	Herefordshire
0369	F Coleman	Dorset	Wiltshire
6441	S R B Done	Lincolnshire	London
6565	D H Ebbah	Hampshire	Nigeria
3468	P Edwards	Ghana	Somerset
6530	S M I Elazhari	Gloucestershire	Sudan
6333	J M Greatorex	Bedfordshire	Norway
3581	T J R Havard	Belgium	Fife
6362	A Kaminski	Scotland	Warwickshire
3207	A J Landers	Shropshire	Wiltshire
5264	I Livingstone	Kent	Lancaster
6099	I W Makin	Oxfordshire	Suffolk
6351	C D Nicklin	Derbyshire	Staffordshire
6550	M J Oliver	Bedfordshire	North Yorkshire
3866	S P Pearson	Essex	Denbighshire
5758	A C Poole	Hampshire	Wiltshire
6379	R D Power	W Midlands	Isle of Man
6376	N M A Preece	Tyne & Wear	Hertfordshire
5121	T Reeves	Derbyshire	Staffordshire
4570	A P Savva	Cyprus	Zimbabwe
6528	K R Scrivens	Worcestershire	Gloucestershire
4893	T F Stephens	Ivory Coast	Essex
6551	E F Stephenson	Bedfordshire	Lancashire
3479	W R Walton	Warwickshire	South Yorkshire
6367	G P Wardle	Portugal	Warwickshire
6270	P M Wightman	Tyne & Wear	Lancashire

Gone Away

Name	*Last known address*
B L Milford	National Rivers Authority, South Western Region, Manley House, Kestrel Way, Sowton, Exeter, Devon

Personal taxation

Personal Taxation Services (PTS) is a firm which has been set up to help people claim refunds from the Inland Revenue on their Income Tax should they have been paying too much. The Company will provide, by post, a free tax code assessment for any employee, checking that you have not paid too much tax. over the last six years, and ensuring that you have claimed all of your entitlements. If you have overpaid any tax, PTS will get it back from the Inland Revenue.

You will pay nothing at all for an assessment of your tax. However, if you are due a rebate, PTS will deduct 35 % in the pound (£), in return for the advice you have received from them and pass the balance onto you. There are no other hidden costs. In the rare case you are found to be paying too little tax, PTS will advise you but not the Inland Revenue. You will also be informed if your tax code is correct.

For more information, contact: **PTS Ltd, FREEPOST SK1892, Stockport, Cheshire SK4 2YD.**

Pioneering Technology specialist group news

'A wonderful day'

What a wonderful open day and what a lot to see! The organisers, Massey Ferguson, were expecting between 3,000 and 6,000 people, mainly employees and their families. On the day, between 8,000 and 10,000 turned up. The news had spread and visitors came by the coach load. It is not often that there is a chance to look around a major manufacturer of tractors and the public responded to the invitation. In the middle of it was the Institution's display stand, put on by the Pioneering Technology Specialist Group. It was too great an opportunity to miss.

Anyone who has organised a major open day will know the amount of work that needs to be put into the planning stages. Massey Ferguson's last open day was six years ago and was a relatively modest affair. This year, it was to celebrate the 50th anniversary of the production of the first 'Fergie 20' tractor that the factory gates were again opened. There were displays of Massey Ferguson equipment from UK and other countries. There was a organised tour around the factory with guides in production cells explaining what they did. Because of production pressures, the factory barely stopped and many of the workforce had already worked for four hours before the start of the open day.

Most of the displays and stands were on the adjacent sports field with a 'Grey Fergie' pulling a bus service between displays. It was on the field, in a marquee, that we had our stand and over 20 members signed the attendance register. Other attractions included a chance to see the remote controlled tractor endurance bump track, the simulated paddy field used for testing, and 'Perkoil Express', the renowned Massey Ferguson pulling tractor reputed to deliver over 900 kW from a 10.5 litre V8 engine originally designed to produce 135 kW.

The first TE20 tractor to roll off the line in 1946 was on display in the museum. That anniversary had been celebrated on Saturday 6 July (accompanied by champagne).

The Massey Ferguson PR department had kindly provided a number of photographs for the Institution's stand. One of them was of the ceremonial drive-off recording the professional involvement of members in conservation and heritage work. Other photographs covered areas of professional involvement including Forestry Engineering, Amenity and Landscape and Training & Education.

William Waddilove
PTSG

The Institution and the Internet

Surfers among you might like to try the Institution's pages on the World Wide Web. The URL is:

http://www.cranfield.ac.uk/safe/iagre/

The pages have been designed by **Patrick Peek**, an MSc student at Silsoe College, under the supervision of **Colin Watt,** one of our members. Our thanks go to them both, and to the college for hosting the site.

The pages will be updated at regular intervals (when the Secretary has learnt how to), thus giving branches and specialist groups the opportunity to publicise events. If you have any comments or suggestions for the pages, please let Mike Hurst know. The email address is:

secretary@iagre.demon.co.uk

but faxes and letters are just as acceptable.

Michael Hurst
Secretary

Water Resources & Environmental Policy courses

A new undergraduate course in Water Resource Management, and a Master's course in Environmental Policy and Management have been established at the Cheltenham & Gloucester College of Higher Education

The undergraduate course is designed for people who are involved in a junior capacity in the management of water or related areas. The prior educational and practical experience of intending students can be used to accredit study at Level I within the College's Undergraduate Modular Scheme. This means that they would normally require to complete only Levels II and III to obtain a degree, and then potentially to progress to higher level study in more specialist fields. There are also opportunities for students to utilise current work-based projects in their degree studies, making it very flexible. We anticipate that students would be able to negotiate some day release from their employer in order to attend the modules, and Cheltenham is a very accessible location for a wide area of the country. The tuition fees for the undergraduate programme to degree level are currently £1960 for the full programme, assuming entry at Level II. In addition, accommodation and transport charges for the Fieldweek module would be required. The exact amount of these is dependent upon the destination chosen, but does not normally exceed £200. Fees are guaranteed for the duration of the programme, provided there is no break in study, and various payment methods are available.

The postgraduate course is normally most suitable for people who already possess a first degree in a related area, but we have previously accepted students with Higher Education experience to HND level in appropriate disciplines, combined with relevant work experience. Naturally many students are more highly qualified than this, and some have existing MA/MSc or PhD qualifications. Again, the course is flexible, and can be studied in various modes over various periods of time. Students may exit with a Certificate, a Postgraduate Diploma, or a Masters degree. It is possible to focus particularly on aspects of water management or, through the 'Independent Study' module, to widen their focus of study beyond the listed option modules, into areas such as waste management and recycling policies, Agenda 21 or ecophilosophy. The tuition fees for the Certificate are £840, for the Postgraduate Diploma £1680, or for the full Master's programme £2240.

Contact: **Carolyn Roberts, CHELTENHAM & GLOUCESTER College of Higher Education, Department of Geography & Geology, Francis Close Hall, Swindon Road, Cheltenham, Gloucestershire GL50 4AZ. Tel: 01242 532971.**

Letter to the Editor

Sir,

MISUSING MEMBERSHIP

I read with utter concern the article with the above caption in the Summer issue of Landwards. I admit that some unscrupulous Nigerian nationals have dented the image of the country with the Advance Fee Fraud referred to in your article. I wish to emphasise, however, that these illegal endeavours thrive because the perpetrators have international collaborators who also participate in these criminal activities. Any victim of the fraudulent mail who intends to make large sums of money through the proposed bank transfers for 'no jobs done' is equally guilty.

These fraudulent offers are very irritating to all honest Nigerians. I believe a common sense approach to this issue by all honest people, coupled with a timely warning as given by the Institution's Secretary should stop the criminals in their tracks.

Yours faithfully,

Adeniyi E. Talabi, MIAgrE
Federal Ministry of Agriculture,
Strategic Grains Reserve Storage Division,
Block 1, Manzini St, Wuse Zone 4,
PMB 135, Abuja, Nigeria

Institution membership changes

Admissions - a warm welcome to the following new members

Member

B Dabeesing (Mauritius)
S Seeruttun (Mauritius)
M H Shah (Oman)

Associate Member

M Adamson (Oxon)
J M A Desbiolles (Australia)
M J Holden (Essex)

Associate

M W Bell (Tyne & Wear)
S Conolly (Inverness)
I McL Ferrier (Scotland)
J M J O'Sullivan (Hants)
J A Wilson (Scotland)
A T Zeleke (London)

Transfers - congratulations on achieving a further phase of your professional development

Member

A A Al-Ghazal (Saudi Arabia)
R G Hallchurch (Wilts)
E J Ratcliffe (Staffs)
E O F Udeagbala (Surrey)

Associate Member

L Anota (Beds)
S J Dicks (Northants)
O A Fajemisin (W Midlands)
A Kaminski (Warwicks)
N M A Preece (Herts)
I Smith (Norfolk)
P M Wightman (Lancs)
S P Wilson (York)
A T Zeleke (London)

Associate

J M Bellarby (London)
C D Boreham (Notts)
W Bowden (Beds)
J C Carr (Lincs)
B A P Crenn (Warwicks)
J O Fashanu (Tyne & Wear)
A Finney (N Ireland)
M A K Ghazavi (Tyne & Wear)
A T Glazebrook (Bucks)
C S Graver (Berks)
A D Gregory (Herts)
C M Heslin (Essex)
M C W Home (Shrops)
R Jackson (N Ireland)
M W Peters (Devon)
R D Power (Isle of Man)
S C F Robertson (Norfolk)
M K U Sarker (Beds)
K R Scrivens (Worcs)
C V T Scullane (Warwicks)
S D Vaughan-Jones (Beds)

Death - with great sadness we record the death of:

W G Warr (W Midlands)

Engineering Council

Registrations

CEng

R B Low (Surrey)
J P Middleton (Kenya)
N C Portch (Ghana)

IEng

I Bown (Derbys)

EngTech

S W E Butler (Oxon)

Transfers

CEng

G P C Henry (Cambs)
A J Landers (Shrops)
T E G Lee (Devon)

Affiliated Organisations

Mr C M Blackbrough IEng MIAgrE
Bomford Turner Limited, Evesham

Mr D Balfour
BSW Harvesting Ltd, Perth

Mr G W Canning AIAgrE
Canning Professional Services, Winchester

The Secretary
Douglas Bomford Trust, Silsoe

Mr D E Spencer AMIAgrE
Environmental Care and Construction, Llanelli

Dr C D Mitchell CEng FIAgrE
Farm Energy Centre, NAC

Mr I Turner
Law-Denis Engineering Ltd, Wotton-under-Edge

Mr L Butters EngTech AMIAgrE
NFAEE, Southwell

Mr R C G Danby MIAgrE
RDS Technology Ltd, Nailsworth

Getting the message across

Over the last 8 years I've noticed students with good ideas but unable to put their case across effectively. They will lose out in the long run.

Woolley & Associates can offer your members and students a free 90 minute evening presentation on presentation techniques. This will demonstrate some techniques and our intention is that perhaps some of members would want to come to a full day fee paying course.

We've already done this for IMechE - Greater London Branch - Young Members' Section and we've recently achieved provisional approval as a Law Society CPD provider.

For more information, contact: **Roger Woolley, Woolley & Associates, PO Box 992, Blackheath, London, SE3 9DQ. Tel: 0181 852 8260.**

News of Members

Tim Stephens is back in the UK after working for a period in the Ivory Coast. He is now looking for work and has experience relating to all aspects of irrigation and earth dams (siting, design, construction, repair and maintenance). If anyone is interested, his telephone number is 01255 221420.

Congratulations to **Robin Power** who graduated from Birmingham University in July with a BEng (Hons) in Manufacturing Engineering with French. Robin has now started a postgraduate engineering course based at the Engineering Department of Cambridge University. This is an Advanced Course of Design, Manufacture and Management which provides one year of career training and meets the requirements of the major professional engineering Institutions. The course uses a series of two week 'live' investigatory company-based industrial projects, together with numerous factory visits and an informative series of lectures to transform graduates into experienced professionals ready to fill management positions at the end of the course. To gain overseas industrial experience and insight, the course includes an overseas tour of three weeks in either Europe or South Africa.

Paul Wightman is at present undergoing training as an engineering technician with Westfalia where he is helping with supporting the dairy equipment sector of the market, especially milking machines.

Reginald Ward who is living in Argentina is extremely concerned about the damage which is being done by the burning of tyres, and claims to have discovered the cause of the ozone hole and the refrigeration effect. Reginald says that he has been trying to stop the practice of burning tyres as a frost protection method and he has proved that the massive freezing in all areas where tyres were burnt caused extensive damage to plum, peach and almond orchards. The overflow of the refrigerant gases caused extensive damage to neighbouring late flowering orchards. The massive continued onslaught of burning all through the nights and sometimes the day caused freezing, man-made temperature drops. The effect of this damaging bad practice has been both costly and has completely destroyed the production in the area. The refrigerant gases are now absorbing the sun's heat at higher levels and unfortunately the desert cannot remedy this vast cloud which is now eating up the ozone layer. Reginald says that he has tried to put a stop to this practice but to no avail. He suggests that a successful method would be to spray water on the fruit trees when frost is likely to occur and says that there is plenty of water in the area which could be used. The concern shown by Reginald is understood by many members and we wish that he is more successful in getting tyre burning banned in Argentina, in the future.

Simon Done who completed a MSc at Silsoe College last year has worked with SAFAD (Silsoe Aid for Appropriate Development as a water engineer in Cameroon for the first 6 months of this year. He has now started a 2 year contract with ODA under the Associate Professional Officer Scheme. He will be working for a year in London which will be followed by a year overseas on an ODA project.

Congratulations to **R H (Mick) Marsden** who has recently received his 50 year membership certificate. In his letter of thanks Mick says: "The IAgrE offers many advantages to its members; not least that we are much more than just names and numbers on membership lists. This was borne out to me many years ago when I was at Wrest Park (it was NIAE in those days) and working on a small portable rice thresher. The field trials took place in Malaya and on one Sunday morning I had a visitor. It was no less than Col. Johnson. He was over 90 at the time and on a tour of SE Asia on behalf of his company, Roadless Traction. It was a great honour to have such a distinguished guest, he thought that he would 'drop in' as he had heard that a member was working in that area. He was our Founder President and there cannot be many ordinary members of any engineering institution who have enjoyed such a privilege." Thank you Mick for your interesting and appreciative comments. Do any other members have similar recollections that they would like to share with members in this column?

Acknowledging the receipt of his Long Service Certificate, **Francis R Frampton** - a legendary figure in the glasshouse industry - and now with Frampton Associates writes: "My 25 years has four highlights. In the fifties I reduced the cost of aluminium glasshouses by 30%, thereby eliminating wooden commercial glasshouses. For six years, we built at the rate of 75 sq ft per minute for a 40 hour working week. As the finale of an eight-part TV series on British architecture, the Edinburgh Royal Botanic Garden glasshouse was described as: 'The finest example in Britain of the use of modern materials in the creation of an environment'. I also chaired the committee that created the pioneering Wind & Snow Load Standards, glasshouses being the only buildings in Britain that were outside the National Code. More recently, and more fascinating, has been the task of assisting medium and small companies to take lots of little steps towards becoming World Class. Big oaks from little acorns grow!"

AAWC

Produced by: Land Technology Ltd, Edinburgh

Printed by: Barr Printers, Glenrothes

New British Standards for agricultural machinery and for buildings

BS EN 632: 1996
Agricultural machinery. Combine harvesters and forage harvesters. Safety.
Specifies requirements for design, construction, elimination/ reduction of hazards and information to be provided on safe working practices. No current standard is superseded.
Priced at £45.50 (£22.75 to BSI Members)

BS 5502:
Buildings and structures for agriculture
BS 5502: Part ll: 1996
Guide to regulations and sources of information
Identifies the statutory instruments and regulations which apply to buildings and structures used for agricultural purposes. This guide is not intended to provide an interpretation of the regulations, which is a matter for the appropriate government department or local authority. Supersedes BS 5502: Part II: 1990.
Priced at £45.50 (£22.75 to BSI Members)

Contact: **BSI Customer Services, tel. 0181 996 7000.**

Shielding against electrostatic discharge

ERA Technology has launched a project to investigate the effectiveness of shielding bags for protecting components sensitive to electrostatic discharge (ESD). Metallised semi-transparent shielding bags are widely used in the electronics industry for packaging electrostatic discharge sensitive devices and circuit boards. These are designed to protect components sensitive to electrostatic discharge from possible ESD damage during storage and transit in electrostatically uncontrolled environments.

This investigation includes examination of the requirements of the European Norm EN100015: 1: 1992 and the International Electrotechnical Committee's draft technical reports IEC 1340-5-1 and -2. It also involves the development of a comprehensive test programme assessing conformance with these requirements. A key reason for this work is that ESD shielding test pass/fail limits are not currently specified by any standard. The draft IEC 1340-5-2 technical report is perhaps the first to offer guidance in this respect, recommending a minimum of a one-thousand fold reduction in ESD energy experienced by a sensitive component within a shielding bag.

A range of proprietary shielding bags from across the market is to be evaluated, including assessment of their shielding effectiveness using the ESD Association S11-31 shielding test. ESD protection effectiveness will be further investigated using ESD sensitive FET components contained within the bag, subjected to a simulated ESD stoke. Possible damage will be assessed in terms of changes to the FET gate leakage characteristics. This innovative assessment procedure will allow comparison of the ESD S11-31 test result with practical component protection data. This work is expected not only to help shape future electrostatic damage prevention standards, but also to improve understanding and specification of the shielding protection performance required by modern electronic devices during handling and storage.

ERA Technology is believed to be the first UK company to offer the Electrostatic Discharge Association standard ESD S11.31-1994 test for evaluation of the performance of electrostatic discharge shielding bags. On completion of this work programme, ERA expects to offer members and clients a complete shielding bag assessment service to EN100015. A report on the findings of the project, which will be offered free of charge to ERA members, is expected to become available early in 1997.

Further information from: **Dr Jeremy Smallwood (electrostatics section leader), ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey KT22 7SA, England. Tel: 01372 367000.**

Video reviews

Classic Tractors

Scripted by Brian Bell
Producer: Farming Press Videos
Running time: 55 minutes
Price: £14.95

For this video you really must be a tractor enthusiast. The programme is almost entirely archive film from the 1902 lvel through to 1990's air conditioned monsters. So if this is your 'bent', sit back with a glass of whatever, relax and watch a whole range of tractors in no particular order roar across your screen.

The production is first class the commentary by Chris Opperman (radio broadcaster) is very professional.

In short, a good Christmas present for your 'dyed in the wool', out and out tractor buff. Enjoy it; but for me, perhaps I'll have the glass of something and Dire Straits!

MJH

Henry Ford's Tractors 1907-56

Producer: Farming Press Videos
Running time: 59 minutes
Price: £14.95

The video is an excellent broad based picture of Ford's contribution to tractor production. It starts at the Dearborn museum showing the 1907 experimental model. In fact, it has an interesting 'potted history' developed by the collection manager Jim McCabe who demonstrates how, by piecing together car components, they developed the 'automatic plough'.

Michael Williams, the agricultural historian, goes on to tell the Fordson story, visiting a wider range of restored working tractors.

As always, the programme is well prepared with first class footage of a whole range of common and distinctly uncommon tractors from the Ford companies past.

The video is aimed at the enthusiast and for them I can recommend its purchase. I do, however, point out that nearly 60 minutes of looking at tractors will not suit everyone, particularly as technical content is limited.

MJH

Precision farming - the management of variability

Richard Earl, Paul N Wheeler, B Simon Blackmore and Richard J Godwin

Precision Farming is the title given to a method of crop management by which areas of land/crop within a field may be managed with different levels of input depending upon the yield potential of the crop in that particular area of land. The benefits of so doing are two fold:

i. the cost of producing the crop in that area can be reduced and,
ii. the risk of environmental pollution from agrochemicals applied at levels greater than those required by the crop can be reduced.

This is an excellent example of where both economic and environmental considerations are working together.


Richard Earl


Paul Wheeler


Simon Blackmore


Richard Godwin

Richard Godwin is Professor and Head of Agricultural & Biosystems Engineering Department, Dr Richard Earl is Lecturer in Agricultural Engineering, Simon Blackmore is Lecturer in Information Technology and Coordinator of the Centre for Precision Farming, and Paul Wheeler is Senior Research Officer and Head of Machinery and Systems Engineering Group, all based at, Silsoe College, Cranfield University, Silsoe, Bedford MK45 4DT, United Kingdom.

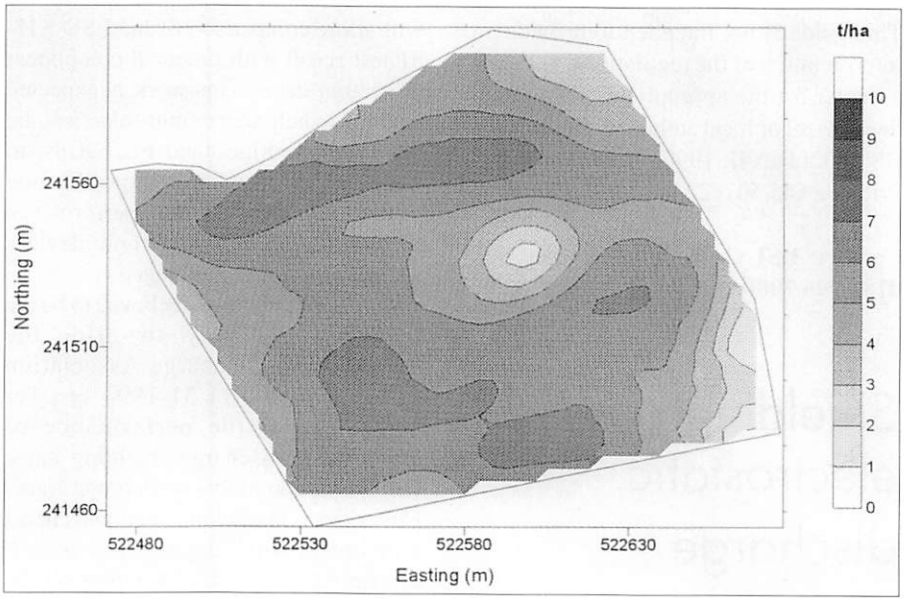


Fig.1 Yield map

This method of farming has been made possible in recent years by the production of yield maps *(Figure 1)* which are created by continuously "weighing" the flow of crop as it is harvested from the field either by the combine or trailer *(Figure 2)*, and recording their position by reference to a satellite based global positioning system. With a variable rate spreader (for example) equipped with a global positioning system comes the capability to apply the required inputs at different levels in the field. The decision on the level of input is made by the farmer/agronomist based upon previous yield maps and supporting soil and crop data. This information is used to generate an application plan *(Figure 3)* which is designed on the computer in the farm office. The plan is transferred via a disc to an on-board computer in the tractor equipped with a global positioning system to which the variable rate spreader is mounted.

While European developments have tended to concentrate upon the production of yield maps as the lead to improved management; North American developments have concentrated upon measuring variability in soil fertility and compensating fertiliser inputs accordingly, and the current thinking (Hummel, 1996) is for the development of additional sensors for real time measurement of in-field variability. To make the best decisions, both approaches are required and the task for the next five years of development is to integrate them to arrive at the best management guidelines for practical farmers (Rawlinson, 1995). This paper reports the state of the progress to date.

2. Measuring variability

Spatial variability can be measured by recording factors at precise locations within fields. Yield maps are produced

by fitting a yield monitor to a combine harvester to record the amount of grain harvested at any particular time. One yield monitoring system utilises the ability of grains to absorb gamma rays as an indicator of the mass flow rate i.e. an isotope-based emitter with collector are positioned either side of the grain elevator in the combine, and the attenuation in collector signal is monitored. Another approach uses light emitters and collectors either side of the combine clean grain elevator, and relates grain flow to light interruption levels. There are also mechanical systems that monitor the volume of grain by using a paddle wheel and sensor. The wheel turns when grain flow reaches a predetermined level. A differential global positioning system (DGPS) is used to record the actual position in Eastings and Northings. A similar system is adopted for soil sampling, except that the samples are collected manually and sent away to the laboratory for analysis. This data can then be filtered, converted and presented as a contour map as shown in *Figure 1*.

The global positioning system (GPS) was developed by the American military for accurate positioning of military personnel and targets. The earth is banded by 24 GPS satellites that transmit very accurate timing information. The GPS receiver picks up the signals from as many satellites that are available as they pass within range. A greater number of satellites corresponds to more reliable positioning. So as to restrict access to this position information, the signals were encrypted with a randomised positional error that could be turned on and off. With this error turned on (normal situation) the inherent accuracy of the GPS is approximately 100 m. Field tests have shown that trees and tall buildings close to the receiver interfere with the accuracy.

For improved accuracy, the GPS can be corrected by using two receivers, where one receiver is mounted in a stationary position while the other is on the tractor or combine. This system is known as a differential global positioning system (DGPS). The stationary receiver appears to move due to the introduced randomised positional error. This error signal is then transmitted to the mobile receiver and deducted from the incoming signal, as shown in *Figure 4*, and this reduces the overall positional errors. There are now a number of companies supplying differential correction signals nationally. Each service is classified by the rated accuracy, (e.g. 5-10 m or sub 2 m) and attracts an annual subscription charge.

Fig. 2 Trailer based weighing system alongside the sugar beet harvester.

3. Non-combinable crops - yield mapping

The majority of yield mapping to date has been achieved by using grain flow measuring systems, in conjunction with global positioning systems permanently fitted to combine harvesters. Obviously this approach, by definition constrains the range of crops that can be mapped.

As mobile or tractor mounted DGPS systems become available there is the opportunity to use different sources of information for crop yield data. This approach allows yield maps to be produced for a variety of crops, in particular high value root and forage crops grown in rotation with combinable crops.

There are two systems that use this approach, a trailer based weighing system, developed by Silsoe College in conjunction with Massey Ferguson, and a conveyor based weighing system, developed in the U.S (Cambell *et al.*, 1995). Both systems provide a method of obtaining crop mass flow data that can be spatially referenced by using a DGPS and subsequently processed to produce yield maps.

By adapting a trailer to incorporate a weighing system capable of working while moving, *Figure 2*, yield maps of a large range of crops can be produced,

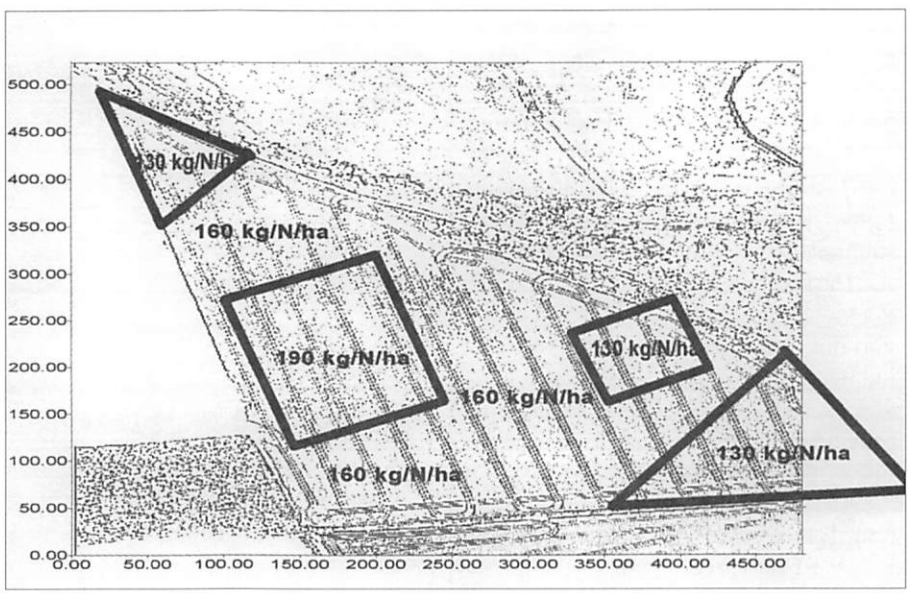


Fig. 3 Example of a probable fertiliser map.

Table 1 Factors influencing yield variations.

Factor	
Little control	***Possible control***
Soil texture	Soil structure
Climate	Available water
Topography	Water-logging
Hidden features	Nutrient levels
	pH level
	Trace element levels
	Weed competition
	Pests and diseases

without the need to modify the harvesting equipment concerned. The disadvantage of using a trailer based system is that most harvesting operations require a minimum of three trailers to maximise workrate. The use of a single instrumented trailer means that either the workrate is reduced or not all of the field is recorded and so mapping software has to interpolate between recorded areas. The trailer based weighing system was developed primarily as a research tool, to allow mapping of a range of non-combinable crops, and also to develop the technology sufficiently so that it could be incorporated into harvesting machines, e.g. weighing systems for crop tanks in sugar beet or potato harvesters.

The trailer based system uses a subframe to isolate the hydraulic lift rams from the main trailer body. The hydraulic rams are attached between the original lower chassis and the new subframe and load sensors are positioned to be isolated from any forces in the hydraulic rams. Tipping is achieved by the new subframe pivoting at the rear of the trailer.

The instrumentation and data processing system uses a signal filter and an algorithm that allows monitoring of loading rate to within ±0.2 kg/s in most conditions. This is sufficiently accurate to provide meaningful data for the production of yield maps.

An alternative approach, as mentioned above, is to instrument a conveyor in sugar beet harvesters to give a measure of crop mass flowrate (Cambell *et al.*, 1995). This involves measurement of incremental weight and conveyor speed, and has been shown to be capable of producing results. The method may have potential for adaptation for different crops, (potatoes, carrots, onions, etc.), although the degree of accuracy is unspecified. Obviously, this approach necessitates adapting particular types of root harvesting machines to obtain yield maps of different crops.

4. Factors influencing crop variability and potential management actions

Viewed from a farmer's perspective, the most likely objective for adopting precision farming technology is to increase the economic return from their land. Important issues are to:-

1. establish the major causes of variation i.e. factors limiting the potential of areas within a field,
2. consider which of these are controllable, and
3. assess and prioritise possible management actions in terms of economic advantage.

There are many interacting factors, see *Table 1*, which can influence crop growth and ultimately profit. Some of these cannot be controlled directly, e.g. soil texture (proportions of sand, silt and clay), climate (temperature, sunshine hours and precipitation), topography and hidden features. These factors, although not controllable in themselves, have knock-on effects which may be influenced by varying management inputs. For example, an area of shallow low-yielding soil within a field may benefit from small doses of fertiliser applied regularly, rather than the more conventional approach. Other more controllable factors, their affects on crop performance and potential approaches to their management are discussed below.

Soil compaction

Soil compaction can adversely influence all stages of crop development, including yield and quality; however, amelioration is expensive in terms of time taken and power required (Earl, 1996). Compaction often reduces the volume of large pores in the soil and may restrict root growth through increased mechanical resistance and/or poor aeration (Bengough, 1991).

Following studies undertaken by Silsoe College and ADAS (Marks and Soane, 1987), particular attention should be given to field entrances and headlands. These studies, undertaken between 1978 and 1985, concluded that:

i. subsoil loosening did not increase the yield of autumn sown crops on medium and heavy textured soils during 17 harvests,
ii. from 25 harvests of spring sown crops, increases in subsoil loosening were obtained on six occasions on light soils in years of moderate to severe drought.

In the cases of the spring sown crops, where positive responses were obtained, there was evidence of soil compaction in the untreated plots, and the average increase in yield from soil loosening was 11 %. From the above and the results of a investigation of soil physical conditions,

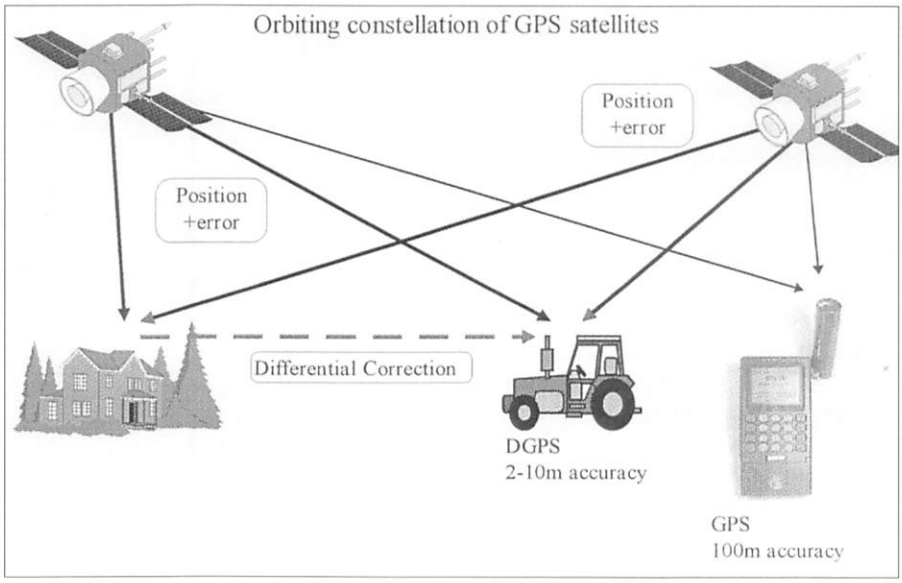


Fig. 4 Principle of operation of Differential Global Positioning System (DGPS).

following the harvest in 1996, in four contrasting soils involved in precision farming, studies showed no restriction to rooting depth (0.8-1.2 m) in the field centres. Compaction and restriction to root depth were observed only in the headland areas, of which *Figure 5* is a typical example. Hence, there is little evidence to promote subsoil loosening of complete fields. This is further supported by the results of a trial by Bidwells (Fuller, 1996) who reported a 3 % increase in yield due to subsoiling for winter wheat. The obvious response is therefore to target the soil loosening to tramline areas, headlands - especially those used for turning - and any other zones known to be significantly affected by compaction. Hence, dig a number of profile pits (4 to 6) within the field, guided by yield maps to identify areas which require amelioration, and the depth at which compaction problems occur, and subsoil the field accordingly.

Available water

Deficiencies in the available water capacity of soil can result in increased risk of droughtiness and crop water stress. Potential management actions may include:-

1. ameliorating compaction problems (discussed previously) to encourage deeper root development and increased moisture retention;
2. determination of organic matter levels at different locations across the field and, if areas within the field are found to be low in organic matter (<2 %), considering the application of organic fertilisers where needed to increase the moisture holding capacity of the soil;
3. monitoring the soil moisture status and, if the available water is low in discrete areas within the field due to differences in soil texture (e.g. areas of sandy soil), irrigating those areas during critical periods for high value crops;
4. reducing other inputs where the available water cannot sustain the potential crop yield.

Waterlogging

Waterlogging can result in poor germination, establishment and subsequent crop development, flooding, reduced soil strength and, therefore, increased susceptibility to compaction and smear. Management guidelines are listed below.

1. Establish (using profile pits) whether a slowly permeable pan exists in certain areas of the field and, if so, at what depth. Subsoil or shallow loosen as appropriate when soil conditions are favourable for loosening.
2. If no pan is found but the permeability of the soil is low, consider draining selected areas within the field using the following techniques (Spoor *et al.*, 1992).
   a) If clay content is sufficient and soil is suitable for moling, pull close-spaced (2 m) minimoles across affected area and direct drainage water to a ditch or moled-main collector.
   b) If soil is unsuitable for mole drainage, use a low cost mole liner system.

Soil nutrients and pH

The effects on crop performance of imbalances of nutrients and acidity are numerous and varied. Low soil pH (<6.0), for example, encourages root diseases like club root in oilseed rape, whereas high pH puts the crop at risk through boron deficiency. High nitrogen levels encourage softening of cells in cereals which can result in lodging; however, nitrogen deficiencies impede crop development. High sulphur levels promote increases in acidity which have knock-on effects eluded to above. Potential management actions may include the following.

1. Guided by yield maps and nutrient analysis of soil and crop samples and/or soil water, identify areas within the field which require closer examination to establish likely yield potential.
2. If appropriate, consider digging profile pits to establish whether soil depth is limiting. If this is the case in certain areas, the application of lower quantities of nutrients more frequently may be beneficial.

<u>*For nitrogen*</u>

Approximately 2/3 of applied N accounts for 95 % of the yield, provided that the optimum application is achieved. The other 1/3, therefore, can only produce an additional 5 % of yield. Applying crude economics to this as follows:-

for a 10 tonne per hectare crop @ £100 per tonne,
150 kg N/ha produces the maximum potential of 10 tonnes = £1000
100 kg N/ha produces 95% of the maximum potential i.e. 9.5 tonnes = £950;
and taking away the cost of the fertiliser at £0.35/kg (£52.50 and £35.00, respectively), gives a potential net benefit of £32.50/ha by going for the extra 5% of yield.

The difficulty of this approach is knowing in advance what the maximum yield potential for a particular area within a field will be and this is currently being addressed by researchers. It may prove feasible to develop site-specific response curves by applying five levels of N to discrete areas within the field. Future management strategies may involve applying less N early in the season (e.g. 2/3) and waiting to assess the likely economic benefits of applying part or all of the remainder. If this approach is to be successful, then it will necessitate targeted monitoring of N levels during critical periods because N levels fluctuate continuously. A one-off soil analysis during the season is probably not the most appropriate approach. There would be a need to monitor levels over a period of time at specific points in the field using soil solution and crop sap analysis. Kits for use by farmers are now commer-

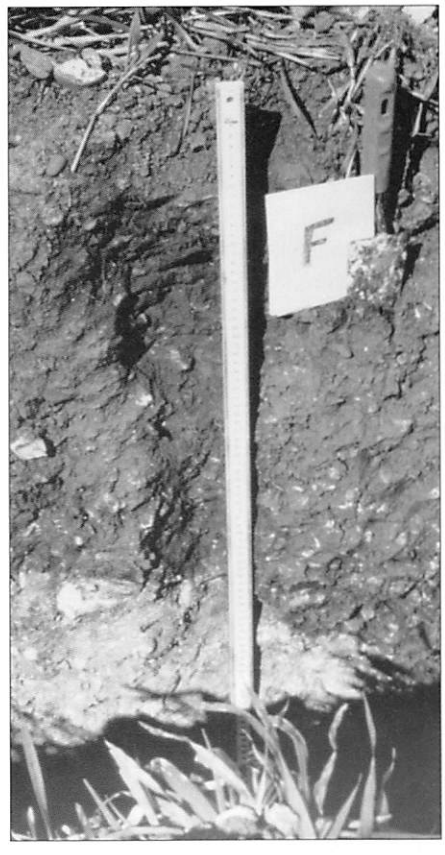


Fig. 5 Soil profile showing compaction and root restriction.

cially available.

For less soluble nutrients (P, K, etc.)
One possible approach to managing the application of these nutrients is to adopt a replenishment strategy whereby due regard is given to the crop yield, and hence quantity of nutrients removed and therefore replenishment required, for different areas of the field. Certain difficulties associated with this approach are highlighted below:

- for a low yielding area, if the low yields are due to insufficient nutrients in the soil in the first place, then a future application of more than just replenishment may be appropriate in this instance;
- for high yielding areas, if there are excess nutrients in the soil, then a future application of less than replenishment may be appropriate.

For pH
A potential management action could be to identify areas within the field where acidity levels require attention by monitoring soil solution and use this information to develop a treatment map for the variable application of lime.

Crop protection
Pests and diseases, if allowed to develop unchecked, can very soon destroy a crop. There is a general reluctance on the part of farmers, with good reason, to consider variable applications of fungicides and pesticides because of the risks of recurrent problems due to temporal changes in the populations of insect pests and diseases. Generally, a prophylactic approach to pest and disease control is advocated. Weeds compete with the crop for water, nutrients and radiation; however, they have limited mobility and, for a typical cereal field, they often grow in well-defined patches covering less than 40 % of the area (Wilson and Scott, 1982). This provides management opportunities for varying herbicide treatments spatially. Management actions may include those advocated by Stafford and Miller (1993) whereby weed species are located and identified with the aid of a hand-held GPS and herbicide is applied selectively using a patch sprayer. Potential savings in herbicide of up to 35 % could be achieved in this way. Oerke (1995) suggests that weed control accounts for approximately 50 % of all crop protection expenditure with herbicide applications costing £13 to £75 per hectare. There is, therefore, scope for savings to be made through the variable application of herbicide.

Application maps
Once the manager has decided on how to treat the fields, an application map is prepared. This is created on the farm office computer and shows the precise location and quantity of the treatment or application within the field. This could be in terms of seed, fertiliser or spray application or other field treatments such as cultivation. It should be mentioned that the ability to best use the technology of precision farming to maximise return, is dependent on the ability to develop optimised treatment maps. Although the creation of these maps is not technically problematic, the ability to optimise map content needs further development and this is being addressed by researchers.
The treatment map is stored on a smartcard (credit sized memory card) or computer disk that is then inserted into the controller in the equipment concerned. The equipment uses DGPS for location and accesses the data stored on the treatment map to determine the level of application to be applied at particular points in the field. For example, if fertiliser was applied in a variable manner, the treatment map would define fertiliser application levels *(Figure 3)*, for different locations in the field and the fertiliser application equipment would automatically vary the rate accordingly. The operator, although able to see what application rate was being applied (from a display within the tractor cab), would not need to make any adjustments.

5. Potential economic benefits

A full economic analysis cannot be conducted until the results of current research programmes are available. However, it is possible to make assumptions, given below, based upon the yield map in *Figure 1*. This shows an average yield of 6.85 t/ha which resulted from a uniform application of nitrogen of 200 kg/ha, applied to give a target yield of 7 t/ha. Assume that:

i. 20 % of the field which yields on average 5 t/ha or less does so due to soil compaction in the headland areas and that this can be effectively remedied by triennial subsoiling which raises the yield, based upon the results given in *Section 4*, by 10 % (0.5 t/ha);
ii. 15 % of the field yielding 6 t/ha will never attain 7 t/ha and can therefore receive 35 kg/ha less nitrogen, together with the 20 % given in (i) above;
iii. 20 % of the field capable of yielding 8 t/ha is yielding 7 t/ha and would benefit from an extra 40 kg/ha of nitrogen.

The current prices of wheat, nitrogen and subsoiling are given in *Table 2*, together with the additional capital costs for precision farming. This gives the cost of software for the farm office, the combine mounted yield mapping kit and the additional costs of producing a variable rate fertiliser spreader totalling £9,480. When this is amortised over 5 years at an interest rate of 7 % and over a land area of 250 ha, the annual cost is £8.90/ha.

Table 2. Current prices and capital costs.

Prices	
Wheat	£100/t
Nitrogen	£0.35/kg
Subsoiling (Nix, 1995)	£50/ha
DGPS Licence fee	£390/year
Capital costs	
Software	£1,260
Combine kit	£6,220
Fertiliser kit	£2,000
Total:	**£9,480**

The cost-benefit analysis given in *Table 3* based upon the three assumptions above produce a benefit of £33.68/ha from which must be subtracted the costs of £16.59/ha that includes the annual licence fee for the DGPS, resulting in a net benefit of £17.09/ha. Whilst modest, this benefit has been calculated on very conservative assumptions and, in fact, could be larger depending upon individual field conditions. It happens to agree with the finding of research by Hydro (Agri) in Germany during the last cropping season.

To this benefit other savings in reductions of pesticides and herbicides of up to £50/ha for each, could also be added if less than blanket applications were feasible.

Using this figure of net benefit for

Table 3. Cost-benefit analysis.

Benefits		
Assumption:		
i. 20 % x 0.5 t x £100/t	= £10.00/ha	
ii. 35 % x 30 kg/ha x £0.35/kg	= £3.68/ha	
iii. 20 % x 1 t/ha x £100/t	= £20.00/ha	
Total benefits		£33.68/ha
Costs		
Assumption:		
i. 20% x £50/ha x 1/3	= £3.33/ha	
ii.	Nil	
iii. 20% x 40 kg/ha x £0.35/kg	= £2.80/ha	
iv. Equipment costs	£8.90/ha	
v. DGPS Licence Fee (£390/yr)	£1.56/ha	
Total costs		£16.59/ha
Net benefit		**£17.09/ha**

both the wheat (2 Mha) and barley (1.3 Mha) growing areas in the UK gives a total industry benefit in excess of £50M/annum. Estimated figures for potatoes are of a similar order of magnitude.

6. Conclusions

1. Precision Farming has the potential for more efficient use of inputs.
2. Maximising the net benefit is the most likely management scenario with net benefits in excess of £17/ha resulting from improved fertiliser and soil management strategies.
3. Changes in treatment application rate are likely to be modest.
4. Precision farming is the process of managing variability which, in turn, improves the overall efficiency of the agronomic process. This improved efficiency is beneficial to the farm both economically and environmentally.

Acknowledgements

A significant proportion of the work of Silsoe College is funded by Home-Grown Cereals Association, Hydro (Agri) and Massey Ferguson for research undertaken in collaboration with Arable Research Centres, Shuttleworth Farms and Soil Survey and Land Research Centre.

The authors would like to thank Massey Ferguson and Shuttleworth Farms for the use of their data in this paper, Justin Smith of Arable Research Centres and Dr Nicola Cosser of Silsoe College for advice on agronomic aspects.

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Fumigation Code of Practice updated

A revised Approved Code of Practice (ACOP) on the control of substances hazardous to health in fumigation operations has been published by the Health and Safety Commission (HSC). The new edition provides practical guidance to employers on how to apply the provisions of the Control of Substances Hazardous to Health Regulations 1994 (COSHH) to fumigation, including the assessment of risk before a fumigation operation is started, the selection of appropriate control measures and their application during the operation.

The ACOP, first published in 1988, has been restructured to reflect the sequence of actions in a fumigation operation, and to comply with HSC's new criteria on the role of ACOPs. The document has also been updated to take into account subsequent changes to COSHH. The ACOP is supplemented by a Guidance Note on fumigation from the Health and Safety Executive (HSE). This gives more detailed guidance on good practice, and addresses issues specific to the use of methyl bromide and phosphine. It replaces existing HSE Guidance Notes on the use of those substances.

Welcoming the revised ACOP and guidance, Dr Peter Graham, head of HSE's Health Directorate, said: "Fumigation can be important for public health, but it is also an inherently hazardous process in which a toxic gas is deliberately introduced into an enclosed space at dangerous levels. There are, however, well-established techniques and systems of work to reduce the risks and ensure that, after fumigation, the area is resumed safely to normal use. The revised ACOP and guidance have been produced in close consultation with the industry, and set out clearly what to do to assess and control the risks. I commend them to all involved in fumigation work."

Copies of the HSC Approved Code of Practice, *'Control of Substances Hazardous to Health in Fumigation Operations'*. ref L86. ISBN 0-7176-1195-7, price £8.50 net each, and the HSE Guidance Note CS22. *'Fumigation'*. ISBN 0-7176-1218-X, price £5.00 net each, are available from: **HSE Books, PO Box 1999, Sudbury, Suffolk, COI0 6FS. Tel: 01787-881165.**

Look out for Sira's intelligent artificial eye

All of the research projects for the fifth intake of PhD research associates into the Postgraduate Training Partnership (PTP) between Sira and University College London have been conceived with just one idea in mind - to develop the world's first intelligent artificial eye.

According to Anne Burns, Sira Technology Centre's technology marketing manager, this means combining visual sensing, artificial intelligence and 'virtual' data presentation into a single system. Not only will such a system know what it's looking for, it will also be able to evaluate and take decisions about what it finds.

"Collectively, the long-term aims of the October 1996 intake of PTP research associates will be to provide an intelligent artificial eye that can be instructed in a simple manner to perform any visual task," she says. "Each individual project, however, has been designed to specialise in one aspect of intelligent imaging, for example in machine vision, sensor arrays, neural networks or software agents," she adds.

In its initial form, the intelligent artificial eye will be an intelligent visual inspection system. This will be capable of recognising defects or distortions in a product, deciding by its previous experience whether the differences warrant action, and then initiating the action, either to reject the product or to make adjustments to the manufacturing process. Subsequent developments will extend to surveillance of scenes to detect intruders and establish personal identities for security purposes.

Sira Technology Centre was set up in 1993 to manage collaborative research and development projects and industrially-sponsored research programmes. Its Intelligent Imaging Programme focuses on 'optical' non-contacting sensing systems, including data processing based on artificial intelligence technologies, and user interfacing elements such as virtual reality. Blue-chip companies such as Rolls Royce, IBM, Unilever, British Gas, Pilkington and British Steel are members of the multi-client Programme, as are the Metropolitan Police and Southern Water Services.

Postgraduate Training Partnerships were introduced by the Department of Trade & Industry (DTI) and the Engineering and Physical Sciences Research Council (EPSRC) in 1992. They are partnerships coupling universities and independent research and development organisations, such as Sira, to provide coherent programmes of PhD research projects for high-quality graduates.

The PhD projects of the seven research associates in this October's PTP intake are sponsored by DTI & ESPRC and involve the following five topics:

Benchmarking image processing - quantifying the performance of different image-processing algorithms to select the best for real-world applications;

Interpreting image sequences - developing image analysis techniques to extract important information automatically without the tedium of manually searching through hours of video tape from closed-circuit television systems;

Neural networks in image processing - developing better techniques to overcome the key design problem of presenting the image to the neural network;

Cameras and lighting for machine vision - improving image capture to simplify image processing.

Software agents for image processing - applying the new agent-based approach to solve the multi-disciplinary problems associated with assembling complete image acquisition and processing systems.

Contact: **Anne Burns, Sira Technology Centre, South Hill, Chislehurst, Kent BR7 5HE. Tel: 0181-467 2636**

Big Four rise to £11 billion energy challenge

Tourism contributes £11 billion every year to the British economy - the same amount as is wasted by British industry through poor energy management. Now the Big Four British engineering Institutions have pooled their knowledge and expertise to tackle the problem. The Institutions for Chemical, Civil, Mechanical and Electrical Engineers - with support from the UK Government's Energy Efficiency Best Practice Programme - have launched *Energy Management*, a training package aimed at all sectors of industry. Energy Management includes:

* **a 22-minute video,** produced by the Institution of Chemical Engineers with contributions from video material produced by the Energy Technology Support Unit, highlighting the importance of energy efficiency with case studies showing how much has been saved by companies from a number of different industrial sectors;
* **an extensive overview of energy use in industry,** outlining the background, objectives and benefits of energy efficiency - as well as the motivation and risks involved - and exploring the methodology of energy management, the techniques of energy efficiency and the technical opportunities available;
* **a wide variety of real-life case studies** highlighting some of the many and varied energy saving projects which companies have adopted to reduce waste, increase profitability and protect the environment - often at low or no cost to themselves;
* **an appendix with a comprehensive bibliography** to supplement guidance notes provided with the package;
* **a workbook covering "good practice profiles"** studied in the course;
* **overhead transparencies** of all graphical information and lists;
* **trainers' notes** suggesting additional exercises and ways to develop discussions within training groups.

"Energy and its management is a fundamental issue for all sectors of industry today," said Dr Alan Rudge, Chairman of the Engineering Council. "This collaboration, the first of its kind between these major engineering Institutions, is a tribute to the improved relationship built since the launch of the new Engineering Council - and *Energy Management* is an invaluable tool for industry in its fight to remain competitive," he added.

The *Energy Management* training package costs £500 (plus UK VAT). Further information from: **The Bookshop, Institution of Civil Engineers, 1 Great George Street, London SW1 P 3AA. Tel: 0171 665 2019.**

Have you ever thought you're in the wrong business ?

A friend of mine is a lecturer in management studies at the local university. Over the years he has had the opportunity to study hundreds of businesses from the inside. He has seen the profits and losses, the successes and the failures.

One evening, I casually asked him what made for a really successful business? I thought it was a bit of a daft question really, so I suppose I wasn't expecting a very serious answer. But to my surprise, he responded without hesitation and with absolute confidence.

In his view, the single most important characteristic which typified a successful business was that the owners (or managers) were not preoccupied with the day to day running of the business. I was surprised, for I thought the quickest route to bankruptcy was if I lost sight of the day to day running of my business. He explained that these successful businessmen and women had struck a delicate balance between keeping in touch with their business without getting bogged down with the many humdrum problems which are bound to arise in any busy organisation.

I was beginning to feel a little insecure because I spend most of my working day bogged down in humdrum problems. I asked: "But, if they don't spend their time sorting out the problems, what do they do?" According to him, the consistently successful people spend a high proportion of their time focusing on how well they are meeting the needs of their customers and establishing the best, most cost-effective, ways of attracting new ones. In other words, he suggested, they do what a business graduate would call Strategic Marketing.

By now I was feeling very defensive. I explained that I didn't have the time to read the minds of my customers. Nor was I an expert in advertising, promotions and the like. He gave me a sympathetic look and explained that most businessmen were in the same boat and that's why they use business consultants - in the same way that they use mechanics to fix the car and builders to mend the roof.

"But don't consultants cost the earth ?" I asked. His reply surprised me. Apparently, the majority of the fees charged by such firms are heavily subsidised with grants from the DTI. He also told me that audits which are aimed at identifying areas of significant improvement are often undertaken either free of charge or for a very modest fee.

Management consultants Allery Scotts maintain a database of DTI consultancy subsidies and will supply further details free of charge. Simply call their Bristol head office on 01454-329713 quoting reference PRO12.

New maize drill from Stanhay, and ski coulters for the Singulaire

A vacuum-operated precision drill for large seeds, including maize and beans, has been introduced by Stanhay Webb. The launch follows four years' intensive development by the company in the UK, North America and Africa. A key feature is that the Salvo 650 will plant large seeds in rows as narrow as 305 mm to give growers a wider choice of growing systems.

The design of the Salvo revolves around its patented low maintenance seed metering unit which has virtually no moving parts and sows the seed accurately even at higher drilling speeds and in the toughest of soil conditions. Accurate seed placement results from the unit's very short, direct seed drop into the ground. The "open" design of the unit's selection mechanism enables continuous pick-up of seeds, even when the Salvo is planting high density crops or is working at speed.

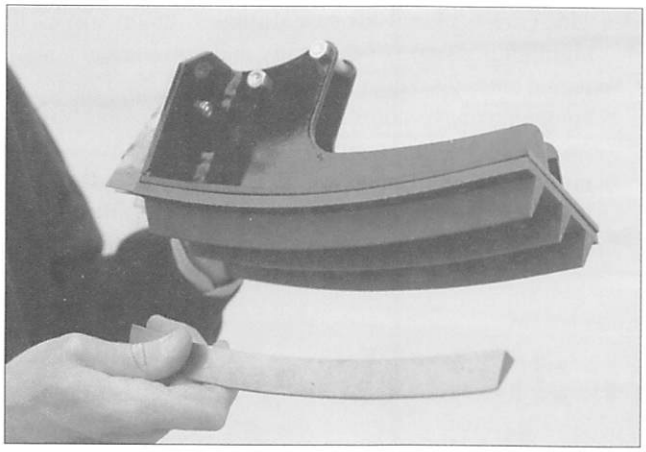
The Salvo metering unit is easy to set up because of its highly visible seed plate and just one vacuum setting for most types of large seed. Each seed hopper has ample capacity for more than a half hectare pack of maize seed.

Contractors will appreciate the fast drilling speeds which are achievable through the Salvo's steeply angled parallel linkages with adjustable penetration springs. Two stage furrow opening creates a sharply defined furrow and this ensures that each seed is planted firmly at a uniform depth and spacing. Large diameter drive wheels with deep lug tyres give a choice of 12 seed spacings per seed plate.

Soil coverers with adjustable blades direct the correct amount of loose soil back over the planted seed and zero-pressure tyres on the rear wheels consolidate the soil, giving good seed-to-soil contact for even crop emergence.

Optional extras for the drill include a fertiliser applicator, a sliding tool bar for 6-row machines, double disc furrow openers and a seed monitor. The Salvo 650 is available initially in 4 and 6-row configurations. Price of a standard 6-row drill complete with hydraulic markers is £8495.

In response to customer demand, Stanhay Webb have also extended the range of ski coulters for their Singulaire precision drills and now offer a choice of 32 different types with either cast metal or non-stick polymer ribs. Both versions produce extremely clean V-shaped furrows 20 mm deep, leading to increased accuracy in planting says Stanhay.



Stanhay's new coulters can be fitted with either non-stick, or hard wearing cast metal ribs.

The coulters are available in widths from 65 mm to 150 mm in one, two and three line versions. The 'ski' shape of the coulter enables the drill to operate more efficiently in wet and sticky soil conditions, with the polymer-ribbed versions enhancing this characteristic even further, thus minimising time spent in cleaning the coulters during drilling.

Prices start at £52 per complete coulter assembly for a single-line non-stick polymer-ribbed coulter ranging through to £132 for the 150 mm triple-line non-stick version and £147 for the 3-rib cast metal coulter.

Contact: **Mike Heywood, Stanhay Webb Ltd, Exning, Newmarket, Suffolk, CB8 7HD. Tel: 01638 577206.**

New spray system improves control and safety

The LASER agitation and recirculation system from Knight Farm Machinery speeds up spraying operations, protects the environment and reduces chemicals wastage.

With the LASER system, operators do not need to empty rinsing water from spraylines before starting to spray. By the time the sprayer has been filled, the contents of the spraylines and the tank have the same concentration.

When a conventional sprayer has been washed out, the spraylines are full of rinsing water. The operator then either starts to spray as soon as he moves off, which risks leaving an untreated area of crop, or he remains on the headland and sprays until he believes the spraylines have been purged of rinsing water which risks wasting expensive chemical and causing pollution.

LASER keeps the contents of the spraylines constantly in motion, unlike conventional spraying systems where the chemical solution may be static for up to 50 per cent of the time.

At the end of spraying operations, water used to rinse out the spraylines is returned to the main chemical tank for pumping out into a disposal plant.

The new system also gives Knight the unique ability to use a flow-based control system with sprayline recirculation. The system works with all sprayers but is particularly relevant to application techniques using low volumes, such, as the AirJet twin fluid nozzle system and the Degania air sleeve system. It is also valuable where liquid fertiliser applicators are used.

Contact: **Knight Farm Machinery Ltd, Wireless Hill, South Luffenham, Oakham, Rutland LE15 8NF. Tel: 01780 722200.**

MF presents its 3-millionth tractor to Save the Children Fund

Massey Ferguson's Coventry factory has produced its three millionth tractor - setting a record for any plant of its kind in the world. The three-millionth was driven off the assembly tracks on 15 October, just over 50 years after the plant produced its first tractor on 6 July 1946.

To mark the production milestone and the factory's Golden Jubilee this year, the three millionth model - a 66 DIN hp MF375E - is being donated to The Save the Children Fund for a project in Zimbabwe. Producing machines in the 30 to 82 kW range, the 180,000 m^2 plant is the largest in the farm equipment industry devoted solely to tractor manufacturing.

In its first 10 years, output was based on a single model, the TE20 'little grey Fergie' which earned the plant world renown virtually from its inception. Its first multi-model range was launched in 1964, and today the factory manufactures more than 20 different models in two ranges to meet the needs of customers in over 140 countries. Overseas sales consistently account for around 90 per cent of production, contributing over £ 1 + million every working day to the UK's export earnings.

As well as producing fully built-up tractors, the factory also manufactures CKD (completely knocked down) kits for assembly in MF licensee plants in 12 countries.

A reputation for reliable performance and durability have made the Coventry-built machines the spearhead of MF's success in world markets. They span the most popular power categories sold worldwide and account for about six out of every ten of the company's global sales of tractors.

Last year - the 33rd successive year in which MF tractors have retained their place as the world's best selling brand - production of the company's 200 and 300 series ranges in Coventry reached its highest level since 1981. Overall output was up nearly 38 per cent from the previous year, and this included an increase in the number of built-up tractors produced to the best for 14 years.

High capacity semi-mounted plough joins Vogel & Noot range

A high-capacity semi-mounted reversible plough, designed to make the most of modern high power wheeled tractors, has been added to the Vogel & Noot Euromat 3S range from Anglia imports. The Euromat 3S Herkules 1000 comes in six- to nine-furrow sizes, using an articulated frame to ensure that all bodies work to the correct depth over undulating ground. It also features a headstock that can pivot sharply for compact, fast headland turns.

UK introduction of the high-capacity model coincides with production of the Austrian manufuturer's Euromat 3S plough range topping the 10,000 mark, with sales continuing to grow. "Vogel & Noot's technological edge in plough development has had positive effects on our market share" says sales and marketing manager, Michael Wurzinger. "Total exports increased around 13% during the first six months of this year, with particular success in Great Britain where the Vogel & Noot Euromat 3S range continues to earn a reputation for robust build, quality wearing parts and simple setting-up."

Euromat 3S Herkules 1000 semi-mounted plough comes in six to nine furrow sizes for tractors up to 180 kW.

The Herkules 1000 is a 'bend in the middle' design, with a joint in the beam between two sets of bodies ensuring that even working depth is maintained as the long implement works undulating ground. A two-wheel carriage supports the plough at this point also, providing tighter turns than where rear-mounted wheels are used, as well as a stable base for safe road transport.

Vital statistics include an interbody measurement of 1000 mm for exceptional trash and crop residue clearance, and a choice of 760 mm, 820 mm and 900 mm underbeam clearances for the shear-bolt model; 780 mm and 820 mm when auto reset is fitted.

The plough also provides a choice of four easily-set working widths from 360 mm to 480 mm, and is available with a choice of general purpose solid and slatted mouldboards from the comprehensive - and hard-wearing - Vogel & Noot range.

Other optional equipment includes hydraulic or air brakes, a plough wheel steering system for added manoeuvrability, electro-hydraulic controls, and a central lubrication system that minimises preparation for a day's ploughing. Prices range from £25k for the 6f shearbolt model to £33k for the 9f autoreset.

For further information, contact: **Charlic Dyke, Anglia Imports Ltd, Folgate Road, North Walsham, Norfolk NR28 OAN. Tel: 01692 407233**

Market expansion for VarityPerkins

VarityPerkins - part of Lucas Varity plc - has won new breakthrough business with leading German and Austrian agricultural and industrial equipment manufacturers.

Mannesmann Demag Fordertechnik Ag has launched two new telescopic crane models powered by VarityPerkins. A new compact, two-axle telescopic crane is fitted with Perkins six litre Phaser engine and a 3-axle, 50 t class machine will take Perkins 1300 Series engines.

Demag's AC75 City Class crane has a distinctive 'nose-down' boom and is designed for on-road use in Europe. The first major manufacturer to launch such a design, the machine offers the driver excellent views of the road while travelling. It is also extremely compact, combines superb manoeuvrability with an increased work capacity because of its ability to transfer quick and easily to and from the work site. The engine offers 156 kW at 2500 rev/min and was selected because of its low noise and compliance with Stage 1 European emissions legislation.

Steyr, Austria's number one manufacturer for tractors up to 113 kW, has introduced a new range of light, low, four wheel tractors available with rear wheel drive powered by Perkins 900 Series engines. Offering the same advantages as its successful Multi-Trac Series, the new tractor is especially suited to alpine slopes.

900 Series, was unveiled last year as one of the world's cleanest three cylinder, direct injection, naturally aspirated diesel engines for industrial and agricultural applications. The engine was brought to market in just 18 months - 12 months ahead of conventional timeframes - using simultaneous engineering techniques. This 2.7 litre engine develops 37.5 kW at 2250 rev/min and typical applications are forklift

Demag's AC75 City Class crane powered by a six litre Perkins Phaser engine.

trucks, farm tractors, welding, compressors and generating sets, tractor digger loaders and wheeled loaders.

VarityPerkins German company, Perkins Motoren mainly supplies and services manufacturers of industrial, construction and agricultural equipment. About 50 per cent of engines sold are supplied to manufacturers of fork-lift trucks such as Clark and Linde. Another 30 per cent are supplied to manufacturers of construction equipment such as Schaeff, Fuchs, Atlas Weyhausen, Hanomag, Kramer and Habaumag. The remaining 15 per cent were sold to Claas, tractor manufacturer Lindner, MDW Combines and several other agricultural manufacturers. Perkins 900 Series engine is also supplied to Linde Ag - to power its range of advanced technology H20/25 fork lift trucks.

Desta, the Czech Republic's large manufacturer of fork lift trucks, recently selected 900 Series to power vehicles in its 1.6 to 2 tonne range; and Daedong of Korea launched a range of tractors powered by 900 Series.

VarityPerkins has also signed a 5 year agreement, worth more than US$ 150 million to supply engines from its 900 and 1000 Series ranges to Case's Doncaster plant to power a range of 38 to 75 kW tractors. Full production will begin next year.

Mike Baunton, VarityPerkins Group Chief Executive said: "VarityPerkins is committed to offering all its customers full range capability and this agreement demonstrates the confidence Case has in our products. It also shows VarityPerkins has the ability to continue to develop the 'Win with Winners' strategy which has been so successful for us and develop long term partnerships with leading world-wide OEM's."

VarityPerkins powers one in five of all farm tractors over 26 kW and has an ability to tailor its engines precisely to the customers' equipment requirements. The crucial criteria for agricultural engines is robust reliability with technological simplicity. The Perkins 1000 Series range has won accolades from around the world for its product innovation and operating performance.

Price broken in thermometry

GWI announces the TM-908, an instrument which offers, for the first time on the UK market, a high performance non-contact thermometer for only £99. The hand held TM-908 measures temperatures in the range -10 to 300 deg C fast, and from a distance - just point at the target and read the temperature.

Non contact thermometers detect the infrared energy that is radiated from the surface of all materials above absolute zero, and convert it into a digital display reading on the instrument. On the TM-908, the reading is accurate to +/- 2 deg C, with resolution of either 0.1 or 1 degree.

Additional features which give the TM-908 an impressive price/performance ratio include adjustable emissivity to match all surfaces, selectable C/F, average /max /min and hold modes, and RS-232 output for data recording. Included with every instrument are batteries, carrycase and instructions.

This instrument is an invaluable tool in farming, and in the food retailing and processing industries for general purpose temperature measurements.

Contact: **Peter White on 01727 861110.**

Compact Claas Quadrant for contractors

For the 1997 harvest, Claas introduce 2 new big square balers replacing the Quadrant 1100. The two new models are the Quadrant 1150 and 1150 Roto Cut. Both produce the same size compact big bale (80 cm wide x 50 cm deep x up to 2.4 m long) of the model they replace. This size of bale has proved to be particularly attractive to stock and pig farmers having to handle big bales inside buildings where space is restricted and for those wishing to bale silage, hay and straw.

Improved operational safety features designed to satisfy the needs of contractors as well as farmers has been made by moving away from shearbolt protection towards safety overload clutches; steps have also been taken to improve the cleaning effect around the knotters. The Roto Cut version is entirely new and follows the introduction of the Quadrant 1200 Roto Cut 12 months ago.

The 1150 Roto Cut is equipped with 2.1 m wide pick-up and 2.0 m pick-up on the 1150. The main pto drive shaft now has an overload clutch replacing the traditional shearbolt in the flywheel. Similarly, the shearbolt protecting the drive from the gearbox to the packers has been replaced with an overload clutch. If the packer overload clutch is activated, the pick-up is automatically stopped to prevent more crop being forced in. Friction and safety clutches result in less downtime for the operator who will no longer have to stop and replace shearbolts.

The Quadrant 1150 Roto Cut is comparable to the 1150 but has safety clutches interlinked to stop the rotor mechanism should the packers become overloaded.

The Roto Cut crop slicing mechanism is similar to that fitted to the Rollant and the new Variant round balers. From the pick-up, a 4 tine spiral rotor feeds the crop through 12 spring loaded knives, giving a theoretical chop length of 70 mm. The knives are easily removed for sharpening and can be disengaged from the tractor cab by operating the tractor hydraulics.

Both models are fitted with 4 heavy duty knotters and twin cleaning fans to keep them clear of dust and chaff. A twine failure indicator is also fitted.

The Quadrant 1150 has a power requirement from 64 kW and is priced at £46,700. The 1150 Roto Cut requires a minimum of 75 kW and costs £46,700. Included in the price of both models is a bale accumulator that stacks 2 bales high.

For further information, contact: **Roger Marshall, Claas UK Ltd, Saxham, Bury St Edmunds, Suffolk IP28 6QZ. Tel: 01284 763100.**

Controlling electricity spending starts here

The first step to saving money is to find out where it's going. Here's an idea that's so simple, it's a wonder no-one thought of it before! Costplug tells you the cost of running your electrical equipment, so you'll know where you can make the best savings. At the press of a button, Costplug displays the financial cost of using any plug-in electrical appliance: the cost per hour, per day, per week, and per year, as well as the total cost of electricity for any single use, all with or without VAT.

Recently launched, Costplug has been an instant success. "Householders have bought them in their thousands", said inventor Laurence Trackman. "They've been bought by Hospitals, Local Authorities, Universities and Schools, Housing Associations, Environmental Groups, and businesses, from the largest to the smallest. Most organisations buy several, so they can use them to compare the running cost of new capital equipment before they buy, and get saddled with years of running costs. And they're used a lot to raise awareness that *wasting electricity costs money*". This clever British invention is now being sold around the world.

Costplug is absolutely simple to use, and should pay for itself many times over. It's BS safety approved, guaranteed 12 months, and is available at £24.99 ex VAT, direct from the manufacturer.

For further information, contact: **Laurence Trackman, National CostTrackers Ltd, PO Box 251, Bristol BS99 1HP. Tel: 0117 942 6660.**

SeeSnake locates drain line problems

SeeSnake is a new high-performance camera/transmitter system from Ridgid/Kollmann for locating and diagnosing line problems in all types of industries. Whether it's a blocked or collapsed drain line, a jammed conduit line or a damaged chimney, SeeSnake identifies the problem fast.

The compact black & white camera head and push cable easily negotiate multiple 90° bends in 50-250 mm lines ensuring you reach the problem. Unique lighting and video system focus down the line to see trouble before you're in it. The picture is so sharp, newsprint is legible inside pipe.

Quality components like hardened stainless steel camera housings and spring assemblies, scratch-proof sapphire crystal lenses, Kevlar wrapped fibreglass cable and slip rings proven to over 1,000,000 cycles are used to ensure long service. All Ridgid/Kollmann SeeSnake cameras and push cables are pressure tested to 100 m and both are waterproof.

Designed for quick set-up, simply plug in and turn on the monitor and begin pushing the camera into the line. Push rods are not required. Available with a high resolution monitor, the system works with any video monitor or VCR for crisp, clear viewing/recording of the camera's path inside the line. An optional pipe location transmitter allows for exact location of line problems.

Contact: **Jill Winter on 01993 774315.**

Digital soil map of the world & derived soil properties on CD-ROM

The Digital Soil Map of the World (DSMW) CD-ROM (version 3.5. November 1995) is based on the FAO/UNESCO Soil Map of the World. The CD-ROM contains two types of files, DSMW map sheets and derived soil properties files with images derived from the Soil Map of the World.

DSMW map sheets

The Digital Soil Map of the World consists of ten map sheets: Africa, North America, Central America, Europe, Central and Northeast Asia, Far East, Southeast Asia, and Oceania. The maps are available in three different formats: one Vector format (ARC/INFO Export) and two raster formats called ERDAS and IDRISI (or flat raster) formats.

All the maps are in geographic projection, with spherical datum. The co-ordinates are expressed in degree decimals. The scale of the original map (and the vector formatted data) is 1:5 000 000. The cell size of the raster data is 5 x 5 arc-minute.

Derived soil properties

The Derived Soil Properties files consist of interpretation programs and related data files. The programs are written in QuickBASIC version 4.5 and can be read using a DOS or OS/2 operating system.

Included are programs that interpret the maps in terms of agronomic and environmental parameters such as pH, organic carbon content, C/N ratio, clay mineralogy, soil depth, soil and terrain suitability for specific crop production, soil moisture storage capacity and soil drainage class. The output is given in the form of maps and data files which can be stored for later retreival.

Special country analyses can be made for specific soil inventories, problem soils and fertility capability classification for every country in the world. The output is in tabular form. Also included are maps of classification units of the World Soil Reference Base units and topsoil distribution, which can facilitate the teaching of soil science.

In addition, there is a soil database developed specifically for environmental studies on a global scale, which includes soil moisture storage capacity, soil drainage class and effective soil depth.

The full installation of FAOSOIL requires 92 MB of free hard disk space. Users who do not have enough disk space can still carry out the partial installation which requires only 8 MB.

The Digital Soil Map of the World & Derived Soil Properties is available on CD-ROM as a one-time purchase at a cost of £275 plus shipping (plus VAT where applicable).

Contact: **Nicola Temple, Microinfo Ltd, PO Box 3, Omega Park, Alton, Hants GU34 2PG. Tel: 01420 86848.**

Ferrag offers more choice

As one of Europe's leading suppliers of pto-driven and tine cultivation equipment, Rau, through their UK partner, Ferrag, are extending their range of tined cultivators available to the UK farmer with the introduction of the KULTIMAX which has been extensively used in France, Germany and Eastern Europe. Development of this product has been in line with ever-increasing tractor power.

Initially, Ferrag will concentrate on two hydraulic folding models which all have a choice of tines, with a clearance of 10 cm in 4 rows. Optional equipment includes spring-loaded clod bars and choice of single, tandem parallelogram rollers or coil packer. A finger harrow can also be included in the build, either on its own or in conjunction with a rear roller.

The model KR with 60 x 60 x 5 mm main frame is available in working widths of 4.1 to 6.1 metres. Weights range from 750 kg to 1665 kg, suitable for tractors from 50-90 kW.

The heavier DK model with 90 x 90 x 8 mm frame has Rau DEKA tines as standard and comes in working widths of 4.5 to 8.5 metres, with weights from 1520 kg to 2680 kg for tractors from 64-150 kW.

"Rau have a great reservoir of product which they sell in volume", says George Randles, of Ferrag, "and the KULTIMAX gives real depth to the range which consists of the TERRAMAX precision cultivator, the X-SEM which is designed for mounting drills on, and the POLYMAG, set-aside/straw incorporator".

Prices for the KR41 start at £2,403, to £10,963 for the DK85.

Contact: **George Randles, Ferrag Ltd, PO Box 90, Haydock Lane, Haydock Industrial Estate, St Helens, Merseyside WA11 9UU. Tel: 01942 272777.**

Book Reviews

A Guide to the Measurement of Humidity

Publisher: The Institute of Measurement & Control, 87 Gower Street, London WC I E 6AA
ISBN 0 904457 24 9

The influence of atmospheric moisture is so widespread in agriculture and horticulture that few agricultural engineers can have avoided involvement with its measurement and control in one or more of its manifestations. Those who are not familiar with this subject can be forgiven if they are bemused by the multitude of ways in which humidity is defined and measured, or if they are confounded when first faced with a psychrometric chart.

Many substantial reference works have been devoted to this topic - and indeed a thorough understanding of the subject cannot be acquired from light reading. However, there is undoubtedly a need for texts which provide a sound introduction to the subject.

This Guide was prepared by specialist staff at the National Physical Laboratory in co-operation with the Institute of Measurement and Control and with support from the National Measurement System Policy Unit of the Department of Trade and Industry. An independent panel of humidity specialists from UK industry and official bodies influenced its structure and control, and views were obtained from an impressive array of national and international organisations. The Foreword by the President of the Institute of Measurement and Control states that the guide was written to meet the needs for a basic advisory document for users of humidity instrumentation, and that it was intended to be readily accessible; practically available; widely acceptable. and to contain objective criteria against which good practice can be judged.

The authors have delivered a clearly laid out text, in A4 format, starting with concepts, terms and definitions; followed by the significance of temperature and pressure for humidity measurements. Ensuing sections cover methods of measurement; selection of the type of hygrometer according to requirement; calibration; recommended practices in humidity measurement and quality assurance. Tables, charts, formulae and a section on the use of software packages for calculations and conversions are followed by worked examples of calculations. Finally, there is a graded list of further reading.

This reviewer's opinion is that the authors have produced a concise and readable reference text for anyone seeking a broad understanding of the nature of humidity measurement and its attendant problems. It is certainly readily accessible and practically available (from the IMC). It should also be widely acceptable.

SWRC

Ferguson Implements & Accessories

by John Farnworth
Publisher: Farming Press
Price: £18.50 (in hardback)

This is the latest in a series of books published by Farming Press aimed at farm machinery buff world wide. Each look back and records some part of the history of mechanisation, mostly in the twentieth century. *Ferguson Implements and Accessories* has been compiled by enthusiast John Farnworth. I have to say that I found it the very best of its type. Like many others, it has plenty of illustrations and is very well presented but for me the thing which put it at the top of the pile is its historic perspective.

The work concentrates on the dominant period of the grey TE Ferguson but it also includes implements for the Ferguson-Brown, Ford, Massey Harris and TO Tractors.

It has been painstakingly arranged in chronological order and hence gives a clear progression and catalogue of the vast array of implements produced.

The text is concise and is well backed up by price and parts list, together with model numbers and adaptations. The book provides a key reference to the influence of Harry Ferguson on the mechanisation of Agriculture.

MJH

Choosing the right antifreeze

Which antifreeze to choose has probably never been regarded by the agricultural industry as a particularly important issue. ARCO Chemical aims to change this situation by promoting the use of a new premium quality product based on propylene glycol.

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ARCO has teamed up with a number of well known antifreeze suppliers to supply this propylene glycol based product under the brand name Trigard™. The use of the Trigard™ logo on their packs will give the assurance of a quality product allied to this strong safety message.

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Roger Dingley, ARCO Chemicals spokesman continues, "Knowing that each tractor or truck is carrying a product low in toxicity is the added bonus which makes the Trigard™ proposition so appealing."

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