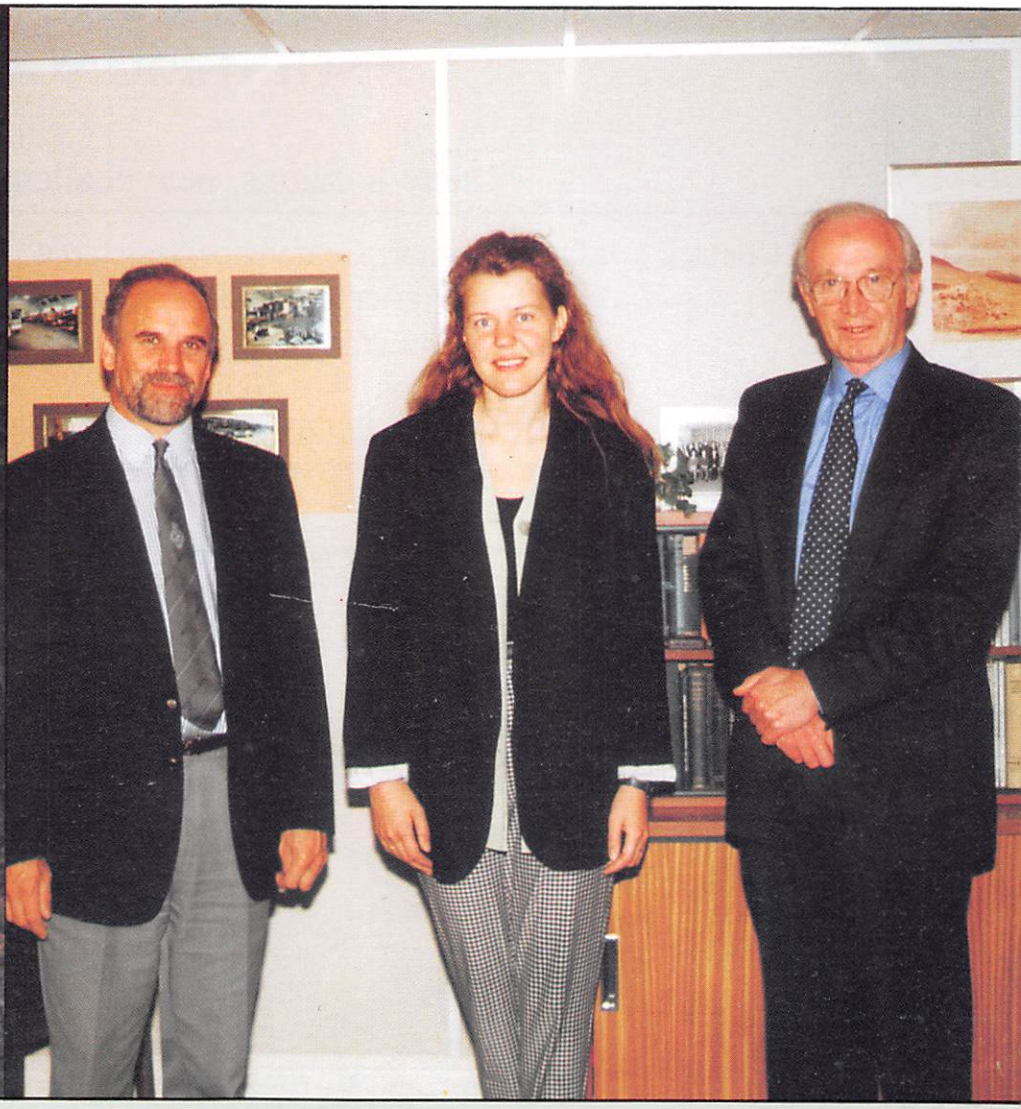
The Agricultural Engineer

Incorporating Soil and water

Volume 48 Number 4 Winter 1993



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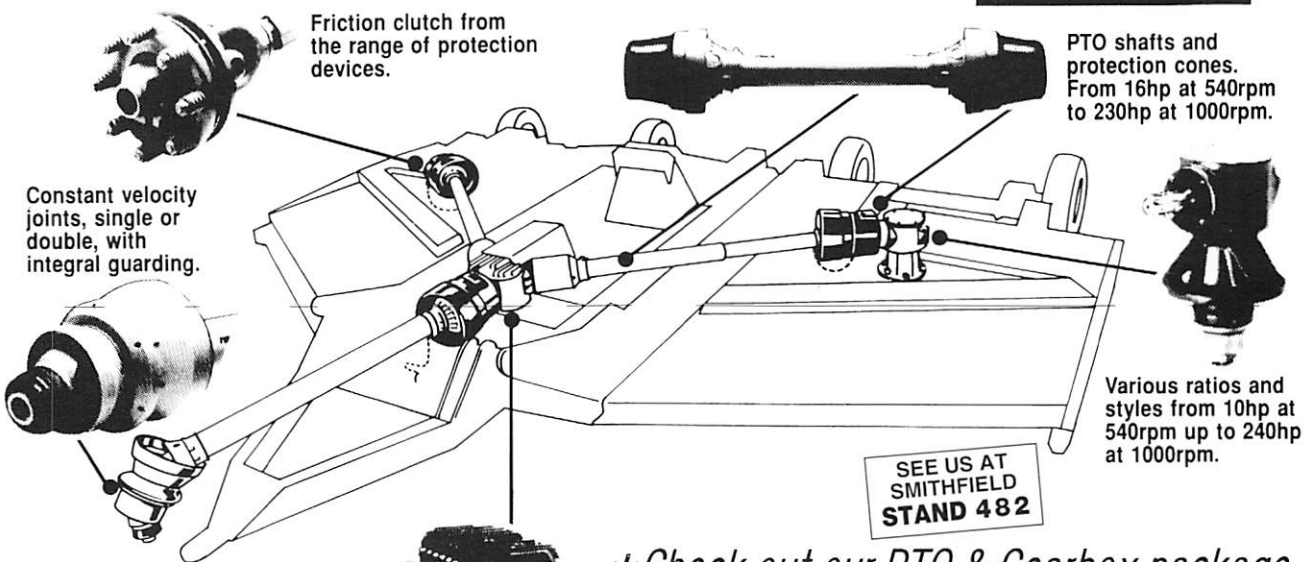

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The Agricultural Engineer

Incorporating Soil and water

Volume 48 No.4, Winter 1993

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Front cover: (left picture) Jason Bayley 1993 winner, West Midlands Branch Award for Best Project at Warwickshire College of Agriculture. (Right picture) The 1993 winner of the Forestry Engineering Specialist Group Award, Britt Helleren, with Geoff Freedman (left), Secretary/Treasurer of the FESG and (right) Roger Hay, FSEG's Chairman *(see Newsletter).*

Regular Features

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Nominations for public appointments

Brian Finney

We have been approached through Engineering Council for nominations for public appointments. This means putting forward names of those who have been recommended, or who have themselves expressed an interest in being considered, for inclusion in the central database maintained by the Public Appointments Unit of the Cabinet Office. The database is used by Ministers and Departments when making appointments to public bodies. Examples given are the Police Complaints Authority, National Consumer Council, Regional Health Authorities and Transport Users' Consultative Committee. The work ranges from full time to perhaps half a day a month; remuneration from senior professional salary to expenses only. Appointments are normally for three years.

There are clearly many areas of public interest in agriculture, forestry, horticulture, and in education, amenity, sport, and environmental conservation in the countryside, where Institution members have outstanding skills and experience. It would be to the credit of the Institution, and to the engineering profession, if such people did take part in high profile public work. If you feel that you would wish to be considered for inclusion in the register, and can be released from present commitments for, say, a minimum of one day a month, please contact Mike Hurst, our Secretary, for an application form.

Brian Finney, *President*

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The Institution of Agricultural Engineers

Environmental precision

Ag-Chem Equipment Co and its importer in UK, FLO-TAG of Rugby, announce the availability of its Soilection precision application system.

The heart of the Soilection system is the creation of computer maps, showing areas of common requirement, interpreted and converted as a control disc to be read by the application machine; be it fertiliser spreader, crop sprayer, slurry tanker, lime spreader or a precision drill or planter.

Soilection monitor displays map/field information and status/ alert bulletins – all on the same screen.

The rate 'commands' come from the different coloured areas nominated on the digitised map, held in the on-board computer and shown on the driver's screen. Five different rates are programmable but, if the machine is travelling over an area where the level of any element is already adequate, the machine will close off the product.

The Soilection system also has a 'blend on the go' facility where the application vehicle can hold different products separately and mix them on the move in response to the commands from the digitised map. Liquid fertilisers and sprays are applied by the same principle, with compartments for the different products which are only pumped into the spray boom in response to the map's commands.

In the case of slurry or organic by-products, a Soilection machine can control the quantity applied to each area in accordance with the fertility of that area and also so as not to exceed the level of possible contamination.

FLO-TAG, PO Box 62, Rugby CV22 7EF (Tel: 0788 535981; Fax: 0788 535980).

Monitoring water quality

Testoterm Ltd of Emsworth, Hants (Tel: 0243 377222) announce the launch of its new range of measuring instruments specially suited to the water industry.

The Testo 251 and 252: two multi-purpose instruments – the 251 measures temperature, pH and redox; the 252 takes the same three measurements with the addition of conductivity, giving a complete measuring system for the analysis of water quality.

The Testo 230 and 240: each offers two measurements with one instrument; the 230 measures temperature and pH and the 240 measures temperature and conductivity. The manufacturer points out that the rugged water-proof casing renders these instruments especially suitable for effluent testing.

Grassland South West

Grassland South West, now well established as the major working grassland demonstration in the south west of England, will take place this year at the Royal Bath and West showground, Shepton Mallet, Somerset on 11 May.

Grassland South West is always held on the same land and, as always, it is a first-year re-seeded ley. The Showground's neighboroughing Bagborough Farm will again provide the 40ha site in 1994. Host farmer, Raymond Longman runs a three year grassland rotation especially to coincide with the event.

Responding to the huge increase in forage maize growing in southern Britain, Grassland South West will for the first time include a major maize growing demonstration which will be coordinated by the Maize Growers Association. Techniques will include the relatively new to Britain system of starting the crop under plastic sheet.(see photograph below).

ICI Fertilisers, Lloyds Bank plc and Dalgety Agriculture are joint sponsors of Grassland South West.

Soil investigation instruments

Leonard Farnell range re-launched

Soil investigation specialist, Leonard Farnell & Co, has upgraded and re-launched its on-site equipment range following the company's aquisition by the Stevens Measurement and Control Group.

Hand augers and bits now available include Jarrat, Spiral Flights, Chisel, Buckets, Gravel and Dutch Augers. This comprehensive range enables users to bore into all types of soil.

For soil core sampling, tools and accessories now available include standard and stainless steel options, for where minimum contamination is required. Specialised instruments have also been introduced for mud sampling and undisturbed peat core extraction.

Leonard Farnell & Co Ltd, North Mimms, Herts (Tel: 0707 264488).

Drilling maize under plastic

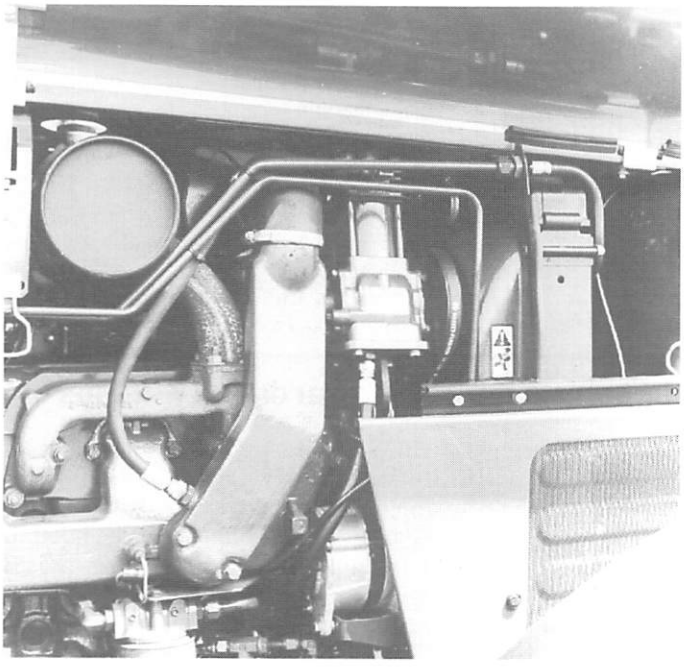
Farm trials in Cheshire and Lancashire this year demonstrated the significant benefits of drilling maize under plastic. Earlier maturing and higher dry matter contents are the main advantages. The machine that lays the plastic and drills through it is being imported from France by Burdens Lincolnshire of Sutterton near Boston; it costs £20,000.

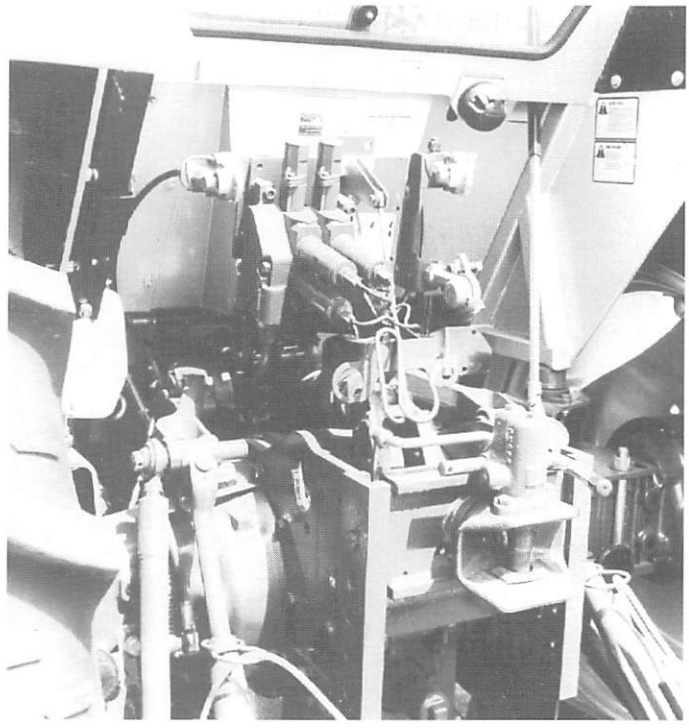
The four row Jeantil combined plastic layer and Monosem drill.

Air brake kit

Improved safety and increased payloads are the benefits claimed for a tractor air brake kit, developed jointly by Humberside Hydraulics and Massey Ferguson. Single or dual line braking circuits are available, both as retrofit kits and as a special build option on certain new MF tractors.

The main components of the kit are a compressor, drawing filtered air from the engine induction manifold, a reservoir fitted under the cab and a control valve interfaced with the tractor brake system. Standard-size air line connectors are mounted at the rear of the cab.





(left) Tractor offside – showing air intake extension bolted to the engine manifold and air brake compressor next to the fan belt; (above) tractor rear – showing the three air brake couplings immediately below the cab window; two to the right of the valve block and one to the left.

The system provides the capability to operate HGV type drawbar trailers behind the modified tractor – an attraction for contractors in farming or forestry.

Humberside Hydraulics Ltd, Hull, (Tel: 0482 227423).

Distributor for Sudtech (Beham) slurry pumps

Braintree-based Carier Pollution Control (Tel: 0376 323349) has been appointed distributor in the UK and republic of Ireland for the complete range of slurry pumps manufactured by Sudtech of Germany and based on the Beham system.

Included in the range are stationary and mobile models for agricultural and industrial use, with 7.5–22kW electric motor drives as well as tractor driven versions. Capacities are up to 6000l/min and pits up to 6m deep can be served.

'Green light' given to first rapeseed-based oil

John Deere has introduced a new biodegradable transmission and hydraulic oil produced from oilseed rape.

Bio-Hy-Gard is approved for use in the transmissions and hydraulics of the new John Deere 6000 and 7000 Series tractors, as well as earlier tractor lines. This versatile oil can also be used in the hydraulic systems of combines and forage harvesters, as well as in many lawn, turf and groundcare machines.

In contrast to conventional mineral oils, Bio-Hy-Gard is readily biodegradable (about 87 percent of the oil is broken down within 21 days) and it is therefore likely to be of particular interest for use in parks and gardens, sports and leisure areas, golf courses, nature reserves and forests.

This new product offers another outlet for rapeseed grown for industrial use on land set aside under EC regulations.

A chance to have your say on Health and Safety

The Health and Safety Commission is inviting individuals, businesses and organisations to submit evidence about the benefits or costs of health and safety regulations to its Review of Regulations by the end of January, 1994. The review is seeking to ensure that these regulations do not impose unreasonable burdens on business.

Commission Chairman, Frank Davies, said: "Our review of the 400 or so sets of health and safety regulations for which we are responsible is now well under way. We should have as much first hand evidence as possible about the benefits and costs which these regulations bring. That is why we want people to participate".

Contributions should be sent, before the end of January 1994, to:

HSC Review of Regulations, Room 330, Baynards House, 1 Chepstow Place, Westbourne Grove, London W2 4TF.

Drainage principles and practice

This is the second edition of ILRI Publication 16 and the text has been completely revised to bring it up to date with current practice. The previous four volumes have now been consolidated into this one publication of 26 chapters together with an extensive bibliography. There are 1200 pages, 550 figures, 140 tables, a list of symbols, a glossary and an index.

The new edition has chapters on topical drainage issues (eg environmental aspects of drainage), drainage structures (eg gravity outlets) and the use of statistical analysis for drainage and drainage design. Current drainage practices are thoroughly reviewed. Recent developments (eg computer applications in drainage) are briefly touched upon.

Obtainable from booksellers or direct from the Institute for Land Reclamation and Improvement, PO Box 45, 6700 AA Wageningen, The Netherlands.

Price is US $100.00.

Mega outputs for Claas combines

A new range of five 'Mega' series combines for 1994 will feature the Claas APS (accelerated pre-separation) system, first introduced on the Mega 218 combine in 1992.

The APS system uses an accelerator and concave placed ahead of the main drum and concave. Easily threshed grain is separated before it reaches the main drum, thus allowing crop to be loaded into the system at a faster rate.

As loose grain in the straw is no longer carried around the drum onto the straw walkers, the straw walkers also can handle greater volumes of material. Given that 90% of the grain is separated at the drum, Claas claim that pre-separation has great potential benefits compared to devices placed after the drum.

An independent survey of Mega 218 users found outputs up to 30t/h in wheat and 25t/h in barley with minimal losses and good grain quality.

Claas UK Ltd, Bury St Edmunds, (Tel: 0284 763100, Fax: 0284 769839).

Water from sunshine

A new pump claims to be the first solar powered, purpose-designed pump for submersible operation in standard 100mm diameter boreholes at depths down to 70m.

Two, 48W solar panels power the pump, which can deliver water at a rate of 220 - 320 l/h. The motor is 24V dc and a battery back-up system is recommended. The battery can trickle charge when solar power is too low for pumping directly.

Suggested uses include livestock watering, remote leisure facilities and holiday homes.

Shurflo Ltd, Surrey, (Tel: 0737 242290, Fax: 0737 242290).

Open meeting to point engineers towards fine turf needs

'Golf course engineering – from green field to fine turf' is to be the theme of the inaugural open meeting of the Institution's newly formed Amenity and Ecological Engineering Group. To be held in conjunction with the BIGGA Turf Management Exhibition in Harrogate next January, the seminar is scheduled to take place between 2pm and 5pm on Thursday, 20 January 1994 at the St George Swallow Hotel, Ripon Road, Harrogate.

The meeting will address areas of interest to engineers, greenkeepers and others concerned with the future development and application of machines, methods and systems employed within the professional turf and grounds maintenance industry.

BS 7705:1993
New British Standard on specifation for brake systems for special forestry machines

Copies of the standard are available from BSI Customer Services (see page 111 for address), price £23.60.

Slurry in the bag

The ECOLAN slurry bag system is manufactured from heavy duty EPDM rubber and has a guaranteed life of 20 years. Installation requires some excavation work with topsoil being stripped back to create an earth bund and the floor being dished down to a depth of one metre at the centre. Mixing and filling pipes are set in a one metre square concrete pad.

By sealing slurry from the atmosphere, ammonia and odorous gases cannot escape and extra capacity, normally required to store rainwater collecting on the tank, is unnecessary. Experience in Holland suggests that little crusting occurs and mixing is seldom necessary. Prices start at £23 per cubic metre installed.

Details from the importer: Andrew MacWilliam Farm Supplies, North Devon, (Tel: 0237 441524).

Mobile bulk weight sensing

On-board weight measurement to an accuracy of within 50kg for tipper and bulk blower lorry bodies is provided by a new system called 'Loadwatcher'. The sensing components fit under the tipping body.

Facilities include ticket printing and batch weighing, giving both purchaser and seller confidence whether delivering or uplifting. Loadwatcher also permits filling to capacity without risk of overloading in the absence of a weighbridge. The system can be upgraded to measure individual axle loads.

Maywood On Board, Basingstoke, (Tel: 0256 470649, Fax: 0256 840937).

New parts warehouse

Massey Ferguson has completed the massive logistical operation of transferring its international parts warehouse from Manchester to the heart of the country's motorway network at Desford, Leicestershire. The state of the art facilities has enabled MF to cut the time for parts coming into stock and being available for shipment by half. Urgent orders can be ready for dispatch within two hours.

Green Business: The Greenhouse Effect

Two sourcebooks from IMechE

Each of these books contains lists of useful sources of information together with over 250 abstracts and details of recently published material relevant to the topic.

Prices are:
Green Business: £29.50 plus £1.50 postage (£2.50 overseas).
Greenhouse Effect: £23.50 plus 50p postage (£1.50 overseas).
or both publications; £39.95 plus £1.50 postage (£2.50 overseas).

The Sourcebooks are available from; IMechE, Information and Library Service, 1 Birdcage Walk, London SW1H 9JJ (Tel 071 973 1267).

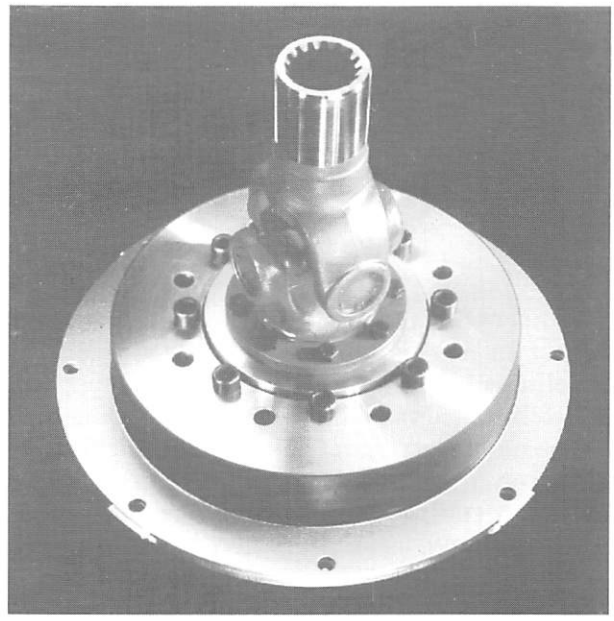
Calibration of Anemometers

ADAS Farm Buildings Research Team, based in Reading, is offering a calibration service for anemometers. Dust, corrosion, vibration, component wear and temperature and humidity changes can affect the accuracy of these sensitive instruments.

A wind tunnel is used for calibration which is carried out to traceable National Physical Laboratory standards.

Contact Colin Pearson or Geoff Owen on 0734 392357.

Flexible drive couplings



The new TORMAX range of flexible couplings has been developed for off-road vehicle applications, especially agricultural and construction machinery. The couplings are designed to fit onto universal joints to absorb shock loads and permit radial and axial flexibility. The design of the couplings is particularly aimed at reducing dynamic stresses in universal joints caused by torsional vibrations produced by diesel engines.

Radial and axial ventilation ducts provide self cooling as the coupling rotates. Elastomeric elements are made from natural rubber, said to make the couplings maintenance free.

Full details from Posiva, (Tel: 0724 281868, Fax: 0724 282808).

Spaldings launch grass care product range

After 25 years of successfully supplying replacement parts and workshop equipment into agriculture, Spaldings has launched a grass care product range. The product range includes replacement cutting cylinders and rotary blades for all popular makes of trailed gang and ride-on mowers in the UK. Delivery of products will be by Spaldings free three day delivery service (orders over £75) or overnight at a small cost.

Engineers and the environment

A nine point Code of Professional Practice has been drawn up by the Engineering Council. Issued for the benefit of 290,000 registered engineers and technicians from 42 engineering institutions, the Code aims to encourage greater awareness, understanding and effective management of environmental issues. The nine points of the Code are as follows:

1	ROLE	Work to enhance the quality of the environment
2	APPROACH	Maintain a balanced, disciplined and comprehensive approach
3	ASSESSMENT	Make systematic reviews on environmental issues
4	COST BENEFIT	Balance economic, environmental and social benefits
5	MANAGEMENT	Encourage management to follow positive environmental policies
6	CONDUCT	Act in accordance with the codes of conduct
7	LAW	Know about and comply with the law
8	PROFESSIONAL DEVELOPMENT	Keep up to date by seeking education and training
9	COMMUNICATION AND PUBLIC AWARENESS	Encourage understanding of environmental issues

The Code is seen as an umbrella document and individual institutions may have additional requirements to suit their particular disciplines.

People and organisations with interest in the Code are expected to include the following:

- Engineers
- Owners/Employers/Managers
- Trade Unions
- Government
- Professional institutions
- Higher educational institutions
- Schools
- General public
- Media.

The Code will come into effect on 1 March 1994. Engineers and technicians registered with the Engineering Council are expected to adhere to good engineering practice wherever and whenever possible and the Council considers that this Code of Professional Practice will assist them in achieving this standard.

The Engineering Council is at 10 Maltravers Street, London WC2R 3RE (Tel: 071 240 7891).

Mechanical performance of a straw incorporation cultivator equipped with a pneumatic crumbler roller

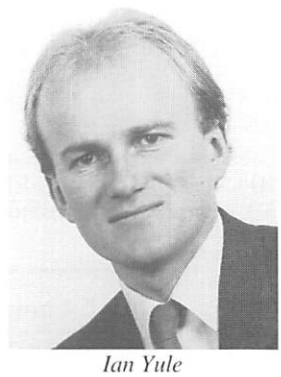
Klaus Doerkes and Ian Yule

The necessity to incorporate straw has led farmers to invest in new machinery. The requirement to avoid timeliness penalties has resulted in high output systems which have led to an increase in power demand.

The main restriction while using draft implements is the relatively poor utilisation of the tractor's engine power output. A cultivator with a crumbler roller acting as a fifth wheel is offered as an alternative to increasing tractor size.

Additional benefits have been found in terms of better clod breakdown, straw/soil contact and soil consolidation. This latter feature avoids the requirement to make the implement heavier to achieve good consolidation.

Klaus Doerkes



Ian Yule

The practice of burning an estimated 5-6 million tonnes of surplus straw annually in England and Wales (MAFF 1984) has caused increased official and public concern within the last twenty years, finally resulting in the burning ban from 1992.

Benefits and problems of straw incorporation

Increased importance has been placed on straw incorporation as a means of straw disposal. Consequently, recent research work has focussed on the agronomic aspects as well as the mechanical feasibility of straw incorporation.

The results of this work reveal the outstanding long-term benefit of an increase in soil organic matter content due to regular straw incorporation leading to improved workability and increased water retention (Powlson 1987).

Problems occur, however, when excessive soil wetness restricts the time available for straw incorporation and enhances the likelihood of anaerobic soil conditions and microbial toxins. This in combination with lower soil temperatures results in straw decomposition rates being slowed. It is most important therefore that a period of 4-6 weeks is maintained between straw incorporation and seeding of the successive crop, otherwise yield losses are likely to occur (Rule 1984).

Straw incorporation may also cause increased incidence of pests, especially slugs (Glen 1992), and diseases (Dawkins 1984). According to Christian (1985), another potential disadvantage is the physical presence of straw which may be tantamount to yield losses by impeding cultivation and drilling equipment, resulting in poor germination and establishment.

K Doerkes and I J Yule are members of the Department of Agricultural and Environmental Science, University of Newcastle upon Tyne.

A 'fast pass' system is required

Apart from those areas in Scotland and Northern England with soil and weather conditions extremely hostile to straw incorporation, the potential problems have been proved to be solvable within the scope of long-term experiments. This means that regular straw incorporation does not necessarily reduce crop yields provided a suitable technique is employed and the following objectives are met:

- Chopped straw and other residues are intensively mixed within the top 100-150mm layer of soil.
- An intimate soil/straw contact is provided.
- Excessive loss of moisture is prevented.
- Incorporation starts immediately after harvest, employing a system with a high work rate, so that the detrimental effects of decomposition do not affect the following seed.

Fig 1. Final design of cultivator; illustrating power transmission line.

These objectives together with the timeliness constraints indicate that successful

straw incorporation requires a 'fast pass' system with good performance characteristics and high work rates.

Prototype cultivator with rear-mounted driven roller

Based on the above requirements, a first cultivator prototype for straw incorporation was developed within the scope of a design project by Ridges (1992), serving as a basis for an improved design (Doerkes 1993).

The cultivator consists of two rows of rigid tines fitted with doubleheart shares and a rear-mounted driven pneumatic roller (Fig 1).

The tines are attached to the framework to provide lateral spacing of 240mm between points which guarantees sufficient penetration and loosening as well as mixing of straw and soil within the entire working width of the cultivator. To avoid blockages, a clearance of 700mm between the cultivator points and the base of the frame was chosen (Köller 1983).

– the roller

A key element of the cultivator prototype is the rear-mounted roller. It consists of twelve 155 x SR13 car tyres mounted onto a common axle. Four rods are passed through the respective wheel hubs with two driving hubs situated on either end of the roller. By tensioning these four rods the tyres are compressed so as to transmit the driving torque from wheel to wheel by using the frictional forces acting between the tyre surfaces. To allow the pack to be compressed, one drive hub is welded to the axle – the other requires to be moved axially. For this reason this hub is keyed allowing 150mm axial compression of the tyres.

The roller is connected to the framework by two trailing arms being supported by two fixed pivots welded to the rear crossmember of the frame. Two turn-buckles adjust the implement's working depth by varying the position of the roller relative to the cultivator frame.

– the power transmission

A mechanical power transmission line was selected to drive the roller.This comprises of a bevel gearbox mounted on the rear crossmember of the cultivator frame, a PTO drive shaft connecting the input shaft of the gearbox and the tractor PTO shaft and another drive shaft leading from the output shaft of the gearbox to the chain drive of the roller on the left-hand side of the implement.

The connection between the drive shaft and the driving sprocket of the chain drive is achieved by means of a 35mm shaft with splined profile on one end. This leads through the centre of the pivot assembly of the trailing arm and is supported by a self-aligning Y-bearing unit on either side of the pivot housing.

With the centre of rotation of the trailing arm and the drive shaft sharing a common point, depth adjustments of the roller can be made without the chain tension being affected. A ratchet clutch is incorporated into the power transmission line as an overload protection device.

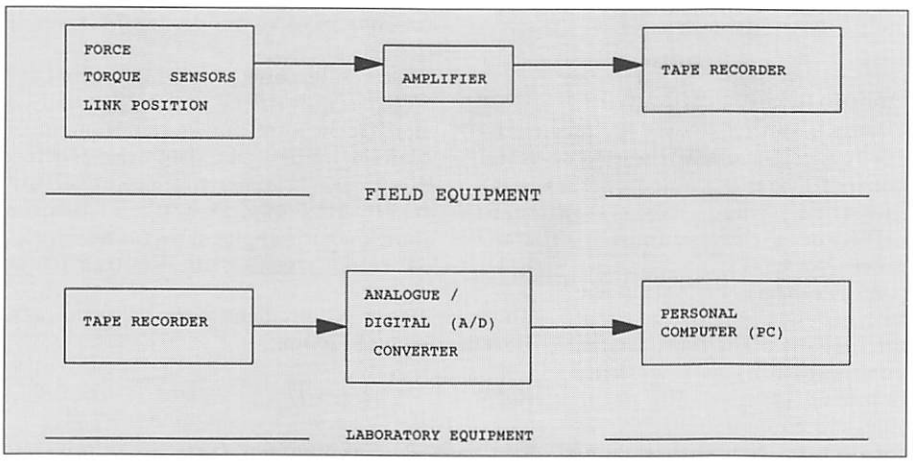


Fig 2. Block diagram of data aquisition system.

– roller speed control

The problem of matching the speed of the tractor rear wheels and the roller for a wide range of forward speeds was solved by using the tractor's ground speed PTO. In doing so, rotational speed of the roller was known in relation to the tractor's forward speed and the implement's flexibility was extended.

The reason for driving the rear-mounted roller is to reduce the cultivator's draught force requirement and to improve consolidation of the top soil layer.

Field test procedure

Field trials were used to test two of the stated objectives of the cultivator:

1. The draught force and power requirement for different cultivator configurations.
2. The effect of the cultivator on the top layer of soil.

– optimum cultivator configuration

The determination of the optimum cultivator configuration involved two parameters ó transmission ratio and working depth. The undriven roller version was compared with three driven transmission ratios at working depths of 80mm, 120mm and 160mm resulting in a total number of twelve different types of run.

The transmission ratios were 2.77:1, 2.57:1 and 2.4:1. These ratios produced 6% skid, no slip/skid and 7.6% slip of the roller relative to the tractor rear wheel. These variations were achieved by changing the driving sprocket of the chain drive.

Field tests were carried out in August, 1992 following the wheat harvest on a

Fig 3. The test tractor – 1) the bottom link transducers; 2) the toplink transducer; 3) the linkage position sensor; 4) the torquemeter.

sandy clay loam with a moisture content of 25.4%. Chopped and evenly spread wheat straw, (yielding on average 8.8 t/ha) had to be incorporated.

– power requirement

To calculate the cultivator's overall power requirement, the draught force, the forward speed and the torque in the transmission line of the roller were measured for each run.

The average forward speed was determined by a cyclometer, whereas the data collection of force and torque required an elaborate data acquisition system as shown in Fig 2.

Strain gauges were used to measure force and torque, which necessitated the integration of an amplifier into the system. The output signals of this strain gauge conditioning and amplification unit were recorded on tape in the field. These analogue measurement signals were digitized by means of an A/D-converter and stored on disk for further analysis with the aid of a spreadsheet programme.

The force measurement system was designed and calibrated at Cologne Fachhochschule (Kleineheer and Laubner 1989, Bawadi Bawali-Kleine and Hartleitner 1990, Lutter and Glaser 1991, Stahlhut 1992). The system measured the horizontal and vertical forces in both bottom links, the forces acting along the top link and the linkage position.

The torque needed to drive the roller was measured by a torque dynamometer inserted into the power transmission line.

– cultivating performance

Soil comminution within the top 80mm of soil was taken as a measure of the cultivator's performance. Six samples for each of the twelve run types were taken to fulfil the requirement for statistical data analysis. Aggregate size distribution was measured using a set of British Standard test sieves with aperture sizes of 75, 63, 50, 37.5, 28, 20, 14, 10 and 6.3mm.

Results

Draught force requirement

Draught force was reduced by 13-24% when using the driven roller configurations compared to the undriven one. No significant differences were found between the driven versions.

As an example, Fig 4 shows the frequency distribution graphs of the four different transmission configurations at a working depth of 120mm. The graph lines are based on 690 samples for each roller option. Figures displayed on the X-axis mark the maximum value of the respective force class.

The graph lines illustrating the driven roller versions have a very similar structure, the most frequently recorded draught force being in the 15-20kN class.

For the unpowered version, draught force variability is greater and the most frequently recorded draught force is in the 20-25kN class.

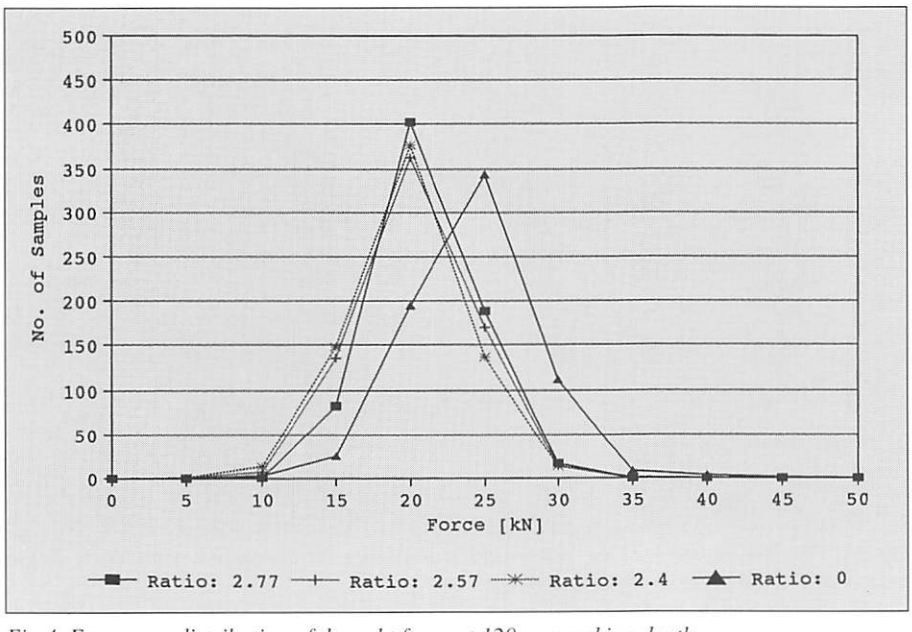


Fig 4. Frequency distribution of draught force at 120mm working depth.

Fig 3 shows the test tractor equipped with the force, torque and linkage position sensors wired to the amplifier.

The cyclometer calculated the forward speed as the ratio of distance travelled and time elapsed.

Despite the similarity of the results for the driven roller versions, driving the roller at the same speed as the tractor rear wheels was found to be the best transmission configuration; both lower and higher roller speeds caused an additional load on the transmission line which in turn reduced the tractor engine speed with no improvement in working effect.

Power requirement

Table 1 shows the cultivator's total power requirement when used with different roller configurations. The power required for the undriven roller version comprises of tractive power only. Driven roller versions have an additional PTO power component.

The results show a reduction in tractive power requirement of 13-17% and an increase in total power requirement of 22-32% when driving the roller. However, driving the roller is not disadvantageous, as better utilisation of the tractor's engine power is achieved.

Tractive power is the limiting factor and the use of PTO power actually promotes higher outputs with a particular tractor/implement combination.

Table 1. Power requirement of the cultivator at a working depth of 120mm.

Ratio	*Tractive power (kW)*	*PTO power (kW)*	*Overall power (kW)*
2.77 : 1	41.1	15.9	57.0
2.57 : 1	40.3	19.5	59.8
2.40 : 1	39.2	22.9	62.1
Undriven	46.9		46.9

Cultivating performance

At working depths of 120mm and 160mm, the loosening of the top layer of soil and the mixing of soil with straw and stubbles was excellent for all transmission configurations provided a forward speed of 8-10km/h was maintained. However, significant differences were observed concerning the soil surface after cultivation.

The driven roller versions produced a much more even and consolidated soil surface than the undriven one, resulting in an intimate soil/straw contact. This visual impression was confirmed by the aggregate size distribution of the top soil layer. Data is presented (Fig 5) as the percentile aggregate size distribution by weight.

The graph shows that a significantly higher proportion of aggregates less than 6.3mm is produced when using the driven roller versions compared to the undriven equivalent. The differences occurring amounted to 8-15%. The greater shearing effect of the driven roller resulted in few larger clods being left compared to the undriven roller version.

Although, the implement has a greater power requirement with the roller driven, the cultivating effect in terms of creating tilth with

the implement more than compensates for this.

As the same tractor was used in all experiments, the improved utilisation of the tractor's power is demonstrated.

Conclusions

The innovative design of the cultivator met the requirements of successful straw incorporation at high work rates.

Better utilization of tractor power with improved physical performance in terms of soil/straw mixing, clod breakdown and consolidation were obtained.

The question of power demand needs to be investigated more fully to establish what the cost implications are for operating the machine.

It is clear that the utilisation of the tractor's engine power is improved by sing the powered roller and the increased power applied to the land results in better clod breakdown.

In terms of the project's objectives, the underlying idea of developing a "fast pass system" for straw incorporation has been accomplished.

Further studies will be carried out to determine the benefit of the additional clod breakdown observed when considering the energy requirement for the complete tillage system.

Acknowledgements

The authors gratefully acknowledge the free supply of the drive line components by the WALTERSCHEID company of Germany and the provision of the force measurement system by the Faculty of Agricultural Engineering, Cologne Fachhochschule, Germany.

Figure 5 Soil aggregate distribution

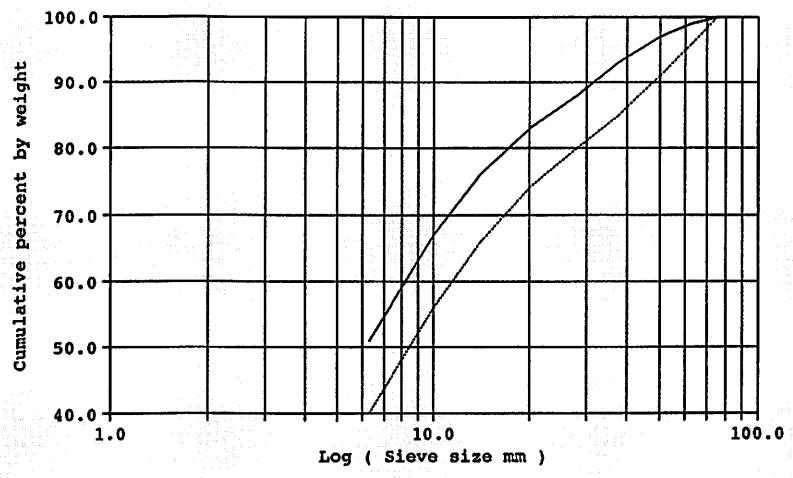


Fig 5. Soil aggregate distribution. ——— *Powered roller* ..... *Unpowered roller.*

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Geographical information systems for agricultural decision support

Ian Bradley explains how a basic understanding of the soil and its field by field variation, together with a geographical information system can be used as part of a farm management plan – so ensuring that good practices are followed and providing help in decision making and the protection of the soil, water courses and drinking water. He supports his arguments with details of two case studies undertaken by the Soil Survey and Land Research Centre.

In 1979 the Soil Survey and Land Research Centre (SSLRC) was commissioned by the Ministry of Agriculture, Fisheries and Food (MAFF) to develop a computer-based soil information system to organise existing and new soil data for England and Wales in an orderly manner so as to facilitate their effective use.

LandIS – the national land information system

The original, soil-based, information system has subsequently been expanded – with the addition of climate and other environmental datasets – to become a national land information system (LandIS) LandIS allows capture, storage, manipulation and retrieval of data on soil and climate, together with other environmental data. It enables users to access information from the Soil Survey's National Soil Map, National Soil Inventory and agroclimatic databases together with derived information about land potential (workability, trafficability, droughtiness, crop suitability).

All LandIS data are geo-referenced according to the Ordnance Survey's National Grid or related to soil series, the basic unit of soil classification.

LandIS is designed to:

- handle large volumes of many types of data
- validate, correct and update data
- relate different types of data and automatically interpret basic data according to various models
- interface with other software such as PASCAL, GENSTAT, FORTRAN and SPANS
- provide a user friendly interface
- produce output in the form of reports, tables, statistical summaries, maps and graphics.

LandIS can be used in two ways:

- through a comprehensive screen-menu system for retrieval and manipulation of data in a specific manner (Bradley 1992). This is done on a daily basis by SSLRC and staff of MAFF, or
- through a consultancy service operated by the SSLRC Computing and

Data in LandIS

- National Soil Map for England and Wales (Jarvis *et al.* 1984) at a scale of 1:250,000 (NATMAP) in raster format at 100m, 1km and 5km resolutions;
- National Soil Inventory for England and Wales: descriptions of soil and site at 5 km intervals (6125 sites), together with a range of analytical data relating to topsoils, such as pH, organic carbon, particle-size distribution, total and extractable potassium, phosphorus and magnesium and eleven trace elements, including potential pollutants (Loveland 1990);
- Soil and site descriptions from auger bores (about 170,000) and benchmark profiles (about 2000), originally described in the field in computer compatible form, as part of the National Soil Map, National Lowland Peat Inventory (Burton and Hodgson 1987) and systematic surveys undertaken since 1979 to produce soil maps at 1:25,000 and 1:50,000 scales;
- Chemical and physical analyses of soil samples taken from the benchmark profiles. These data have been used recently to characterise the English and Welsh units on the European Community's 1:1 million scale soil map of Europe;
- Agroclimatic data at 5 km intervals for England and Wales, including averages of annual, summer, winter and excess winter rainfall, accumulated temperature above a number of thresholds, growing season, crop-adjusted soil moisture deficits, return and end dates and duration of field capacity - a total of thirty different climatic parameters for each 5 km square (Jones and Thomasson 1985);
- National Catalogue of Soils (NATCAT): soil series (720 in total) related properties including soil wetness class, soil workability assessments, machinery work days in autumn and spring as measures of trafficability, crop-adjusted profile available water, nitrate leaching risk class, depths to an impermeable layer, to rock and to a gleyed layer, retained water in topsoils, integrated air capacity and hydrology of soil type (HOST) (Boorman and Hollis 1990);
- Topography: the altitude at each National Soil Inventory point was recorded in the field from the national topographic map. Altitude, slope angle and shape are held for all National Soil Inventory and benchmark profiles and slope class was recorded at all auger bore sites. A 5 km altitude dataset was also compiled for the revised Agricultural Land Classification system adopted by the Ministry of Agriculture in 1988;
- Land use data: this has been recorded at all sites visited.

A paper presented to the Annual Convention of the Institution of Agricultural Engineers, May 1993.

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Information Systems Department.

– The hardware and software

LandIS resides on a Local Area VAX Cluster on the Silsoe Campus. The cluster is powered by a VAX 4300 and a VAX 4200 with more than 11 Gbytes of mass storage. LandIS data and software occupies more than 500 Mbytes on a dedicated disk drive. Remote access is through standard communication networks and British Telecom's Packet SwitchStream.

The system has been built around relationally structured databases and DEC software comprising a common data dictionary for file definition and management, and Datatrieve, a fourth generation language, for manipulation and retrieval. The menu system is called up by a PASCAL shell and the DEC command language. Retrieval of data in batch mode is a new feature of the system.

– The data in Landis

The major sources of data in LandIS, are as shown in the panel on the facing page.

Geographical information systems

Since 1988 SSLRC has used a geographical information system (GIS) to supplement and enhance the modelling and display of its spatial data. SPANS (Spatial Analysis System) is a raster-based GIS developed by TYDAC Technologies Ltd of Canada. The minimum hardware requirements for SPANS Version 4, operating under MS-DOS, are an IBM-compatible PC with a 80386 CPU, at least 30 Mb hard disk and 640 Kb RAM, a VGA monitor and a maths co-processor. The system can be connected to an input device such as a digitising table and a high resolution printer and/or plotter for output.

The recently released Version 5 of SPANS operates under IBM's AIX and OS/2 and requires 486 CPU, with at least 8 Mb RAM, 120 Mb hard disk.

Use of the SPANS digitising module has enabled vector and point data to be integrated with point and raster data from LandIS.

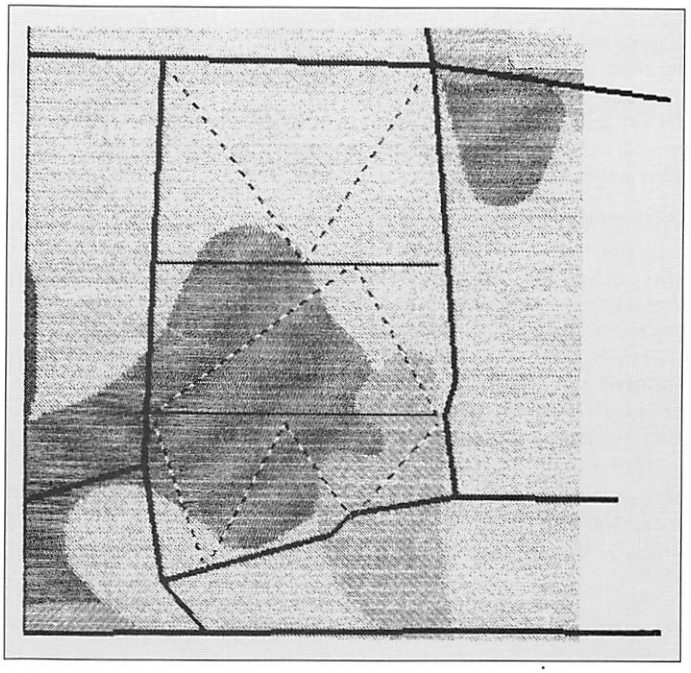

Fig 2. Map of part of the North Yorkshire Estate showing soil sampling strategy suggested by a fertiliser company to take account of soil differences. The field would be divided into three for sampling purposes, and one bulked sample collected from each part along the traverses shown by dotted lines.

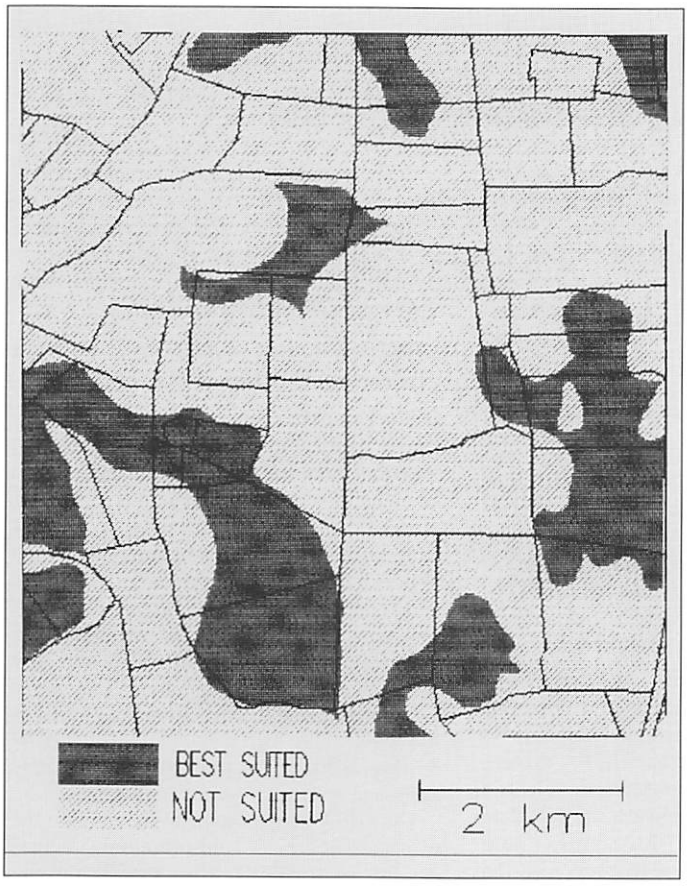

Fig 1. Map of part of the North Yorkshire Estate showing land most suited to growing linseed.

Land assessment and management

Case Study – North Yorkshire

– examining the suitability for different cropping regimes, management techniques and fertiliser applications according to soil type.

An estate extending to over 1620ha in North Yorkshire was surveyed as part of an appraisal on behalf of the landowners, examining the suitability for different cropping regimes, management techniques and fertiliser applications according to soil type. The farms on the estate are predominantly arable with very few livestock enterprises.

Yields of alternative crops often fail to match expectations because insufficient attention has been paid to site requirements. A soil map will help in the selection of the most suitable land for a particular crop. In Fig 1 linseed is shown as being best suited to soils which can be reliably drilled by mid-April and which have adequate moisture reserves.

The soil map provides a strategy for soil sampling and application of fertilisers that takes account of important soil differences and not just field boundaries. Fig 2 shows a soil sampling strategy suggested by a fertiliser company to take account of soil differences. The field would be divided into three for sampling purposes, and one bulked sample collected from each part along the traverses shown by dotted lines.

In much of the Vale of York variable depth to clay or the presence of sand pockets reduces the effective life of mole channels compared with the ten or so years achievable in the most suitable clays. Since mole drainage costs £50+/ha

it is essential that the farmer should be able to predict channel life accurately when deciding whether he should mole and how frequently he should do so. Maps can be drawn, based on the properties of the soils at moling depth, to give estimates in years of the channel life.

Case study – West Midlands

– to show how a knowledge of the soils and land use (whether actual or theoretically most suitable) in the Nitrate Sensitive Areas (NSAs) can be used to assess the effectiveness of the limits imposed and provide a scientific basis for MAFF decision making and farmer land management.

In 1990 MAFF set up ten NSAs and nine Nitrate Advisory Areas (NAA). The pilot areas were selected because their water sources had a high and/or rising nitrate level.

The pilot schemes were established to examine the practical implementation of controls on nitrate leaching from agriculture in potable water catchment areas (MAFF 1993). In 1980 a European Community's (EC) directive on the quality of water intended for human consumption set a maximum permissible concentration of 50mg NO_3/l (11.3mg N/l) in drinking water. This directive was adopted by the member states in 1991.

The EC directive also requires member states to monitor waters, set up nitrate vulnerable zones and produce a Code of Good Agricultural Practice by December 1993.

The nitrate area scheme is to run initially for five years, although the time for nitrates to percolate from the ground surface down to an aquifer and eventually into a borehole has been estimated at 15 to 40 years (Croll 1990).

The Tom Hill NSA

The Tom Hill area of the Midlands, designated as a NSA, is the subject of this intensive study.

The NSA, centred on grid reference SO 820940, lies about 5km west of Wolverhampton on the Shropshire-Staffordshire border. The area is underlain by reddish Triassic Sherwood Sands (formerly known as Bunter sandstone). Sandy drifts and reddish brown Devensian clay loam till, up to 3 metres thick, mantle most of the solid rocks.

The soils were mapped as part of the Soil Survey's detailed systematic survey programme in the 1970s and a map published at 1:25,000 scale (Hollis 1978). The soil map unit boundaries on the published map were digitised using TYDIG, the digitising module of SPANS (Bradley 1993, in press) and imported into the main module. Under a recent commission from MAFF, SSLRC has mapped all the remaining NSAs and Bourne Brook NAA. The maps are held on paper at 1:10,000 scale and in digital vector and raster format.

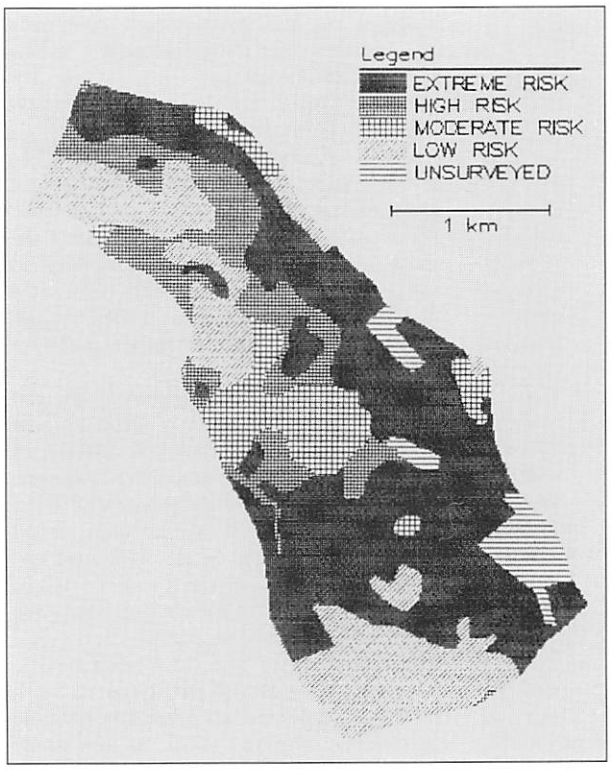

Fig 3. Leaching risk for nitrates of soils in Tom Hill district.

Each soil series has been allocated to a nitrate leaching risk class (Jones and Thomasson 1990) and a map of Tom Hill was produced showing the distribution of the four classes (Fig 3).

Croll (1990) suggests that leaching rates must be less than 20kg N/ha to ensure that nitrate concentrations in the groundwater are less than the EC maximum allowable concentration of 50mg NO_3/l (11.3mg N/l). Davies (1990) suggests that the average excess winter rainfall needs to be taken into account when relating leaching rate to nitrates in drinking water, as is the case for the national scheme of land use on leaching risk class (Jones and Thomasson 1990). Davies cites ranges of 150mm to 350mm of excess winter rainfall correlating with 15 to 40kg N/ha resulting in 50mg NO_3/l in the water.

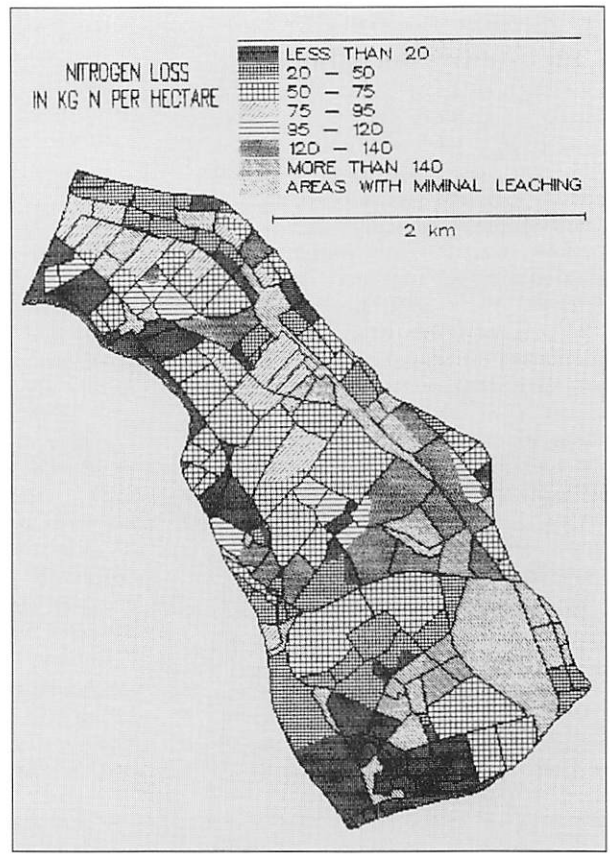

Fig 4. Leaching rate of nitrates by integrating the soil leaching risk with the land use of the Tom Hill district in 1989 before the scheme was established.

– land use limited to medium production permanent grassland and/or forestry?

In the Tom Hill catchment, with an excess winter rainfall of 220mm, this means that leaching rates of up to 24kg N/ha would be within the EC guidelines (that is, equivalent to 50mg NO_3/l). The only agricultural systems known to produce such low leaching rates are low to medium production permanent grassland and forestry systems. By using the area calculation module in SPANS, the proportions of each loss class were calculated and the overall leaching rate for the whole Tom Hill catchment estimated at 51.3kg N/ha under the existing land use pattern (Fig 4).

The GIS was then used to investigate the effects of the basic and premium schemes on the overall leaching rate from the catchment by amending the land use and nitrogen fertilisation level inputs to the leaching risk-land use matrix. The results are presented in Table 1.

– slurry acceptance potential

The suitability of the soils in the Tom Hill catchment for spreading slurry was

catchment for spreading slurry was investigated using the model developed by Clarke *et al.* (1992), following earlier work by Lea (1979).

The slurry acceptance potential model programmed in SPANS uses soil type, hydrology (Boorman and Hollis 1992), slope and duration of field capacity period (assumed to be uniformly 154 days) as inputs to the spatial analysis.

The map produced (Fig 5) can be used to modify the leaching model to identify areas at risk of pollution according to the Code of Good Agricultural Practice for Water (MAFF 1991).

The GIS can further be used to show the effect of a buffer area of no spreading around ponds, water courses and boreholes.

– attention needed to use of nitrates

There may be disagreement on the validity and significance of the limit 50 mg NO_3/l of nitrates in potable water, but what can not be disputed is that there is a need for the farming community to clean up existing practices with regard to the use of nitrates, whether as fertilisers, slurry, manure, sludge or in dirty water.

In the future, organic manures must be seen as a reliable fertiliser rather than as a 'waste'. The almost exclusive concentration on nitrate as the expression of organic waste pollution of soil and water needs to be re-assessed.

In the short term, the effects of BOD and ammonia need to be evaluated, potentially using the same approach as described in this study.

Conclusion

The Tom Hill and North Yorkshire case studies show how a basic understanding of the soil and its variation field by field together with a geographical information system can contribute to improved farm management planning.

Good agricultural practices will ensure protection and sustainable use of the soil, but those practices crucially depend on the kind of quantitative analysis described here.

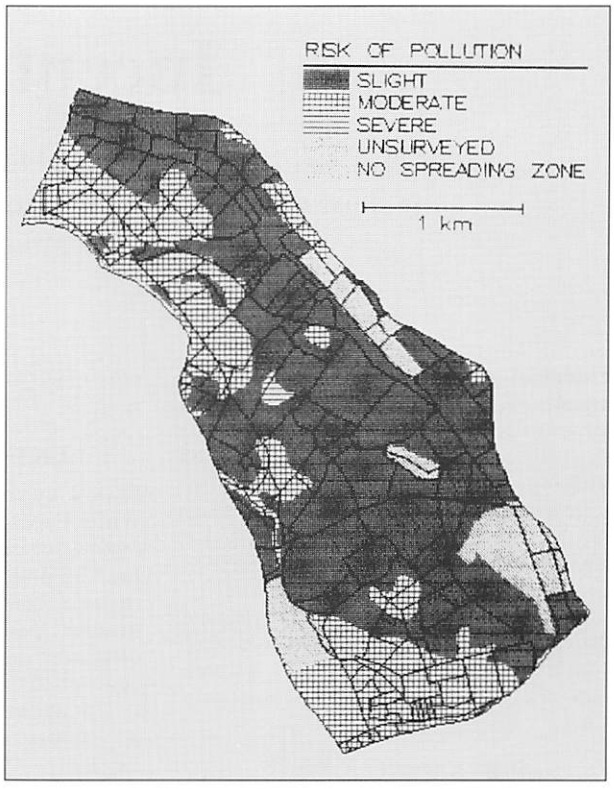

Fig 5. Slurry acceptance potential of soils in the Tom Hill district.

Table 1. The effect of changing land use and fertiliser regimes on leaching losses (in kgN/ha per year) in the Tom Hill NSA.

Land use	*Fertiliser level*	
	Current levels (average 175 kg/ha)	*Maximum (150 kg/ha)*
As in 1989	51.3	43.2
All land under cereals in 1989 as winter wheat; the rest of the area under grass	35.7	28.4
All land under grass	21.9	13.2

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Incentive Finance

Tony Reid reviews financial incentive schemes with particular reference to those designed to support innovative activity by British industry in the agricultural engineering sector.

Financial incentives are made available, under appropriate circumstances to encourage investments in R and D, capital expenditure and vocational training. Funding, which may take the form of grants or soft loans, comes from the EC, national governments and, for smaller projects, from local authorities and development agencies.

This article concentrates largely on those schemes which are on offer to support innovative activity by British industry in the agricultural engineering sector.

Single Company Research

The trend over recent years has been to concentrate R & D support on collaborative projects and, for the larger company, this is now an absolute requirement for the award of research grants.

There are, however, some schemes which are specific to SMEs (small and medium-sized enterprises) and which offer the possibility of modest grants for companies working on their own.

SPUR (Support for Products under Research)

This is the main DTI scheme for companies with less than 500 employees. It offers 30% grants of up to £150,000 to help firms develop new products and processes which involve a significant technological advance. As from April 1994, the cut-off point will be 250 employees.

SMART (Small Firms Merit Award for Research & Technology)

This scheme is directed at companies with less than 50 employees. It is competitive on a regional basis and has deadlines for applications. Stage One winners receive 75% support up to a maximum grant of £45,000. Successful firms have the opportunity of competing for a Stage Two award of up to £60,000 representing a 50% grant.

Regional Enterprise Grant

The Regional Enterprise Grant is for firms located in DTI designated Assisted Areas and with less than 50 employees. The maximum level of grant is £25,000.

UK Collaborative Research

Following the recent publication of the White Paper, 'Realising Our Potential' a number of changes to the Government's funding policy has been announced. The overall trend is to cut back on direct grants, particularly for the larger companies, and to concentrate more on the concept of 'technology foresight' which is all about increasing the industrial awareness of the nation's research capability.

The principal scheme to consider is LINK which has the prime objective of encouraging industry and the research community to work together. It is open to firms of all sizes working with universities or research centres. There are over 30 specific LINK programmes of which the following have some relevance to agricultural engineering:

- Crops for Industrial Use (including mechanical processing)
- Biochemical Engineering
- Food Processing Sciences
- Ventilation, Air Conditioning and Refrigeration
- High Speed Machinery
- Agro-Food Quality
- Technologies for Sustainable Farming Systems
- Biological Treatment of Soil and Water

Each of these programmes has its own budget and life span. The level of funding is generally 50% of eligible costs.

The Advanced Technology Projects (ATPs) scheme, which included a programme for tracked transport systems, was closed in September 1993. The Club R & D scheme is also being phased out from the standpoint of direct funding for research activity.

EC Research and Technical Development Programmes

The Community's *Third Framework Programme* (1991-94) has a budget of about £5 billion. It comprises 15 sub-programmes, each of which has a detailed work plan specifying the topics eligible for funding.

Most of the resources are devoted to supporting Shared-Cost contracts by which successful applicants are awarded 50% grants. There is an absolute requirement for projects to include partners from different Member States and application success is enhanced by having a good mix of collaborators from different countries and involving universities and large and small companies.

Unlike UK schemes, there is no requirement to show financial need for the project to proceed.

The Commission makes periodic 'calls for proposals' within each programme, generally about 12 weeks before the deadline for application. Potential applicants should make themselves aware of developments well in advance of the formal calls bearing in mind the difficulties which are often experienced in agreeing the details of cross-border research projects.

Although the Third Programme has still another year to run, most of the funds are now committed. Details of the *Fourth Framework Programme*, due to start in 1994, are now being drawn up. It is not anticipated that the Shared-Cost Contracts system will be radically changed.

The most relevant programme for the agricultural engineer will undoubtedly be Application of Life Sciences in Agriculture and Fisheries, including Agro-Industry, Food Technologies, Forestry and Rural Development.

A budget of about £350 million has been proposed for this programme. It will include:

- integrated production and processing chains;
- the scaling-up of downstream processing, including 'green' chemical engineering and the creation of a European infrastructure for pilot-scale facilities;
- the development of new farming systems.

Other programmes of relevance are:

- Environment, the new clean technologies and remedial technologies;
- Industrial Technologies, for example advanced production technologies, design engineering, advanced propulsion and traction systems;

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- Clean and Efficient Energy Technologies, for example renewable energies and biomass.

It should be remembered that there are spin-off advantages resulting from involvement in EC research projects, not the least of which is the support given in achieving EC Standards for the products developed.

As from 1994, partners from EFTA countries, such as Austria, Sweden and Norway (but not Switzerland), making up the European Economic Area, will be fully eligible to participate in this programme.

EUREKA

EUREKA is not an EC initiative. It is a non-bureacratic 'bottom-up' framework for supporting technological developments which are generally closer to the market place than the schemes mentioned above. There are no deadlines and no pre-set programmes.

To seek EUREKA support it is up to organisations from different countries to get together and to agree on a research project. The partners then apply to their national representatives for EUREKA project status. In terms of funding, it is up to the relevant governments to decide on the level of support to be given, if any, to the partners.

The EUREKA system operates effectively and can also be used for finding partners to undertake specific research activities.

Funding for UK collaborators has a nominal maximum of 50%, although, as from 1 September 1993, only firms employing less than 250 are eligible.

Examples of EUREKA projects, indicating the prime contractor, are given in Table 1.

Demonstration Projects

In addition to supporting research projects, the EC also funds so-called 'demonstration' activities. Typically, grants of 30-40% are awarded to encourage organisations to set up pilot-scale operations to demonstrate to a wider audience that processes developed in a laboratory actually work in practice. THERMIE is such a programme for promoting energy technologies including the use of biomass and waste, and improved energy efficiency in the conversion of agricultural products. LIFE is a more recent initiative aimed at supporting environmental actions; one of the priorities is the agro-food industry.

Capital Projects

Any support which may be negotiated for capital projects is likely to be based on regional policy and will have to be linked closely to the creation or safeguarding of jobs.

The main scheme in mainland Britain is **Regional Selective Assistance (RSA)**. It is highly discretionary and it is necessary to demonstrate that a grant is essential for the capital project to proceed.

The DTI Assisted Areas map has recently been redrawn with some areas of the south-east becoming eligible for the first time.

One recent example of a RSA award, announced last year, was a grant of £750,000 to Massey-Ferguson for the development of its Coventry factory.

If a factory is located in a designated Coal and Steel Closure Area, and if new jobs are being created, then grants may be supplemented by low-cost loans from the European Coal and Steel Community which has the overall objective of increasing the employment prospects of redundant coal and steel workers.

The Non-Fossil Fuel Obligation (NFFO)

Although not strictly a direct government incentive, the NFFO is an obligation imposed on Regional Electricity Companies (RECs) to secure a certain amount of electricity generated from non-fossil fuels.

This scheme includes all forms of biofuels and it is up to all renewable generators wishing to contract with the RECs to register with the Non-Fossil Fuel Purchasing Agency.

Development Aid

The EC, the World Bank and other multilateral development bodies support agreed projects throughout the developing world. Opportunities to tender for the supply of works and goods are of particular importance to the agricultural engineering sector.

The EC programmes have a particular attraction in that tendering is generally restricted to European firms. The Community also supports agricultural developments in Central and Eastern Europe and in the CIS through PHARE and TACIS programmes respectively.

All opportunities for public procurement are published in the Official Journal of the European Communities, S Series.

Applying for Incentives

Companies should, first of all, make sure that they are aware of the schemes available.

If a suitable scheme is identified, the guidelines and conditions should be carefully studied. Grant applications take time and this should be taken into account at the forward planning stage.

The principle underlying all UK state funding is 'additionality' which means that there is an absolute requirement to demonstrate that the project cannot go ahead, as envisaged, without public sector support.

For this reason, there should be no formal commitment to a project until the grant has been approved.

For large projects particularly, there are obvious advantages in using specialised consultants. They are aware of the schemes, can save management time and can maximise the chances of making a successful application.

Table 1. Examples of EUREKA projects.

Ref No.	*Project*	*Prime contractor*
EU176	Robot for citrus fruit harvesting	Industrias Albejar SA, Spain
EU266	Farming systems employing an autonomous	Arnex Navigation Systems AB, Sweden
EU303	Animal identification and registration system based on electronic transponder	Texas Instruments, Holland BV
EU317	Industrial production system for fresh yoghurt	Gervais-Danone AG, Germany
EU320	Articulated vehicle for soil preparation in arid and steep terrain	Empresa de Transformacion Agroria SA, Spain
EU331	Robot for rose plant handling and grafting	Universal Plantas SA, Spain
EU650	Automated ecological flower bulb farming	La Compania General del Azafran de Espana SA
EU820	New filtration technology for the sugar cane industry	Rhone-Poulenc, France
EU847	Biomass-fuelled power plant	Abb Energie AG, Austria

Review of recent British Standards

by M D P Matthews

BS AU50 : **Tyres and Wheels**
Part 1 : **Tyres : Section 4 : Agricultural Tractor and Machine Tyres :**
Subsection 4.1a : 1993 (ISO 4251-1 : 1992) **Specification for designations and dimensions for ply rating marked series tyres.** (9 pages)

This part of the international standard establishes the designation in use and dimensions of the ply-rating marked series of tyres for agricultural tractors and machines. Definitions of terms used follow those given in *ISO 4223-1*. The method of marking the ply rating marked series of tyres is recommended in terms of the nominal tyre width code, nominal aspect ratio, nominal rim diameter, load rating and additional information. Tables are provided for the dimensions and tolerances of agricultural drive tyres, steering tyres and implement tyres. Further tables are provided of dynamic radius indices which are used exclusively for the calculation of forward ground speeds.

Subsection 4.5 : 1992 (ISO 7867-1 : 1992) **Specification for designations, dimensions and marking for metric series tyres.** (7 pages)

Specifications in Subsection 4.1a are revised for metric series tyres for traction, steering and trailed implements covering the tyre designation codes and the relevant specifications and dimensions. Additional information is provided on the calculation of "design tyre" dimensions with tables of guideline values.

BS 5861 : 1992 (ISO 500 : 1991) **Specification for rear-mounted power take-offs on agricultural tractors.** (13 pages)

With reference to ISO Standards 4156, 4254, 6489 and 6508, this international standard specifies the requirements of type 1, 2 and 3 rear-mounted power take-offs on agricultural tractors. Standards are provided for manufacturing requirements (ie. dimensions and tolerances, shaft end shapes and hardness values). The direction of rotation, the location on the tractor and the clearance zone around the shafts are specified. The shape of the master shield attached to the tractor as supplied by the manufacturer is specified in drawing and tabular form.

BS AU169A : 1992 (ISO 3795 : 1989) **Method for determination of burning behaviour of interior materials for road vehicles and tractors and machinery for agriculture and forestry.** (12 pages)

A method specification is provided for determining the horizontal burning rate of materials used in the occupant compartment of road vehicles and of tractors and machinery for agriculture and forestry after exposure to a small flame. It is intended to provide a means of comparative testing rather than an evaluation of in-vehicle burning characteristics. Definitions are given of burning rate, composite material and exposed side. The method requires the material to be held horizontally in a standard holder within a combustion chamber and fume cupboard. The ignition flame is provided from a standard bunsen burner using gas with known calorific value. The method of taking material samples, their shape and dimensions are specified. Following a detailed test procedure, the burning rate is calculated in millimetres per minute and reported in association with all the test particulars.

BS 7560 : 1992 (ISO 8210 : 1989) **Method of assessing, testing and reporting characteristics and performance of combine harvesters.** (7 pages)

A procedure, for use in several crops, is specified for the measurement and testing of self-propelled and trailed types of combine harvester, either directly cutting or picking the crop up from a windrow. Reference is made to seventeen other ISO Standards.

The test method requires notes on the selection of the test machine, the provision of commercially available accessories desirable for the crops under test, the settings and adjustments and any departures from the manufacturer's instructions for operation. Records are required of machine details, the ground speed and the position of centre of gravity with the machine in a defined state.

Functional field tests involve observation and comment, although records are required of atmospheric conditions, field and crop conditions, work rate and fuel consumption. Measurements are required of seat vibration and the noise level in the cab. The method of carrying out capacity tests is provided in detail and the crop and field conditions have to be such that they have no detrimental affect on the functional elements of the combine harvester.

The arrangements for an optional comparison machine is specified and the requirements of a catching apparatus with conditions and procedure for use and analysis is given. Test data required and the calculations to be made are specified. The details required in the test report concerning general points, functional field tests and capacity tests are also specified.

The standard concludes with a Annex on the conduct of combine tests on sloping ground.

BS 7562 : 1992 **Planning, design and installation of irrigation schemes :**
Part 2 : Guide for acquisition of site data. (14 pages)

The basic site data to be acquired and analysed are identified for the planning, design and installation of irrigation schemes. The standard covers combinations of system design and equipment supply and installation and discusses persons and organisations involved from whom permission has to be sought or opinions consulted. Sources of information and the influences of existing systems are covered and a comprehensive guide to the site plan, climate data, soil and crops is provided. The standard also covers the system of operation and sources of water supply and its quality.

Part 6 : Guide for feasibility and instrumentation procedures. (10 pages)

This part of BS 7562 provides a guide to the format and content for proposals for irrigation schemes and requirements for equipment supply, installation and commissioning. The roles of individuals involved in scheme planning evaluation and implementation are outlined.

The terms used in Parts 2 and 6 of BS 7562 are fully defined in BS 7562 : Part 1 : 1992 Glossary of Terms.

Membership matters....

THE NEWSLETTER OF THE INSTITUTION OF AGRICULTURAL ENGINEERS

Towards a better engineer?

The routes to registration with the Engineering Council are under scrutiny. Far reaching changes are proposed which will 'scotch' the existing system of one-off registration, replacing it with a more flexible and progressive pathway to achieving certificated professional qualifications.

In 1989, Sir John Fairclough, the Chairman of the Engineering Council, initiated two major reviews of the Engineering profession – the unification issue and the Formation Review. Led by an independent Steering group, three Working Groups were set up to look at the three areas of key interest: 'Needs, Demand and Supply'; 'Structures, Methods and Means'; and 'Standards of Attainment'. Within these broad areas *ad hoc* groups addressed a range of issues.

The deliberations of the learned members of these groups are contained in a recently issued Discussion Document entitled: 'Review of Engineering Formation'. This document, all 130 pages of it, describes the changes proposed to the present system. It is set out as a discussion document should be – the details followed by a series of questions that the Working Groups need answers to before they can proceed with firm recommendations.

The essence of the new proposals is to replace the present three tier system of CEng., IEng and EngTech based on early opportunities for study, with three new categories of professional registration. The lower two will effectively combine elements of the three existing classifications but the requirements for the highest tier will be more demanding. Progression through the three grades will take place by means of credit accumulation. The credits to be accumulated will be earned not just from prior learning as is largely the present base, but also from career development – CPD. In addition it is envisaged that other essential skills such as business and communication skills, personal effectiveness and standards of conduct will all contribute towards the required number of credits to allow progression to take place.

Accompanying the discussion papers is a section devoted to supporting information, statistical data and the like. Browsing through this section soon makes one realise the need for a review of our profession. Bar-charts and graphs depict the standing of UK engineering training and development against our competitors, and we fare poorly. Much of this poor performance can be attributed to the unfortunate image held by UK youngsters which discourages them from making the 'right' choice of career when at school. That problem is being addressed by a variety of initiatives which take our profession into schools and 'show it as it is'. The new proposals have the potential to put engineering firmly back on top of the career choice list as a vocation with esteem. Like the NVQ System which is gradually (ever so !) grinding its way into our lives, a competence-based system of progression is to be welcomed. One hopes and prays, though, that the Engineering Council employs a far less bureaucratic method of competence recognition than the NCVQ. The sheer volume of paper and the 'gobbledygook' contained thereon has to be seen to be believed in the preparation of evidence for NVQ's with the result that the benefits of that system have largely been clouded before even partial acceptance by the industry.

If you wish to have your say in these changes, a copy of the discussion document is yours for the asking and an A4 80p sae from the Engineering Council, 10 Maltravers Street, London WC2R 3ER.

Towards a better future

Hard on the heels of the Code of Professional Practice on Risk Issues published by the Engineering Council (see Membership Matters, Spring 1993, and below) comes the second in the series – the Code of Professional Practice on Engineers and the Environment. The nine-point code (more details of which are presented on page 97 of this issue of the journal) comes into force on March 1st 1994. It lays down guidelines to encourage greater awareness, understanding and effective management of environmental issues. The products and processes devised by engineers must, in the future, safeguard the environment.

Engineers must demonstrate to the world that they care about the world. Projects and practices must be energy efficient and waste must be minimised to conserve materials. Environmentally cost-effective solutions must be sought and employed wherever possible. At the launch of the Code in October, Dr David Fisk CEng., Chief Scientist at the Department of the Environment implored engineers to build environmental considerations into the mainstream of their thinking. The Code is soon to be circulated to all engineers registered with the EC.

..... and below: the Working Party responsible for the formulation of the Code of Professional Practice on Risk Issues have invited institutions to approach them for speakers on this topic. Contact Robert F Eade at the Engineering Council in the first instance if you are looking for such a speaker.

Membership Survey

The questionnaires are still arriving: 485 so far, and a few more arrive each day. That means that about 25% of our members have responded. Thank you to all of you.

We are now collating the information and reading the comments. One or two people showed their skills as cartoonists, and several wrote long sentences which wormed their way around the margin of the paper. Nearly a quarter of the respondents read 100% of the Journal, and well over half read 50%. Some 5% thought it too basic, whereas 78% thought its content about right.

We will certainly be extracting the information from the survey in the coming weeks, and publishing the results in the next issue of the Journal. Your replies and comments will help us steer the Institution over the next few years.

Michael Hurst – Secretary

Admissions – A warm welcome to the following:

Fellow J E Owen (Berks) (Re-Admission)

Associate Member T B Adhikarinayake (Sri Lanka); E F Asante (London); C Heaney (Scotland); K Leung (Tyne & Wear); V P Redfern (W Midlands); R S Rout (Oman); G P Wardle (London)

Associate A J Nagy (Surrey)

Student S J Dicks (Northants); N A L Gunn (Essex); B Helleren (Norway); A Kaminski (Scotland)

Transfers – congratulations on achieving the next step

... to **Member** C L E Dyer (Cornwall); B A Kendall (Wilts)

... to **Associate Member** A J Cochran (Scotland); A J Humphry (Somerset); P S Kinloch (Scotland); P J M Krause (Scotland); C A Stark (Northants); D A Yates (Notts)

... to **Associate** S Barraclough (Staffs); S T Bello (Tyne & Wear); J A Blake (Surrey); R J Brindle (Scotland); J E Brown (Cambs); T J Clark (Dorset); G A Clyne (Scotland); P A Dawson (Yorks); R G Donald (N'umberland); M P Duggan (W Sussex); M D Fallon (Wilts); S J Farley (Yorks); D E Gerrard (Yorks); A J Hambley (Scotland); N Hammond (Worcs); S Haresign (Bedford); J C A Henry (Scotland); T E Horlock (Herts); T A Ijir (Hants); F U H Khan (Tyne & Wear); M McLeister (Scotland); B J Magee (N Ireland); J G Martin (Scotland); S G May (Cheshire); A-T Menghistu (Essex); R J Merrall (Dorset); M J Millard (Glos); J Miller (Scotland); J Monro (Scotland); S R Moon (Glos); N P Morris (Wales); Z Nedic (Shrops); C D Nicklin (Derbys); R M Nutt (Suffolk); S R A Pullar (Scotland); B Reid (Scotland); C Reilly (Essex); D J Robertson (Scotland); A J Sadler (Scotland); L G Shail (Worcs); M Shipp (W Sussex); R B Silvester (W Sussex); B W Simpson (Cambs); M W Spry (Wales); M J Symonds (Worcs); T Templeton (Scotland); H G Thomas (Wales); M J Wattam (Tyne & Wear); K-L Weiner (Bedford); M Whiting (Shrops); C J Wigglesworth (Yorks)

Resignations – thank you for your support, we wish you well.

D J Gliddon (Somerset); S R Hunt (Oxon); A C Mwitwa (Zambia)

Deaths – with sadness, and sympathy to those left behind

J A Doel (Worcs); P G Finn-Kelsey (Hants); E J Bals (Hereford)

Engineering Council registrations – congratulations to the following on their election to the grade indicated

CEng F G Ward (Lincs); I J Yule (Durham)

EngTech J A Cambridge-Clarke (Essex); A L Donald (Lincs)

Movements – the following have moved

N J D Adley (Oxon to Notts); L D Ascott (London to Notts); D C Black (Hereford to Swaziland); R A Boak (W Midlands to W Sussex); R Brewer (Cambs to London); I S Burrowes (W Midlands to USA); J A Cullen (Zambia to Scotland); J B Devereau (Beds to Herts); M P Duggan (W Sussex to Tyne & Wear); L J Edwards (Bucks to Tanzania); D S Elsworth (Yorks to The Netherlands); C D Fullerton (Yorks to Scotland); R C P Green (Beds to Shrops); W Hancox (Beds to Scotland); L L Kaluba (Beds to Zambia); M McLeister (Scotland to Norfolk); A Mulder (Netherlands to Spain); L B Ollier (Singapore to W Midlands); J A Sartain (Kent to Notts); J F Scott (Indonesia to Wales); B W Simpson (Shrops to Cambs); I K Smout (Cambs to Notts); M W Spry (Wales to Devon); T F Stephens (Essex to Ivory Coast); R N Walker (W Midlands to Glos); K C Ward (Beds to Barbados); C Wingfield-Hayes (Sussex to Scotland).

Obituary

Ray J Fryett, CIAgrE

Ray Fryett, Institution member for over 25 years and Secretary for 12 years, died on November 8th after a short illness. He was 74.

Ray was held in high regard by those who knew him. The survival of the Institution in the 1970's is still remembered as being largely Ray's doing, and we therefore owe him a particular debt of gratitude.

His period as Secretary covered the Finniston Inquiry and the formation of the Engineering Council, with the consequent new legal and administrative processes required of an affiliated Institution. He took to it all with enthusiasm and competence, and even though he had retired in 1985, demonstrated from the floor of the most recent Annual General Meetings that he had lost none of his grasp of legal and administrative niceties.

Ray had spent upward of 30 years in the agricultural industry before he became Institution Secretary. His early years were in the flour milling, grain, seed and animal feed trades. He was afterwards in road transport contracting, arable and fruit farming, and farm machinery. The war claimed six years, four of which were spent in the Middle East, and he served four years after the war in commerce in Nigeria. Later, he was with the BP Group, where he pioneered the application of liquid petroleum gas to intensive animal production, and animal fodder and human food conservation under tropical and temperate conditions.

In addition to being a Council member and later Institution Secretary, Ray was secretary of the Douglas Bomford Memorial Trust for 17 years. He was given the unusual honour in 1979 of direct election, for outstanding services, to Companion: in effect, elevation on Institution initiative rather than by his own application. In private life he was a keen sportsman and had been a hockey umpire at international level.

We extend our condolences to Muriel, herself well known in the Institution and a loyal supporter, and their family. Ray will be missed by many people.

Brian Finney, 8 November 1993.

Institution Awards

The excellence of the workmanship tipped the balance in the annual *West Midlands Branch Award* to the maker of the Best Project at the Warwickshire College of Agriculture. The 1993 winner was **Jason Bayley,** a farmer's son from Derbyshire and a student on the Maintenance and Repair of Agricultural Machinery course. His project was a big-bale grab, now put to good use on the family farm.

The twelve projects submitted gave the judges, Lyndon Hughes and Bob Voss, a hard time – such was the quality of the entries. The Award, a beautiful model of a 'grey Fergie', was presented at the annual College Awards ceremony.

Following yet another sell-out symposium (see report elsewhere in these pages) the Forestry Engineering Specialist Group have announced this year's winners of the *FESG Student Awards.* Two £100 awards were made this year, one to **Britt Helleren** for her undergraduate project on the hydrology of Loch Lomond, the other to **Dunstan Shemwetta** for his work on the dynamic core penetrometer which assesses the strengths of roads.

These projects, and those that were not successful, clearly demonstrated the wealth of latent talent within our student population. By encouraging students to expand on their ideas, however radical, the industry will be ensured of a steady flow of fertile minds into the ranks. All credit to the FESG for their initiative.

Details of the entry conditions for the 1994 Awards are available from Geoff Freedman, Forest Enterprise, 231 Corstophine Road, Edinburgh EH12 7AT.

More from the field

I am pleased to say that I have received some letters from UK members as well as from overseas and wish to thank all those who have taken the time to write to me. I am sure that these news items will be of interest to many members of the Institution.

Honours

Carl Boswell, *who recently retired from his post as Chief Agricultural Inspector with the HSE, informs me that in the Birthday Honours List he was awarded the CBE. He also holds the Territorial (Officer) Decoration. Well done Carl !*

Pollution prevention

R J Nicholson (Nick) *was ADAS's Regional Mechanisation Adviser in the South West for fifteen years. He has become increasingly involved in engineering aspecrs of handling and storing farm wastes and in 1991 was a key figure in the production of MAFF's Code of Good Agricultural Practice for the Protection of Water.*

Nick moved in May 1992 to the ADAS Soil and Water Research Centre, based at Anstey Hall, Trumpington, Cambridge, and he specialises there in R & D on the impact of land-based industries on the environment. As Senior Research Consultunt, he is responsible for co-ordinating a large programme of work on minimising pollution from farm wastes. He is also involved in advising MAFF's Environment Protection Policy Division on technical aspects of farm waste.

Cymru Consultant

Bill Butterworth *has moved to Canal House, Manhilad, Pontypool, Gwent. His business is now strategic planning in marketing, business planning and manufacturing. He is particularly active in helping stave off financial crisis and expand into new markets. Other professional services include exports, environmental assessment, litigation support and promotion planning. Spheres of activity cover agricultural engineering, food, waste management and renewable fuels. We wish Bill well in his new venture.*

Plain English

The Advisory Committee on Pesticides' Annual Report for 1992 includes a section dealing with the work of the Label and Container Design Panel which is chaired by **John Summerscales** *of the HSE. John is an Area Director/Deputy Chief Agricultural Inspector based in Preston and he sees the work of the Panel as making an important contribution towards pesticide safety. The report covers a whole range of important improvements in the packaging of pesticides. Ongoing work anticipates close integration of container design with closed application systems, and a need to further improve labelling so that instructions are in plain English and to a logical sequence.*

Dark dealings in Shropshire?

For the past four years, **Richard Green** *has been carrying out research at Silsoe College into the computer control of agricultural machinery. At the end of September, after submitting his PhD thesis, he moved to Harper Adams College to work as a lecturer. He tells me that on his first night in Shropshire he was co-opted on to the Wrekin Branch Committee and blackmailed by Geoffrey Wakeham into helping David White co-ordinate the Wrekin Young Engineers Section.*

(Blackmailed? By Geoffrey? Surely not! He's much too nice a man for that! "Encouragement with incentives" – maybe! Ed)

Sponsorship deal?

Mark Spry, *who this year obtained a degree in Environmental Engineering at the University of Wales, Cardiff, had intended to go on immediately to Southampton University to study Irrigation Engineering but, unfortunately, missed out on SERC funding. He is now working on a 6 month contract for Pell Frishmann Water Ltd on the evaluation of drainage area studies. Mark tells me that, after the end of this contract, he hopes to work in some branch of water/drainage engineering before returning to college to study irrigation in October 1994. He would particularly like to hear from any company wishing to sponsor him.*

(Any offers out there? Ed)

African experiences

Tim Stephens, *who left Swaziland last year after working on earth dams, went to Nigeria for six months also to work on an earth dam. He has now moved to the Ivory Coast where, as a Senior Irrigation Engineer with the ADB in Abidjan, he is responsible for irrigation projects funded by the bank in Africa north of the equator. Tim would be grateful to hear from any members who may be in the area. He can be contacted at: African Development Bank, 01 BP V 316, Abidjan, Ivory Coast.*

I have had a very long and interesting letter from **Tim Reeves** *who is working under the auspices of VSO as Projects Officer at the Leprosy Centre, Uzuakoli, Nigeria.*

The Leprosy Centre is developing to provide many things for the local community including not only the treatment of leprosy but also TB, eye care, care of motherless babies and as a general hospital. The Centre is also concerned with training patients in local craft skills after treatment.

Tim works for the Director of the Centre and is responsible for the project and factory supervisors and staff. He has to manage the technical activities which include artificial limb making, shoe making, akwette weaving, cane craft, printing, carpentry, mechanics (mainly cars), farm, piggery, palm oil mill, rabbit breeding, roof tile factory and toy factory.

In addition to providing a training service for patients, many of the projects also generate income for the Centre and therefore strict financial control is required. im also has to deal with the many suppliers and funders of various activities at the Centre.

As the Centre relies on charity for much of its income, public relations and accurate performance data are very important. (What do you do in your spare time, Tim?! – Ed)

Tim would welcome advice, comments and suggested sources of funds from any interested members of the Institution and would be glad to pass on further information about the work of the Centre. Any offers? Surely Tim deserves support!

We have further news of **Dr Eric Paul Whiteside** *who, as reported in the Summer edition of the Journal, is a Coffee Agronomist in Northern Tanzania. The work involves advising on better coffee processing techniques and giving advisory support to the Ministry of Agriculture Extension Services. The Project is financed by the EEC. Paul has worked in Tanzania for over 35 years on agricultural projects.*

Sounds idyllic ...

Keith Ward *has recently moved to Barbados. He has been seconded by Booker Tate Ltd to the Barbados Agricultural Management Co Ltd to take up the position of Agricultural Manager.*

(... but is it so? Let Tony know Keith. Indeed, to you all, whatever you are doing, however mundane it may seem to you, to other members it adds another piece to the colourful jigsaw of our profession. – Let Tony know – drop him a line or two – his address is 32 Beverley Crescent, Bedford MK40 4BY – Ed).

We hear that ...

Dr Bill Day of Silsoe Research Institute has been made a Special Professor of Agricultural Engineering at the University of Nottingham. *A reward for endeavour!*

Geoffrey Burgess, Managing Director of Parmiter Ltd, has been appointed to the board of directors of Charterhouse Turf Machinery.

Roger Walker, lately the Managing Director of the Benson Group Plc, has taken up a similar position with SEM Engineering Ltd of Basildon, Essex.

Specialist List

The Institution maintains a list of corporate members practising as consultant engineers. Any member wishing to be included on the list should send their details to the Secretariat (the format can be found on page 23 of the Members' Handbook and Buyers' Guide). Those received by the end of January 1994 will be included with the next Press Release.

Your Witness ...

The UK Register of Expert Witnesses is a publication intended to provide solicitors and the like with a source of quality experts for them to use in their legal beaverings. The sixth edition is now in circulation, the seventh in the process of compilation. Members who are interested in being included on the register are invited to contact Dr Christopher Pamplin, the Editor, at JS Publications, Goodwin House, Willie Snaith Road, Newmarket, CB8 7SQ. The cost of inclusion is £17.50 + VAT per annum.

ADAS under the microscope

The future corporate status of ADAS is being investigated by the Ministry of Agriculture. The Rt. Hon. Gillian Shephard MP, Minister of Agriculture, Fisheries and Food announced the study in September as the first step in the commitment of the government to privatise this service. *Watch this space!*

New environmental research project

A new £300,000 joint Government and industry project has been agreed under the Ministry's collaborative programme of research with industry on sustainable agriculture.

The aim of the project is to develop the use of the whole cereal plant, including the straw and stems, as livestock feed. Falling grain prices are expected to make their use more attractive.

The Ministry is contributing half the cost of the project.

Going public

The West Midlands Branch, ever on the look out for new routes to members, took the initiative and recently booked some space at a careers event at Moreton Morrell College – the Warwickshire College of Agriculture. The Branch Committee reviewed the results and deemed it to have been a worthwhile exercise, one worth repeating. It certainly puts our Institution in the minds of aspiring engineers, hopefully to influence their choice of discipline.

Bob Voss on duty on the West Midlands' stand at a recent careers event.

Are any other Branches employing similar tactics? If not, then here is another West Midlands' lead that others would do well to follow.

Branch Publicity Officers please note.

Shortwood not short on interest

The Forestry Engineering Specialist Group have done it again! Another very successful symposium, this one on the 'Alternatives to Shortwood'. I'm sure those in this area of our interests understand that title, certainly the attendance suggests that is the case and that the forestry industry is hungry for ideas on the alternatives. More than 120 delegates heard six eminent speakers cover the topic, those delegates represented the entire industry.

Under the auspices of Roger Hay, Chairman for the day and Chairman of the FESG, the proceedings went without a hitch. Principle members of the organising team were Geoff Freedman (FESG Secretary and Treasurer), Margaret Shearer and Jim Christie. The warm and enthusiastic response of the delegates suggested that they felt the time spent had been worthwhile.

Altogether this was a very well worthwhile event, so, if you missed this one but would like a copy of the papers then write to Geoff Freedman, proffering a cheque for £10 made out to the Forestry Engineering Specialist Group. Do it quickly, though – the supply is limited. Geoff's address is: Forest Enterprise, 231 Corstophine Road, Edinburgh, EH12 7AT.

Make a note in your diary for next year's event – same time, same place on 1st September, 1994.

New name for AFRC

On the 1st April 1994 the Agricultural and Food Research Council will become the Biotechnology and Biological Sciences Research Council.

August Claas research award

Claas OHG, the leading German combine and green harvest manufacturer is to sponsor a research award in renewable resources. The award has a maximum value of £20,000 and will be awarded to one or more students or scientists working in the forefront of research into the use of renewable resources.

Rules of entry are available from Claas OHG Research and Development Group, Dept V, 33426 Harsewinkel, Germany.

Closing date is 31st December, 1993.

Branch/Specialist group Meetings 1993/94

Meetings already advised (please see Membership Matters, Autumn 1993) are not repeated in the following list.

January		
10	**Innovative Innovations** – Mr R Balls, ADAS *West Midlands Branch* – Warwickshire College of Agriculture	M Sheldon 0926 651367
February		
17	**Specialist design of machinery in agriculture** – Mr S Skurray *Southern Branch* – Shillingford Bridge Hotel	O Statham 0865 714455
March		
9	**AGM** 7.00 pm, – followed by Dinner – 7.30 pm *Southern Branch* – Wessex House Hotel, Sherfield on Lodden	O Statham 0865 714455
14	**AGM**, followed by **Grain storage in Syria** – Mr D Williams, *West Midlands Branch* – Pershore College of Horticulture	M Sheldon as above
14	**AGM** 7.00 pm *East Anglia Branch* – Brome Grange Hotel	B Bell 0473 890456
17	**AGM** 7.30pm, followed by **Farm waste management** – Dr I Svoboda *Northern Branch* – Carrol House Hotel, Carlton, Carlisle	P Rogers 0388 814141

Lost Members

I give below a list of members and their last known addresses, with whom we seem to have lost contact. If any member knows their whereabouts would they please contact the Secretariat.

C S Balaratnam – Food Research Institute, Werribee, Victoria 3030, Australia.
D R Hendrikz – 65 High Street, Greenfield, Bedford MK45 5DD.
J Miller – 43 West Edith Street, Darvel, Ayrshire KA17 0EE.

BS 7459 : 1991 **Rotating sprinklers for irrigation equipment.**
Part 1 (ISO 7749-1 : 1986) : **Specification for design and operational requirements.** (7 pages)

This ISO standard applies to sprinklers intended for assembly in pipe-line networks, for irrigation in agriculture and horticulture when operated at pressures recommended by the manufacturer. Seventeen technical terms associated with the sprinkler, its use and test are provided along with specifications for the design and construction of sprinkler heads. Test procedures (and their specified conditions) are provided for strength and general design, operation and durability. Information required from the manufacturer in terms of permanent markings on the nozzles and general and operating data is specified. The standard concludes with an Annex showing the rates of flow from a range of nozzles and a method of calculating the equivalent nozzle diameter.

Part 2 (ISO 7749-2 : 1990) **Methods of test for uniformity of distribution.** (6 pages)

General test conditions are specified in terms of the test area layout, the design of collectors and the installation of the sprinkler under test. Atmospheric conditions to be measured and their limitations on the test are specified. A formula is provided for the calculation of application rate and procedures are provided for full field and radial methods of test. An Annex provides a formula for calculating the coefficient of distribution uniformity for the comparison of different sprinklers under varying operating conditions.

BS 6356 : 1992 **Spraying equipment for crop protection :**
Part 5 (ISO 9357 : 1990) : **Specification for tank nominal volume and filling hole diameter.** (1 page)

A table provides specifications for the diameter of the filling hole and the contents' gauge scale for nominal tank volumes between 1 litre and 1,000+ litres for hand-held, mounted, trailed and self-propelled sprayers fitted with tanks without over-pressure for crop protection.

Part 6 (ISO 10626 : 1991) : **Specification for connecting dimensions for nozzles with bayonet fixing.** (1 page)

The connecting dimensions for flat fan spraying nozzles of agricultural sprayers are specified to allow interchangeability. The dimensions are specified in a figure and reference made to *ISO 8169 : 1984 : Connecting dimensions for nozzles and manometers,* which also provides the dimensions of the nozzle body.

Part 7 : 1993 **A guide for typical data sheet layout.** (17 pages)

This British Standard applies to the provision of information by manufacturers and importers of non-air assisted agricultural sprayers whether mounted, trailed or self-propelled as used for the protection and/or fertilisation of crops.

BS 6911 : 1992 **Testing earth-moving machinery :**
Part 6 (ISO 8813 : 1992) **Method for the evaluation of lift capacity of pipe layers and wheel tractors or loaders equipped with side boom.** (16 pages)

A uniform calculation method, with a validating test method, is provided for the rated lift capacity for pipe-layers and wheeled tractors or loaders equipped with a vertical-only pivoted hydraulic or mechanically operated side boom, having a lift capacity greater than 10,000N. Reference is made to six other ISOs and 28 terms involved are defined. Performance requirements are specified in terms of the rated lift capacity and the design of the hoist mechanism. The method of expressing the rated lift capacity is also specified along with a rated lift capacity chart so that it can be clearly identified at specific machine configurations and overhang positions. Eight figures are provided to illustrate machine configurations and measurements.

Part 7 (ISO 9248 : 1992) **Specification for units of measurement and tolerances.** (2 pages)

A table is provided which indicates the basic and derived units to be used in the measurement of dimensions, performance and capacities of earth moving machinery. It also shows the symbols to be used and the tolerances allowed in the measurements.

Part 8 (ISO 10266 : 1992) **Determination of slope limits for machine fluid systems operation (Static test method).** (3 pages)

This international standard evaluates the performance parameters that limit the static slope capability of machine fluid systems operation (ie. engine, power train, fuel and oil systems). The testing can be conducted on a torque platform or prepared slope surface. Suitable equipment is required to restrain the machine in a safe position and to monitor the pressures and temperatures in the fluid systems and to measure the slope. Recommendations for the preparation of the machine are made and the test procedure is specified in order to establish a maximum slope on which the machine can operate without malfunction or damage. An Annex provides a model test report.

BS 6912 **Safety of earth moving machinery :**

Part 4 : 1991 (ISO 10264 : 1990) **Specification for key-locked starting systems.** (1 Page)

A specification is provided for the requirements and location for a key-locked starting system to avoid unauthorised starting of earth moving machinery. Basic requirements are listed for ignition switches, locking devices and the manufacturer's instructions.

Part 5 : 1992 (ISO 2860 : 1992) **Recommendations for minimum access dimensions.** (4 pages)

Minimum dimensions of openings for access of hand(s) (single and two-handed), head, body and arm are specified for both normal and arctic clothing and/or when wearing a hat or helmet. The standard ensures that openings are adequate for inspection, adjustment and maintenance by personnel in the field or workshop. Specific reference is made to *ISO 3411 : 1982 Earth moving machinery - human physical dimensions of operators and minimum operator space envelope.*

Part 6 : 1992 (ISO 3449 : 1992) **Specification for falling-object protective structures on earth moving machinery : Laboratory tests and performance requirements.** (8 pages)

A specification is given for laboratory tests to establish a consistent repeatable means of evaluating the characteristics of falling-object protection structures (FOPS) under loading. It is relevant to crawler loaders, wheel loaders, back hoe loaders, crawler and

wheel tractors, graders and tractor-scrapers. Reference is made to seven other ISOs and definitions are provided of the terms involved. The apparatus required for the laboratory test is specified and the deflection limiting volume requirement is specified. The test conditions and procedure are specified with diagrams of drop-test impact points. The performance requirements are provided and the necessary labelling for satisfactory structures is shown. An Annex provides the lay-out of typical test reports.

Part 7 : 1992 (ISO 3164 : 1992) **Specification for laboratory evaluations of roll-over and falling-object protective structures : The deflection limiting volume for earth moving machinery.** (3 pages)

This standard specifies the deflection limiting volume used in laboratory evaluations of roll-over and falling-object protective structures, the accuracy of measurement and the method of location. Two figures are provided for illustration.

Part 8 : 1992 (ISO 10570 : 1992) **Specification for performance requirements of an articulated frame locking device.** (1 page)

The performance requirements are defined for an articulated frame locking device to prevent unintended articulation of the machine during either shipment or maintenance. The mounting position, its attachment to the machine, its colour and its performance when a force is applied are specified.

Part 10 : 1993 (ISO 5010 : 1992) **Specification for steering capability of rubber tyred, earth-moving machines.** (7 pages)

This international standard relates to rubber tyred, self-propelled, earth-moving machines capable of a speed greater than 20km/h and applies to tractors, loaders, back-hoe loaders, excavators, dumpers, tractor scrapers and graders equipped with either manual steering, power assisted steering or fully-powered steering. The definitions of 13 terms involved in machine steering systems are provided. The general requirements for steering systems and control are laid down including allowances for operation under panic conditions, machines with rear-axle steering, machines that have speeds in excess of 20km/h in reverse and disturbances to the steering system due to external forces. The ergonomic requirements of steering systems are specified involving maximum steering efforts and other factors effecting the movement of the steering control. The performance requirements are stated and general steering tests, a steering test course and a tyre circle test procedure are described. Specifications are given for machines under test. Diagrams are provided for the test course and tests of emergency steering response.

BS 6913 : **Operation and Maintenance of Earth-moving Machinery :**
Part 7 : 1991 (ISO 8927 : 1991) **Glossary for machine availability.** (19 Pages)

This standard, which is printed in both English and French, defines the commonly used terms relevant to the availability (ie. the probability of a piece of equipment being operable when required) of earth-moving machinery so as to assist in the understanding of the terms. The standard relates to all earth-moving machinery as defined in ISO 6165. Definitions are provided under the following headings: Availability Terms, Reliability Terms, Failure Terms, Serviceability Terms and Time Terms. The standard provides 80 different term definitions and an Annex provides information on the relationships between terms.

Part 8 : 1992 (ISO 6405-1 : 1991) **Specification for common symbols for operator controls and other displays.** (30 pages)

This standard establishes the common symbols, independent of language, for use on operator controls and other displays on earth-moving machinery. The symbols are also relevant to other types of self-propelled work machines designed to operate off public roads. Guide lines are provided for designers incorporating the symbols on machinery to maintain the clarity of reproduction and the visual perception by the operator. The guide lines include such points as line thicknesses and actual size. The conventions used and their derivations are indicated. The use of colour on illuminated displays and other symbols is specified. The definition of 140 symbols is provided, each with its ISO/IEC registration number.

BS 4964 : **Symbols for control markings and displays on tractors and machinery for agriculture and forestry and on powered lawn and garden equipment :**
Part 1 : 1993 (ISO 3767-1 : 1991) **Specification for common symbols.** (30 pages)

A total 132 symbols are specified in a similar manner to those specified in *BS 6913 : Part 8 : 1992.*

Part 2 : 1993 (ISO 3767-2 : 1991) **Specification for symbols for agricultural tractors and machinery.** (16 pages)

A further 65 symbols are specified as would be found on harvesters and bucket-loaders, presented in a similar manner to *BS 6913 : Part 8 : 1992.*

BS 5453 : 1992 (ISO 3776 : 1989) **Specification for anchorage for seat belts in protective cabs and frames on agricultural tractors.** (3 pages)

The location requirements of anchorages for pelvic restraint belts in agricultural tractors, along with the force that the anchorages have to be capable of withstanding and the necessary tests are specified. The anchorages themselves are detailed in terms of the choice of location and the position relative to the seat index point, the webbing angle to the horizontal and the dimensions of threaded holes. The test detailed is a static tensile force and the procedure and performance requirement are specified.

BS 6347 Performance assessment of agricultural tractors :
Part 7 : 1993 (ISO 789-7 : 1991) **Method for determination of axle power.** (11 pages)

Test procedures are specified for determining the axle power of wheeled or track-laying agricultural tractors with one or two driven axles. Four relevant terms are defined along with ten units of measurement and tolerance allowed during recording. The preparation for the tractor test is specified including tractor engine adjustments, fuels and lubricants, the procedures regarding ancillary equipment, atmospheric conditions and fuel consumption measurements. The test procedure which involves all driven axles of the tractor coupled to the dynamometer is detailed including the limits on angularity of drive shafts, requirements for exhaust gas discharge, the choice of transmission ratios and the control of speeds and torques. Required measurements are shown with a proforma table of results. A test report specimen is provided for recording the tractor specifications and three other Annexes specify reference fuels. A bibliography lists 24 other standards.

Part 8 : 1993 (ISO 789-8 : 1991) **Method of testing engine air cleaners.** (7 pages)

Reference is made to *ISO 5011 : 1988 Inlet air cleaning equipment for internal combustion engines and compressors – performance testing*. However, BS 6347 : Part 8 includes further test factors (vibration, resistance to fibrous material, resistance to moisture and the effectiveness of safety elements which are designed to block rapidly in the event of a leak in the primary element) in recognition of the special conditions under which engine air cleaners have to operate when fitted to agricultural tractors. A test rig is specified for the vibration assessments along with an eight stage test procedure. Similar procedures are specified for the other three factors. Two materials and their methods of preparation are specified for the test of the effects of fibrous material on the air cleaner. Tests are also included to determine the performance of oil bath air cleaners at severe angles of pitch and roll and automatic dust unloading valves. An Annex provides a test report layout for resistance to vibration and to moisture as an addition to the test report shown in *ISO 5011 : 1988*.

BS 6108 : Part 1 : 1993 (ISO 6489-1 : 1991) **Couplings on agricultural towing vehicles : Part 1 Specification for hook-type.** (2 pages)

The dimensions and positioning of hook-type couplings used in agriculture are specified for use with trailed equipment with a hitch ring complying with ISO 5692, up to a static vertical load of 30kN. The dimensions and locations are described and illustrated.

BS 4742 : Part 2 : 1993 (ISO 5675 : 1992) **Hydraulic equipment for agricultural machinery : *Part 2* Specification for quick action hydraulic couplers for general purposes.** (3 pages)

The essential interface dimensions and operating requirements for the hydraulic couplers used between agricultural tractors and machinery are specified except those used for braking circuits. Reference is made to *ISO 7241-2 : 1986* which covers the testing of quick action hydraulic couplings. Dimensional requirements are identified and detailed in tables. The operating requirements are specified in terms of the maximum allowed pressure drop, maximum pressures when coupled and disconnected, the forces required to connect and disconnect and the maximum spillage of fluid allowed in the process. A specification for the mounting positions of couplers on both the rear and front of tractors is given.

BS 5947 : 1992 (ISO 5700 : 1989) **Method of test for static loading of protective cabs and frames for agricultural wheeled tractors including acceptance conditions.** (17 Pages)

A test method and the acceptance requirements for the static loading of protective structures used on wheel tractors in agriculture and forestry are specified. It is relevant to pneumatic tyred tractors with two or more axles and a mass of 800 - 1500kg. Reference is made to three other ISO Standards and seven definitions are provided of terms used within the tractor and test. Apparatus is described for tests involving horizontal loads and crushing loads and the method of preparing the tractor and its protective structure is detailed. A sequence of tests is specified involving longitudinal loading, crushing and side-loading followed by a second crushing test and a second longitudinal loading. The load application methods and positions are specified for each stage including the point at which the test is stopped. This standard adopts the seat index point (SIP) for the record of seat positioning in preference to the earlier standard seat reference point (SRP). With the aid of nine figures, the forces to be applied and the required clearance zones are detailed, along with the tolerances allowed on measurements. Acceptance conditions are specified including the application of an overload test. Conditions under which an accepted structure can be used on another tractor model are listed and specifications are provided for labelling and the presentation of test reports. An Annex shows the requirements for providing resistance to brittle fracture of protective structures at reduced operating temperatures.

BS 7620 : 1993 (ISO 9982 : 1991) **Specification for industrial belt drives - dimensions of pulleys and V-ribbed belts of PH, PJ, PK, PL and PM profiles.** (7 pages)

Diagrams and tables are provided for the shape and dimensions of pulley grooves and of drive belts for the above profiles. The determination of pitch diameter and the measurement of effective belt length is detailed.

BS 7535 : 1992 **Guide to the use of electrical apparatus complying with BS 5501 or BS 6941 in the presence of combustible dusts.** (57 pages)

Guidance is given on the selection, installation and maintenance of electrical apparatus systems used in explosive gas atmospheres, caused from combustible dust but excluding that from materials regarded as explosive. The criterion of acceptability and 22 terms are defined and the classification of hazardous areas, the properties of combustible dusts and their potential hazards are discussed. Separate sections are provided on the selection of apparatus and systems, installation, inspection, testing and maintenance. Appendices include procedures for area classification, the properties of combustible dusts, the frictional sparking risks of light metal construction, selection of increased safety motors, intrinsically safe installations and their certification, combinations of earthed circuits and screens and a test to ensure that the performance of restricted-breathing enclosures are maintained after installation.

Copies of British Standards

are obtainable through libraries or can be purchased direct from :

British Standards Institution (Sales),
Linford Wood,
Milton Keynes,
Bedford,
MK14 6LE
tel : 0908 220022 ; fax : 0908 320856

Mike Matthews is Commercial Officer at Silsoe Research Institute, Silsoe, Bedford

Patch spraying

Mark Paice

Précis of Paper at the Machinery Management Specialist Group's Conference*
'Crop Sprayers – What Now, What Next?'
held at Silsoe College on 26 October, 1993.

Decisions on appropriate dose rates when applying herbicides are usually made on the basis of whole field weed infestation. However, the trend towards larger fields, made by the joining of several smaller ones, has led to uneven field weed distribution. It is also known that some weed species tend to form patches, and work carried out at Rothamsted Research Institute has shown that these patches can remain stable over several years.

A combination of high costs and environmental / legislative pressures encourages reduced herbicide input. One possible method of reducing inputs whilst maintaining adequate weed control is patch spraying, which can be defined as the **'spatial variation of herbicide dose according to weed density'.**

The realisation of this concept requires the blending of two elements; (a) identification of the weeds and (b) control of the sprayer.

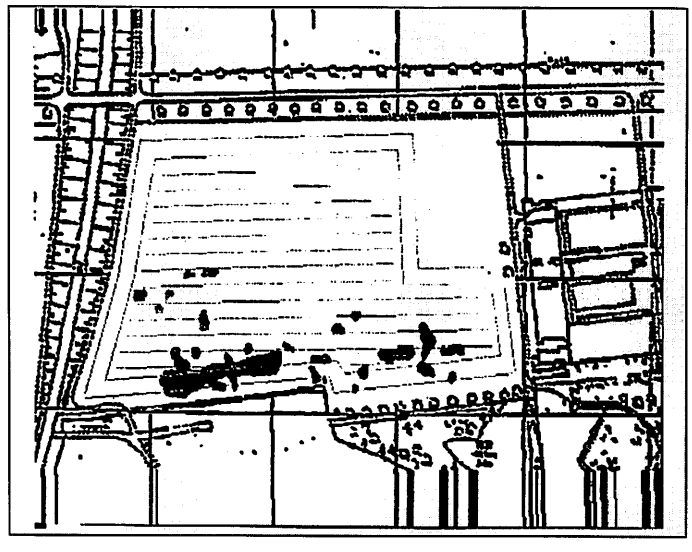
Weed identification

One approach is real time identification of weed plants combined with real time control of dose. This technique is exemplified by the Australian W.A.S.P. and the American Weed Seeker systems. Generally these types of system are only capable of distinguishing between photosynthetic and non-photosynthetic material. Systems to distinguish weeds from crop or even to distinguish between weed species will require much more sophisticated multi-variate pattern recognition algorithms. Large amounts of data will need to be analysed and to do this in real time, with currently available computer hardware, will represent a major challenge.

An alternative approach is based on the generation of weed maps. A spatial picture of weed populations in the field can be built up over the growing season from a variety of inputs. Because of the stability of weed patches, it is likely that the effort to support the weed map can be reduced after the first year. Herbicide dose decisions will be based on the previous year's map. Weed maps will allow herbicide application at times of the year when the weeds are least distinguishable from the crop. This mapping approach will be particularly suitable for grass type weeds in cereal crops and the maps will link naturally with crop management and record keeping systems.

The mapping approach requires the accurate navigation of the herbicide application equipment in the field. A variety of navigation techniques has been proposed including :

- deduced reckoning relative to surveyed tramlines,
- radio beacon networks,
- local radio beacons,
- laser beacons,
- satellite global positioning systems.



With a field map in the computer memory, a sprayer is activated as the weed patches (dark areas in the picture) are encountered. Silsoe Research Institute.

Sprayer control

Patch spraying requires the control of the sprayer to produce a spatially variable herbicide dose.

One method is to **control the pressure developed at spray nozzles.** This technique has been used in the past to compensate for changes in sprayer speed and is a simple low cost solution.

One problem in a patch-spraying situation is that a wide range of nozzle pressures will be required. The square root relationship between nozzle flow and pressure means that pressure variation will be the square of the product of the speed and application rate ranges. Implications of this are that there will be an increased coefficient of variation of the spray distribution pattern under the boom resulting in a wide range of spray qualities leading to either wind drift or reduced efficacy.

A second approach is **on/off solenoid valve control of individual boom sections.** This solution is reasonably inexpensive and has a rapid response time leading to increased spatial resolution. It has the disadvantage of limiting the dose to either zero or full rate. A twin-nozzle system would give three levels of dose plus zero.

Injection metering to control dose rate is another option. This has the advantage that the dose applied can be continuously variable. However altering the dose to the nozzles involves delays due to the response time of the injection metering system and the spray pipework. Pipe delay can be minimised by using narrow bore plumbing. The design of this can help to equalise the delays to each nozzle section. If the delays to each section are known they can theoretically be allowed for in the mapping system. The injection metering system response time is dependant on the technology used.

Conclusion

Work still needs to be done to explore the concept of patch spraying and to investigate the long-term agronomic consequences. Many of the required technologies are becoming cheaper and more readily available to the farmer. It is clear that the potential cost-savings and environmental benefits of this technique are considerable.

M Paice is a Research Officer at the Silsoe Research Institute.

**A report on other papers presented at the Conference will be featured in the next issue of The Agricultural Engineer – Ed.*

The 'threshing prior to cutting' harvester

Jiang Yiyan Du Chenghai Xu Jiamei

The authors report on the field performance of a rice harvester fitted with a stripper rotor and air suction conveying. The function of the circular recess at the base of the stripping teeth and the staggering of the teeth are examined and the minimum forward speed to avoid excessive free grain loss is determined.

In recent years two machine developments for harvesting rice have emerged. One is the AFRC stripper header (SH) which is attached to a combine harvester (Klinner 1987; Klinner 1988; Hale 1990) and the other is a harvester which employs 'Threshing Prior to Cutting' (TPC), developed by the North-East Agricultural College, China (Jiang *et al* 1991).

These two machines differ both in their working principles and in their construction as shown in Table 1.

The stripper header is based on the principle of detaching the panicle from the plant and then threshing the grain/chaff mixture in the combine harvester. A rotor carries eight rows of long,slender, closely spaced teeth, with a recess at the base of each pair. This design gives 360° stripping of grain from the stem. Detached seeds and material other than grain (MOG) are thrown onto a belt and auger conveying system which feeds the attached combine harvester (Fig 1).

The TPC harvester is illustrated schematically in Fig 2. Plants are deflected

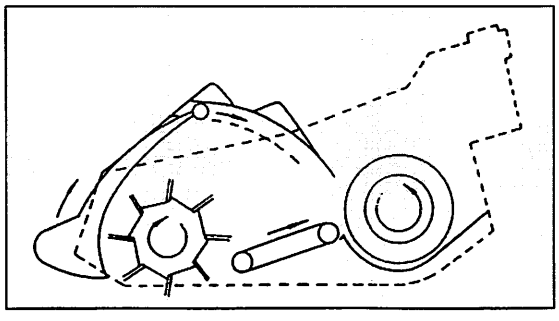


Fig 1. AFRC stripper header.

by the pick-up (1) with the upper part depressed gently and fed by the belt (2) into the thresher (4) with the assistance of air suction from the pneumatic conveying system The grain and MOG are carried through a duct (14) to the holding tank (13) whose base has a discharge rotor (12). Air and small debris pass through the fan (6) to atmosphere. The mixture of grain and chaff is conveyed to the axial flow rethresher-separator (10) where small amounts of broken straw move axially and are expelled. Light chaff, falling from the concave (9) along with grain, is removed in the air flow provided by a cross flow fan (11). Clean grain is elevated and conveyed to a sacking attachment.

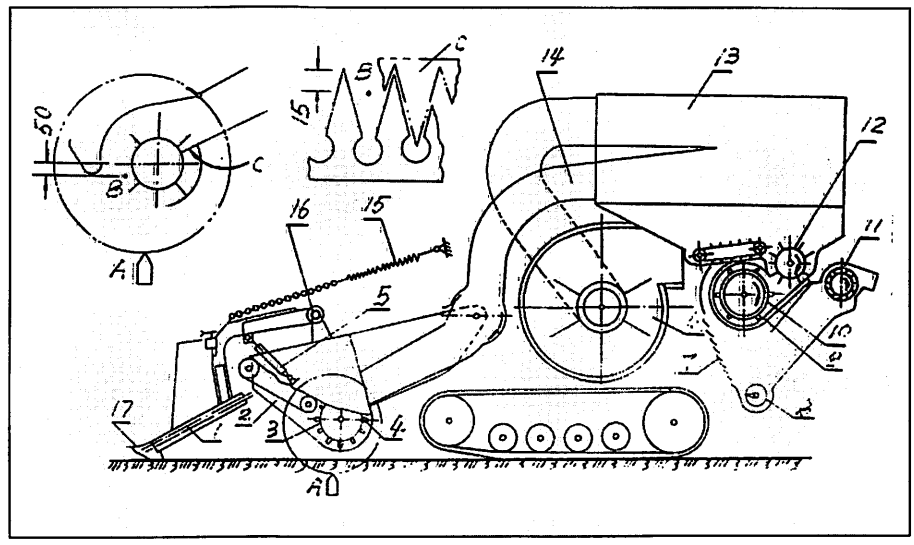


Fig 2. Rice harvester incorporating threshing prior to cutting.

Less grain damage with the TPC harvester

The TPC harvester uses the principle of striking the individual grains by wire looped teeth and with this method, more than 96% of the grain is in a free state, and the rethreshing and cleaning processes are markedly reduced.

With the stripper header the quantity of broken panicles and straw is much greater than that after TPC, and a higher drum speed is required for the threshing. This leads to a higher proportion of broken and hulled grain.

The photograph (Fig 3) shows that the straw remaining after the stripper header (left) is markedly shorter than that after TPC (right). This comparative field test (conducted side by side on the same day) confirms that the TPC takes in less straw.

Higher speed and simplicity of stripper header

Two of the most important features of the stripper header are its much higher forward speed (about two times higher than TPC), and its simplicity of construction. However, as forward speed decreases, the free grain loss increases.

Table 1. Comparison of stripper header harvester (SH) and 'threshing before cutting' harvester (TPC).

Feature		*SH*	*TPC*
Working principle		Detaching mainly the panicles by long slender teeth with recess at base	Striking individual grains by wire loop teeth
Machine forward speed	(m/s)	1.50 – 2.10 or more	0.45 – 1.00
Broken panicles after strip/thresh	(%)	40 – 60	4 or so
Speed of rethreshing	(m/s)	26 – 30	12
Broken and hulled grain	(%)	6.00	0.15 – 0.26
Amount of MOG detached	(%)	10 – 50	9.50 – 11.70

Jiang Yiyan, Professor; Du Chenghai, Engineer; Xu Jiamei, Associate Professor; are with the Department of Agricultural Engineering, North-East Agricultural University, Harbin, Heilongjiang Province, 150030, China.

A low forward speed may be a critical requirement in China and in other Far Eastern ccuntries where it is quite common for the size of the paddy field to be too small for the rice harvester to work conveniently with a high ground speed.

Trials with the TPC harvester

Results of initial field trials with the TPC harvester have already been reported (Jiang *et al* 1991 – two references). Details are presented in Table 2. The objectives of this further study have been as follows:

- To examine the effectiveness of the recess at the base between each pair of teeth;
- To find the minimum ground speed of the TPC consistent with an acceptable level of free grain loss;
- To examine the benefit of staggering the teeth of same shape fixed in position C (see Fig 2) in order to recover the moving grains in the space between the teeth which, otherwise, would be lost from the machine giving higher losses.

Field test equipment and method

A small harvester fitted with a TPC unit and with a swath width of 1.80m was used as a field laboratory self-propelled test unit. A rotor with 8 rows of long slender and closely spaced teeth was fitted in place of the threshing drum with wire loop teeth, as shown in the left upper corner of Fig 2. The swept area was the same as that of the drum (Fig 4). The hood was mounted above the rotor, the position being as recommended by AFRC. The feeding belt (2) in Fig 2 was removed and the pick-up system remained idle. The stripped grain, broken panicles and chaff were conveyed by air flow to the holding tank.

For analysing the function of the recess on the base of the teeth, three diameters of circular recess - 16,. 12 and 5mm were arranged on the rotor's centre, left and right sections respectively. The circular recess of 5mm diameter is too small for a stem to enter but is necessary for ease of manufacture of the teeth.

The field tests were conducted during the period of hoar frost. Round shaped rice, var. *Hei-Jiang-19*, broadcast with a high population (910 panicles per sq.m) and yielding 6876 kg/ha, was used in the tests. Machine forward speed was 1.34m/s.

Table 2. Field trial results of TPC rice harvester[1].

Feature		*Period of trial*				
		Before hoar frost			*Within frost period*	
		Broadcast[2]	*Transplanted*		*Transplanted*	
Machine fwd speed	(m/s)	0.80	0.45	0.80	0.45	1.00
Swath width	(m)	1.80	1.80	1.80	1.80	1.80
Feed rate	(kg/s)	4.61	1.90	3.20	1.20	3.51
Total grain loss	(%)	0.63	0.98	2.33	2.66	1.39
Unthreshed grain loss	(%)	0.13	0.05	0.07	0.52	0.26
Free grain loss	(%)	0.47	0.48	1.23	1.73	1.13
Cleanliness of grain	(%)	97.50	95.30	93.80	97.60	nr
Hulled and broken grain	(%)	0.15	0.24	0.26	0.28	0.25
MOG[3] left standing	(%)	90.50	88.80	89.30	88.30	88.35
Grain moisture content	(%)	22.20	18.70	nr	13.40	14.50
MOG moisture content	(%)	70.50	68.20	nr	59.60	55.50
Crop yield	(kg/ha)	9,250	8,002	nr	6,395	6,999

Notes
1. Field measurements made by Heilongjiang Agricultural Machinery Test and Evaluation Station
2. With high plant population – 933 panicles per square metre
3. MOG = Material other than grain

nr not recorded

Results and discussion

– the recess at base of teeth

From Table 3 it can be seen that the effect of recess size on the free grain loss is quite insignificant. Observations showed that there was little difference between the treatments in the loss of unthreshed grain remaining on stems.

– the stagger of the teeth

The data from the tests exploring the benefit of staggering the position of the teeth showed that with a forward speed of 0.45m/s there was significant difference between two means at the 30% level. As the forward speed increased to 0.80 and to 1.34m/s, the difference between the means was significant at the 40% level, (Table 4).

These results revealed that the staggered teeth configuration increased the free grain loss, the tendency becoming greater as the ground speed decreased.

– the forward speed

Also, it was found that the forward speed of the machine played a major role in reducing the free grain loss. Loss levels did not alter as the forward speed increased from 0.45 to 0.8m/s but became much less at 1.34m/s (Table 4). This forward speed was considered to be the minimum acceptable in terms of grain loss. In fact, a lower loss would have been more desirable.

Fig 3. Comparison of straw remaining after stripping (left) and TPC (right).

The same crop and field conditions as above and three forward speeds were used to examine the benefit of staggering the position of the teeth and the acceptable minimum ground speed.

Field tests were based on a randomised complete block design for each comparison, with four replications for each treatment. In all cases the Least Significant Difference (LSD) test at the 5% confidence level was used to compare two specific means. If the result was not significant then the confidence level was decreased to the 30% or even 40% level.

The action of the staggered teeth

To study the effect of the staggered teeth on free grain loss, it was decided to measure the magnitude and direction of the air flow at specific points in the space between the teeth. This was done using a thermocouple anemometer.

The results of measurement at point B (see Fig 2) with the rotor operating at the speed of 710rpm without the assistance of air suction showed that air flow velocity varied from 10.80 to 11.10m/s across the entire swath, but reduced to 6.0m/s or so at both ends of the swath. The air flow at point B between teeth had tangential direction to the circular trajectory of point B.

These results, together with those presented in Table 4 show that the grain and MOG after detachment from the stem are carried up and backward, not only by the teeth themselves, but by the air flow surrounding the rotor.

It appears that the staggered teeth disturb the surrounding air flow and weaken the rotor's carrying ability. The detached grain and MOG are thrown out by the teeth and strike and bounce against the hood. Any falling grain will be hit again by the fast moving forward teeth.

This effect predominates and controls the grain motion below the hood. As the forward speed of the machine decreases, the falling grain has time to fall to the ground before being collected by the teeth, and grain loss subsequently increases.

For this reason, the stripping rotor operates more satisfactorily with a higher forward speed. As the rice producer said, "With the stripper header you must be willing to drive faster. If you slow down too much you can see grains flying out in front".

Table 3. Effect of circular recess size on the free grain loss* (%).

Size of recess (mm)	*Free grain loss (%)*
12 (left third of swath)	1.40 a**
16 (centre third of swath)	1.31 a**
5 (right third of swath)	1.35 a**
LSD – (at 0.5% level)	0.325

Note: * Average of four replications with ground speed of machine 1.34m/s

**Numbers with the same letter within the column do not differ significantly at the 5% level based on the LSD test for difference between means.

From Table 4 it can be deduced that, at a lower forward speed, the air flow surrounding the rotor plays the larger role in carrying the detached grain than at higher ground speeds.

Conclusions

1. The minimum practical ground speed of a TPC harvester fitted with a stripping rotor is 1.34 m/s. At that point the free grain loss is barely acceptable, and provides a 34-50% increase in the TPC's output.
2. There is no evidence that the circular recess at the base of the teeth has any effect on the level of free grain loss.

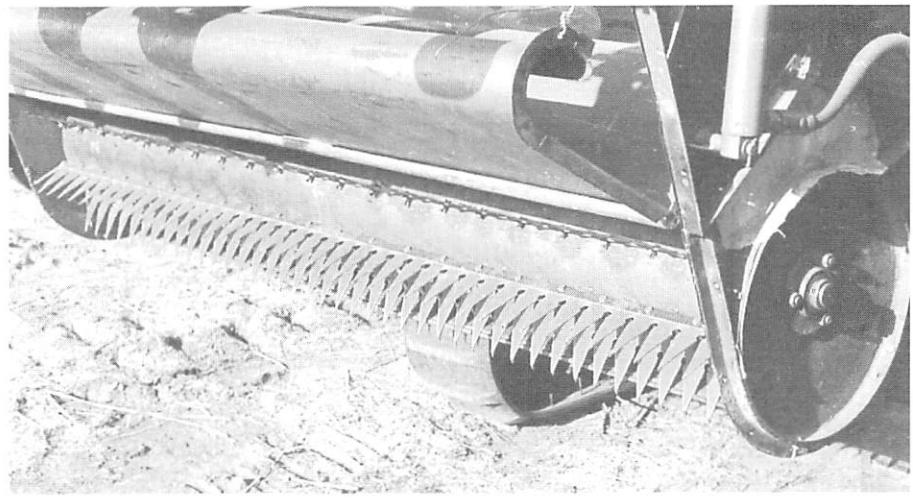


Fig 4. Stripping rotor installed in TPC.

Table 4. Effect of ground speed of machine and stagger position of teeth on free grain loss* (%).

Ground speed of machine m/s	*Disposition of teeth*		*LSD*	
	with stagger (on left half of swath)	*without stagger (on right half of swath)*	*30% level*	*40% level*
0.45	3.60 aA**	2.92 bA**	0.64	
0.80	3.17 aA**	2.57 aA**		0.87
1.34	1.67 aB**	1.31 aB**		0.81
LSD at 5% level	2.00	0.99		

Note: * Average of four replications

**Numbers with the same capital letters within columns and numbers with the same letters within rows do not differ significantly at the percentage level indicated based on the LSD test for difference between means.

3. Contrary to expectations, the provision of fixed staggered teeth increases the free grain loss, (though with little significance).
4. A high tangential air velocity in the space between the rotor and hood has the effect of reducing the free grain loss.
5. The stripping rotor fits into the TPC easily. The TPC with the stripping rotor provides a good combination of higher output, undamaged grain and minimising loss in laid crop.

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The history of the Bristol tractor, 1932-1947
by Geoffrey Stannard

ISBN: 0863328202 Price £19.95 h/b

As a Bristolian and very proud of it, your reviewer must immediately declare a special interest! Yes, I grew up speaking "proper Brisoll" and seeing around me the excellent engineering of the city. My first hero in the engineering field was, of course, Brunel, but later I grew to appreciate the car, bus, aeroplane and eventually tractor companies which bore my city's name.

It has, therefore, been a great pleasure to leaf through this book, tracing the history of this famous little tractor. The author, Geoff Stannard, is an enthusiast and it shows in the work. It is extremely well researched, carefully crafted and very well written. There are 121 pictures and illustrations, many of great historic interest.

It is, of course, a book for enthusiasts of British manufacturing, particularly agricultural machinery.

I can thoroughly recommend it as a detailed study, extremely well presented. If you have an interest in the history of the tractor and its applications, this book is for you. As a Bristolian, I am left to dream of the past that might have been. **MJH**

Soil and Water Conservation Engineering (4th ed)
by Glenn O Schwab et al

Published by John Wiley and Sons Inc
ISBN: 0471499948

Glenn Schwab's book has long been recognised as one of the most important works on soil and water conservation. Many of us have been asked at some time, "If you could only have one book on a subject which should it be?". The question is easily answered for soil and water engineering, "Schwab, of course.".

The purpose of the book is to provide a professional text for undergraduates and graduates interested in soil and water conservation. It really goes without saying that its aim is achieved most emphatically.

In this edition, the excellent text material has been updated, but still continues to emphasise engineering design of soil and water practices. The conversion to the International System of Units (SI) is nearly complete.

The impact of soil and water engineering on the environment has been considered in more depth. There is also a recognition of the role of computers particularly in software and modelling.

In short, this new edition brings improvements to this most excellent of works. No soil and water engineer should be without it.

MJH

Fifty Years of Farm Machinery (from starting handle to microchip)
by Brian Bell

Publisher: Farming Press Books and Videos £18.50 h/b
ISBN: 0852362633

Brian Bell, a fellow lecturer, has had a long teaching career at Otley College. This may well be the best qualification possible for producing an historic work.

Students ensure that lecturers keep abreast of change and there is no better way of knowing a subject than having to teach it. A glance through his old lecture notes must have provided a sound foundation for the study.

It therefore comes as no surprise that this is a very good book. As the author admits, it is a random sample from the period, with emphasis on the early days. This is, of course, inevitable as a wide ranging topic is being tackled. Nevertheless, the material which is does tackle is first class. The layout and text are well organised and easy to follow. There are countless photographs and illustrations which aid in description and understanding.

The index is first class but it is perhaps a little disappointing that there are few references to aid the reader trying to broaden his research.

The readership will obviously include far machinery enthusiasts but I would also like to recommend it to a wider audience. The book offers a real insight to the progress of agricultural mechanisation and changes in machinery design. Anyone interested, therefore, in recent agricultural history and changes related to the introduction of new machinery and methods will find this work invaluable.

MJH

Molecular Biology of the Tomato – Fundamental Advances and Crop Improvement
Edited by John I Yoder

Technomic Publishing Ag Basel Switzerland
Price SFr 238 h/b

This publication contains the edited papers of an international symposium held in 1992 at the University of California. The papers are basically concerned with relatively new bio-engineering techniques and their likely effect on food production.

They describe work on the tomato and how an understanding of the genetics of molecular biology of higher plants can be used to map genes of biological and economic importance and how this information can be used to enhance commercial attributes of the crop such as quality, rate of ripening and disease and pest control.

While the plant model considered is the tomato, the general principles apply to any economic crop. A scan through this book will be very useful to any agricultural engineer or other person in the agriculture or food industry who wishes to have an appreciation of the way biotechnology is likely to contribute to the increased supply and improved quality of food crops in the near future. It is worthy of consideration by specialists concerned with such activities as crop protection and storage where biotechnology may dramatically alter current approaches.

DSB

Authors please also take note!

Our postbag has lately included a flood (well, three letters) of correspondence suggesting ways of improving the journal. Constructive and helpful comments such as these are always welcome – all will be answered and acted on where practicable.

Get up to date!

Sir – Are we professional engineers or not? My reason for asking is that by reading a number of technical journals it is clear that many are just not keeping up to date. Take issue 48 No 2 of *The Agricultural Engineer* for example. One of the advertisers (inside cover and an affiliate at that) is using the initials T Eng which went out years ago. Another, Mid Wales Welded Products (page 35), is making windmills measured in feet with performance figures in gallons. On page 40, Newcastle University gets RPM (which went out years ago) in the graph.

Our competitors and customers must be having a right old laugh.

Now come on chaps. How can we present ourselves as credible engineers with all the talk about unification if we are too idle to keep up to date? No professional engineer under thirtyish will have been brought up on feet and pounds. The last City and Guilds examinations in these obsolete units took place about 1975 and that was after a three year transition in which there was dual unit questions. Those over thirty should have taken it upon themselves to keep up to date, it being no use moaning if a younger chap gets promotion or has your job. I was 35 when SI units came in. For ALL of us there is now the BUZZWORD ... CPD ... Continuing Professional Development. Perhaps we should incorporate this as a requirement for CONTINUED membership. What do you think?

Perhaps you, as Editor, could take a lead in this by rejecting copy containing obsolete units and those which have clearly been multiplied by 25.4 or whatever in an attempt (more like contempt!) to fool us.

Yours sincerely

J Trevor Thompson, Management Tutor
38 Woodpecker Drive, Hailsham, East Sussex BN27 3ES

(Unfortunately, copy is not in sufficient abundance to allow us to pick and choose where units are concerned, although a real effort is made to ensure that SI units are the standard and errors are avoided. Advertising control regarding suitability of units is outwith our province - who pays the piper calls the tune! One can only surmise that the units used are those which are most familiar to the advertisers' potential customers. – Ed)

Let's hear it for the sheep!

Sir – I have been a member of the Institution now for almost twenty years. To me it is totally biased and only concerned about two or three main fields – soil and water, crop drying and developing countries.

We are the only British manufacturer of sheep shearing equipment and sheep and wool are very important to the income of the UK farmer. Over the last twenty years, I have not seen a single paper mentioning sheep shearing, despite millions of dollars being spent in Australia to develop the industry.

Your comments would be appreciated.

Yours faithfully

J A H Williams, Technical and Marketing Manager
Lister Shearing Equipment Ltd, Dursley, Gloucestershire, GL11 4HR

(The imbalance of topics is not intentional but reflects the copy which is received. The submission of articles, either of a general or specific nature, concerning any aspects of land and rural engineering such as livestock, crops, forestry, buildings, pollution and safety is most welcome and all will be considered for publication. There is a wealth of experience in the membership covering a vast range of topics – so, put pen to paper and spread the word! – Ed)

How about more detailed product news?

Sir – Expanding on the replies I have given in the Questionnaire, may I add that I have often wished that the Journal contained more articles describing new engines, machinery, etc. If this were done, could the Journal be put on public sale to draw in more revenue?

Yours sincerely

P F Mundell
19 Gidding Road, Sawtry, Cambs PE17 5TS

(Is there a possibility of a move in this direction? A greater number of near-market articles would perhaps interest more members. The demise of other journals of this type and the continuing supply of copy from a larger number of contributors are two problems which require to be considered. What are the members' views? – Ed)

Accident research

Information sought on tipping ram failures

Sir – I am carrying out research into the causes and prevention of accidents involving tipping ram failure. I would be grateful if any members having knowledge of this type of incident would forward details. Information would be treated in strictest confidence. Details which would be of greatest interest to me are:

1. the type of system fitted
2. the circumstances of the accident
3. the cause(s) or probable cause(s).

I would also be interested to find out if any research on this subject has been carried out previously, and if so, by whom.

Yours sincerely

John G Sullivan & Co
Highfield, Greenane, Killarney, Co Kerry

New President for AEA

David Jenkins, Managing Director of Charterhouse Turf Machinery Ltd, has been elected as president of the AEA for 1993/94.

David Jenkins

David, after a varied career in engineering and marketing, joined Marshall Concessionaires first as General Manager then Marketing Director. He was responsible for the establishing of Jacobsen, Ryan and Bunton products in the UK. In 1982, with his partner Phillip Threadgold he set up his own company, Charterhouse Turf Machinery. Charterhouse has subsequently developed in size and stature and has gained an enviable reputation in the Turf Care Industry.

BACK NUMBERS

We have a quantity of the following issues surplus to requirements:–

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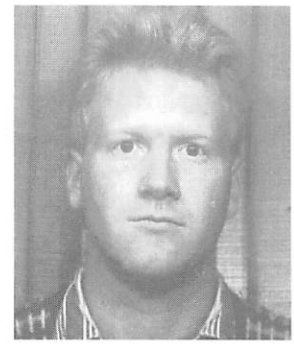
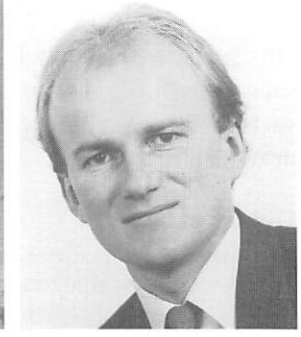
Development of a high speed plough

Jim Scott and Ian Yule



Jim Scott



Ian Yule

The authors describe some interesting initial results from trials with a new plough designed at the University of Newcastle upon Tyne. The plough is capable of sustaining an operating speed of 12km/h and maintaining a good quality of work.

Primary tillage is one of the most expensive field operations on arable farms. The dominance of autumn sown crops means that high workrates are necessary if timeliness penalties are to be avoided.

Modern ploughs still follow animal draught design

Ploughing is the most common form of primary tillage and mouldboards were designed originally to operate at the walking pace of a draught animal. Modern versions deviate little from this principle, the main difference being scale.

Project to design high speed plough

Higher workrates can be achieved by:

- increasing machine width;
  at greater widths, handling and manoeuvrability are major problems.
- increasing forward speed;
  power requirement increases rapidly with speed (O'Callaghan *et al* 1965) and the quality of work is reduced.
- combining operations to reduce the number of passes;
  although a few systems are available to provide a one pass seedbed, the more common systems are based on combining secondary and drilling operations.

The aim of the project was to design a primary tillage tool to operate at a speed of 12km/h.

After assessing existing cultivation methods it was decided to combine a rigid tine with a disc to achieve this speed and maintain good mixing of the soil. It was proposed to design and test an implement comprising three such furrow units.

Trials to determine optimum combination of tine and disc

While the effect of a single cultivation element is sometimes well understood, using components in combination such as a tine and disc, is less well documented.

In order to find the optimum position for the disc relative to the tine, a number of preliminary trials was conducted with a single unit. These trials, on Cresswell Beach, Northumberland, revealed that in sand, a sweep angle of 40°, a rake angle of 15° and with the leading edge of the disc running directly behind the tine, gave the best results.

The trials are illustrated in Figs 1a and 1b. The combination of a tine and a 710mm diameter disc gave an effective furrow width of 355mm.

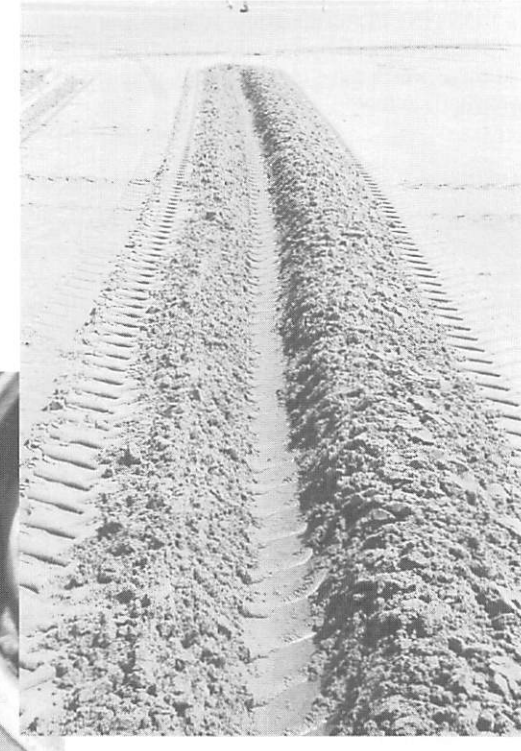


Fig 1. Initial trials using a single unit with serrated and plain discs on Cresswell Beach, Northumberland. a) the tine and disc combination; b) the furrow.

Three furrow version field tested – speed of work

Field testing of the three furrow version showed that an operational speed of 12km/h was possible and could be realistically maintained. The machine had a spot rate of work of 1.2ha/h, and, allowing for a field efficiency of 80%, an actual work rate of 1ha/h was achieved. This is

J Scott is a final year B Eng Agricultural Engineering student and I J Yule is a lecturer in Agricultural Engineering, both at University of Newcastle upon Tyne.

around double that of a conventional mouldboard plough of comparable size.

– surface profile

Two other factors the surface profile left by the plough and its soil mixing ability were measured.

The surface profile of the worked land was measured by a micro-relief meter developed by C Wigglesworth, 1993. The relief meter measures the elevation of 400 points per square metre and revealed a standard deviation of 4.5cm. This is similar to that of a mouldboard plough operating at its normal working speed.

The standard deviation gives an indication of the relative roughness of the surface and can be used to compare the effect of different tillage methods.

Fig 2 illustrates a three-dimensional representation of the surface profile.

– mixing capability

The mixing capability was measured by using different coloured markers placed at known depths across the path of the plough. The position of the markers was recorded once the plough had run through the area, disturbing the markers. The lateral position and depth of the markers were measured and recorded.

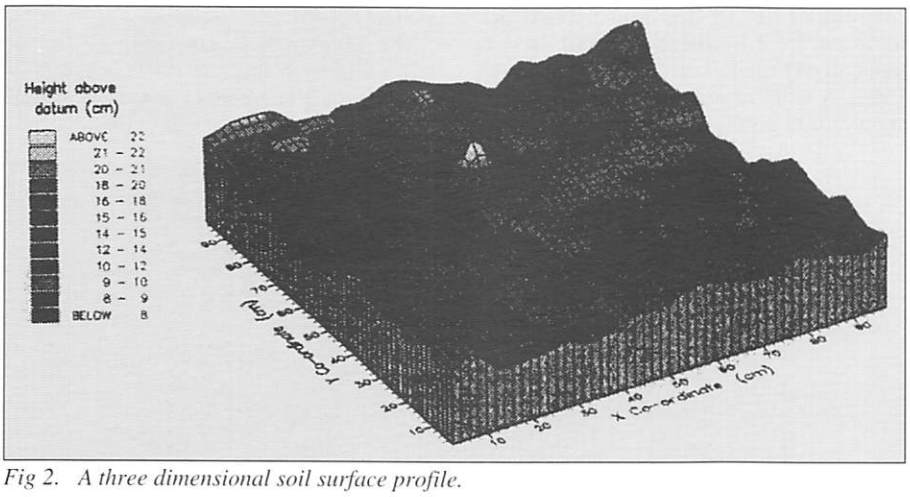


Fig 2. A three dimensional soil surface profile.

The degree of mixing is best illustrated by the two-dimensional graph, Fig 3. The figure shows a greater degree of mixing than would be achieved by a mouldboard plough, which is essentially built for inversion.

– trash burial

It was also encouraging to note that a good deal of surface burial was achieved. This backed up the visual impression given from the field tests.

Lack of surface trash burial is a complaint often levelled against possible alternatives to the mouldboard plough.

Fig 4 illustrates the machine at work during field trials.

Conclusions

While the project does not offer the panacea for primary tillage just yet, it does offer a number of encouraging results which are being further investigated:

- It has proved possible to maintain a speed of 12km/h and achieve a good standard of work.
- The degree of soil shatter was greater than for a mouldboard plough. A further investigation will examine the possibility of exploiting this fact to reduce subsequent tillage operations.
- The implement gave a good degree of surface trash burial and a good soil mixing characteristic.
- It left the surface relatively level which is important when trying to increase the speed of subsequent operations.

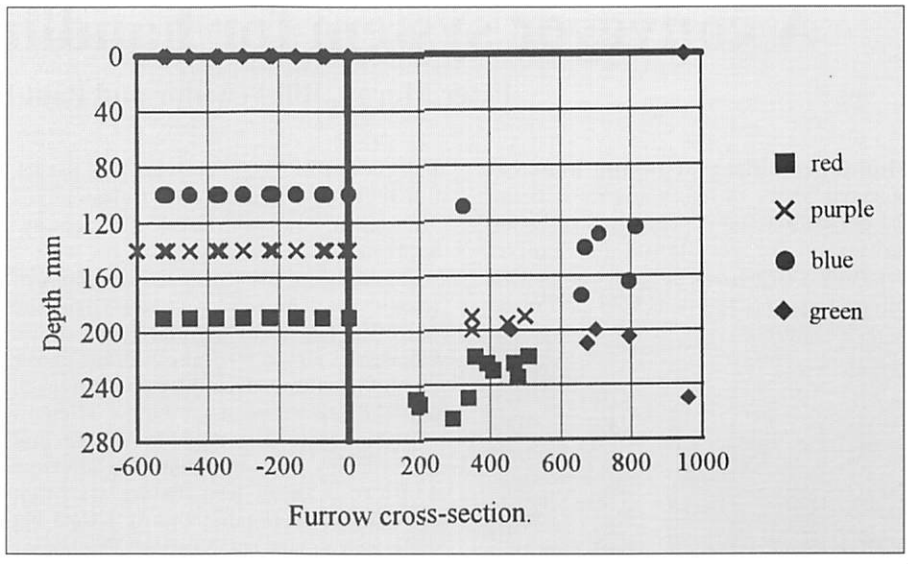


Fig 3. Illustrating the movement of markers in the soil: –600 to 0 illustrates undisturbed soil; 0 to 1000 mm illustrates position to which markers moved.

Further Work

A four furrow version of the machine has been constructed and further trial work is being undertaken to measure its cultivating effect, energy requirement and mechanical performance.

A comparative study will be completed using a mouldboard plough and other primary tillage tools.

Experiments are also planned to use the machine in combination with other devices to produce a seedbed in one pass.

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Wigglesworth C (1993). The development of a micro-relief meter. *B Eng design project* (unpublished). Univ of Newcastle upon Tyne, Dept of Agricultural and Environmental Science.

Fig 4. The high speed plough at work during field trials (March 1993).

A conveyor system for handling laying hens

Peter Moran, Bill Whetlor and Paul Berry

Manual handling of laying hens is a potential source of injury and stress during the population and depopulation of battery houses. An experimental mechanised handling system has been developed for carrying up to 3,500 hens/hour into or out of a battery house. The system is constructed from a number of 2.4m long conveyor sections linked in series. Outside the house, the conveyors take birds directly to, or from, the transport vehicle. Engineering development of the conveyor system has been complemented by research using a range of behavioural tests to assess the welfare acceptability of its novel features. Since bird welfare was of prime importance in the design, the authors are confident that this system will be an improvement on manual handling in terms of bird damage and stress levels.

Fig 1. Manual handling.

Introduction

Egg production is a major agricultural industry in the UK. There are 33 million laying hens in the UK producing over 11 billion eggs per year. At least 85% of laying hens in the UK are housed in battery cages. Typical egg production units in the UK have a number of battery houses containing a total of up to 300,000 hens. Flocks of up to 25,000 birds are kept in each house within a series of tiered cages arranged in rows with access passageways between.

The birds are usually caged in groups of four to six. The rows of tiered cages are on solid floors at ground level or on wooden floors raised about 2.4m above ground level over deep litter pits. A typical passageway between the banks of cages is 0.8m wide but cage furniture and roof support posts may limit the effective width to 0.5m or less. Doors are often provided in each gable end of a shed but these vary in size and location. The houses are typically 16m wide and may be over 100m long.

Hens are transported to a farm and carried into a battery house at about 17 weeks old just before they start to lay. At the end of their laying period at about 75 weeks they are carried from the house to be crated and transported to the slaughterhouse. During the 'population' or 'depopulation' of the house, birds are inverted, held by their legs and carried manually (Fig. 1) for distances of up to 150m. A team of eight handlers will place about 2,000 point-of-lay pullets/hour into a battery cage system or remove about 4,000 spent hens/hour from the house for pre-slaughter transport.

Manual handling of laying hens both on the farm and immediately prior to slaughter is a potential source of injury and stress. Gregory and Wilkins (1989) reported that 29% of battery hens have broken bones immediately prior to slaughter and also that much of this damage was due to commercial de-population of battery houses. They found that removing hens from cages and carrying them to the transport vehicle with three birds in one hand and four in the other, resulted in an average of 24% of birds with broken bones. They also found that the incidence of bone breakage could be reduced to 14% by carefully removing birds from cages and carrying them individually from the house.

A mechanised hen handling system

Even with the most considerate manual handling, bird welfare will be compromised. The dominant reactions of poultry to human beings are fearful and the catching/restraining components of handling can be sufficiently stressful to produce a state of suffering (Duncan,1989 and 1990). A carefully designed conveyor system for transporting birds into and out of battery houses could be of potential welfare benefit.

The Livestock Engineering Group at Silsoe Research Institute (SRI) is currently developing a hen conveyor system which will enable the egg producer to improve bird handling techniques whilst maintaining existing bird movement schedules. By comparison with current practice, the manual catching/restraint component of the handling process and its attendant fear level in the birds may be reduced. Catching crews will be able to concentrate their efforts into carefully handling individual birds into, or out of, transport containers and cages. With careful handling, and birds not being handed from man to man or carried over long distances, physical damage to birds should be reduced.

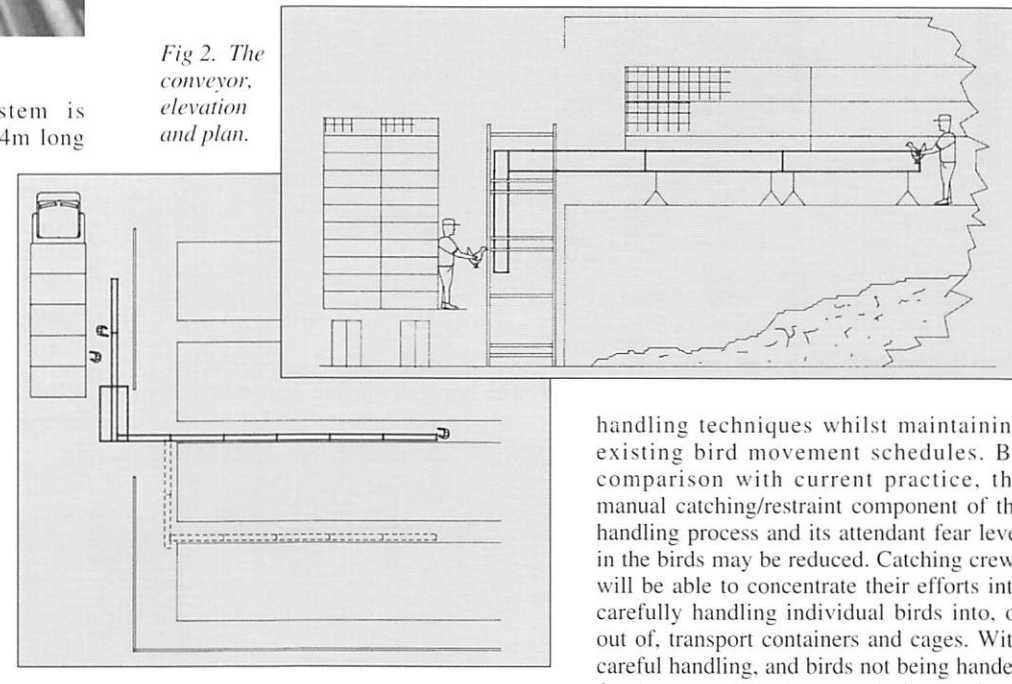

Fig 2. The conveyor, elevation and plan.

A multi-section experimental conveyor has been built which will carry hens along the aisles of a battery house (Fig 2) from transport vehicles to cages and from cages to transport vehicles. The overall length of the conveyor can be varied by the addition or removal of 2.4m long sections.

P Moran, W C Whetlor (both now retired) and P S Berry are/have been with the Livestock Engineering Unit, SRI, Silsoe.

Each section can be mounted on adjustable-height tripod legs so that birds can be carried at a convenient height above floor level within the house. The sections are coupled together such that birds are transferred from one belt to the next with minimal disturbance. The 0.33m wide by 0.2m deep conveyor sections are sufficiently narrow to fit down the narrow passageways of a typical battery house. The length of each section is convenient for man-handling within the confines of a house and for stacking on a road trailer for transport between farm sites. The longitudinal conveyor can be linked directly or via an intermediate conveyor, of one or more sections, to the exterior conveyor. Direct links will be possible when a doorway is adjacent to a passageway or where it is appropriate to fit a series of 'pop' holes in a house wall.

Fig 3. The entrance to the conveyor.

The three sections making up the exterior conveyor at a deep-pit house are supported by a modified builder's access tower (Fig 2). These towers are used on some farms to provide a safe working platform outside a battery house for handling teams moving hens to or from a lorry. The exterior conveyor will move birds between the house and the transport vehicle. Its slope is adjustable through 25° above or below the horizontal to cope with the variation in loading/unloading heights. Despite the complex requirement imposed by engineering and bird welfare considerations, the whole system is built from conveyor sections with identical frameworks and commercially available drive components. The conveyor sections are fitted with tunnel covers which confine the hens and also ensure that they stand within the width of the conveyor belt. These covers are normally 1.2m long, 0.25m at their widest point and allow 0.35m headroom for the birds. The experimental conveyor is fabricated from galvanised steel sheet and the total weight of each 2.4m section with its cover is about 50kg.

Fig 3 shows the first section of the system with a funnel shaped entrance to the tunnel. At the head of each section, the 0.22m wide belt is driven at 0.32m/s by an 113mm diameter, 0.06kW drum motor. The whole system can be powered from a 13A single phase supply. The conveyor belt is pre-tensioned to such an extent that the drum motor is able to drive in both forward and reverse directions. Normally the conveyor belt has a 1.5mm thick polyurethane 'waffle structure' surface with 0.5mm deep ribs at 1.5mm pitch. This belt affords sufficient grip for birds and can be kept relatively clear of bird excreta by a polypropylene brush strip on the belt return.

Exterior conveyors have a 3.5mm thick polyurethane belt with a 2mm deep tread pattern on a 4mm by 8mm rectangular matrix to give birds grip on an incline. When conveying hens the drive pushes the load from the head to the tail of the conveyor. At the tail end, the belt is supported by a pair of 40mm diameter rollers. The specific arrangement of these rollers enables the conveyor to be of general application in the handling system.

Fig 4 shows conveyor sections joined together at the 4 types of junction that the hens may experience during a journey on the conveyor system. In this diagram the birds are shown travelling backwards along the conveyors. This orientation is favoured by the birds and is potentially of benefit to handling to and from the conveyor.

Bird Welfare Investigations at SRI have compared the fear levels in a group of laying hens carried for 40s, at 0.5m/s, on a 20m long, flat belt conveyor with the fear levels in groups of hens carried, for the same time and at the same speed, in the inverted position by hand and by a processing shackle. The noise levels of at least 82dB(C) along the conveyor exceeded the 74dB(C) generated by a 2.4m long conveyor section and which hens have had an aversion to. Despite the possibility that the hens had an aversion to the noise of the conveyor they reached their destination in a less fearful state than those exposed to shackling or human carrying.

Experiments have indicated that birds travelling on a moving belt become unduly disturbed if their toes make contact with the stationary bed plate of the conveyor. They may 'pedal' along the belt on one leg in an attempt to hold onto the stationary structure with the other. They may attempt to leave the belt and perch on the conveyor structure or they may attempt to escape the conveyor completely by running along the moving belt. The covers on the conveyor system are designed to prevent birds' toes contacting the bed plate.

At level or hinged junctions the hens are passed from the tail of one conveyor to the head of the next. At a right angle junction the hens are passed over the side of the next conveyor. Problems are likely to occur as birds travel on an inclined conveyor or as they pass over a joint between horizontal and inclined conveyors. In developing the hen handling system described in this paper, bird behaviour was investigated (Scott and Moran, 1992) in groups of hens conveyed along three sections of conveyor where the final 2.4m long section was horizontal or at an incline of ±25°. Birds experienced difficulty with the transfer from belt to belt at the hinge joint and the incidence of wing flapping, loss of balance and alarm calling significantly increased when birds were conveyed up and down slopes.

In the light of this experiment, the tail roller arrangement and the conveyor couplings were designed so that, in all three cases, birds can be passed on without

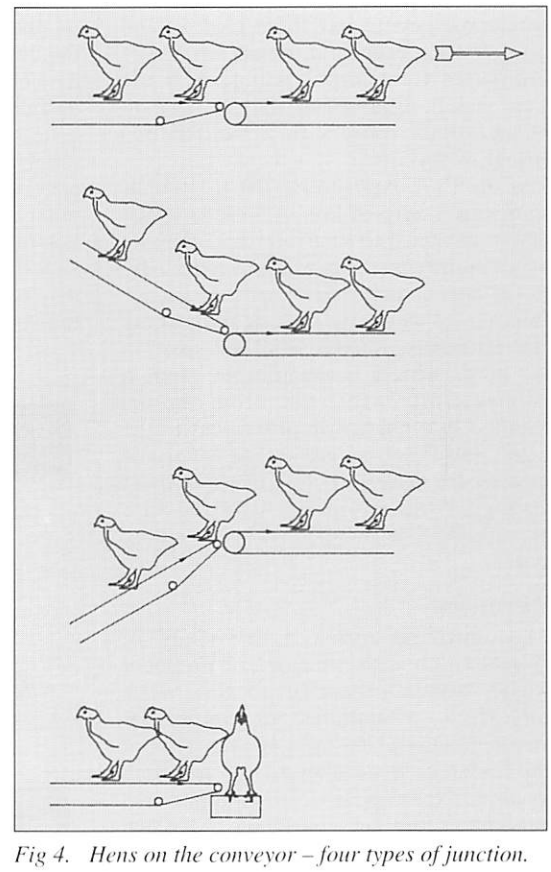

Fig 4. Hens on the conveyor – four types of junction.

trapping their feet or unduly affecting their posture. The surface texture of the belt used on the exterior conveyors was selected to afford a secure grip for birds being conveyed on an incline.

Throughout most of the research and development work associated with the hen conveyor a belt speed of 0.5m/s was considered appropriate to the commercial handling rate and the welfare of the birds. However, in an experiment with a prototype corner joint, this speed was found to be too high. Fig 5 shows a hen entering a corner and about to drop and turn. The experimental tunnel cover was fabricated from thick cardboard. Birds were unduly disturbed by the combination of an 80mm drop with a sudden 90° change of direction.

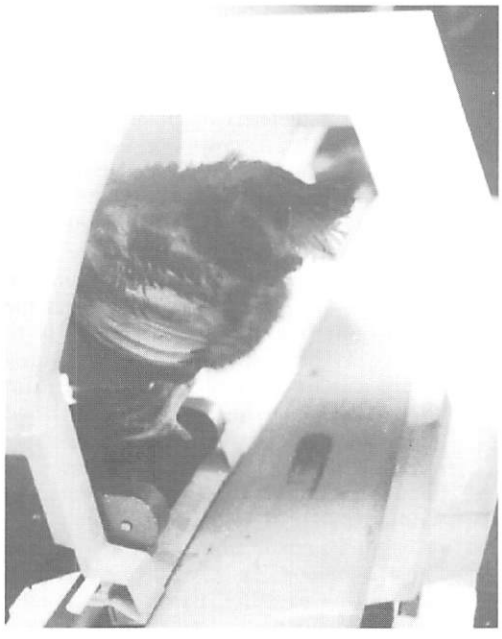

Fig 5. A hen entering a corner.

At the first exposure to the treatment, some birds suffered loss of balance whilst others attempted to scramble back onto the upper conveyor. Birds exposed repeatedly to the corner transfer attempted to escape from the conveyor by running back to the conveyor entry. Reducing the belt speed to 0.32m/s, which is obtainable from a commercially available drum motor, resulted in a marked improvement in the birds' balance at the corner and eradicated their escape behaviour. This belt speed will also give the minimum handling rate appropriate to a commercial hen handling system.

Discussion

The confidential feasibility study in collaboration with a major egg producer which was a precursor to this work identified a number of important considerations which must be addressed in the design of a mechanised hen handling system. Nevertheless, this paper has concentrated on the description of the hen conveyor system and given brief details of the experiments which have served to provide data for the design features which affect the welfare of the hens. The reason for this approach is quite simply that the authors consider the animal welfare aspects of this work to be of primary importance. However, other important design considerations such as the logistics of setting up and operating the system were considered in the feasibility study and have strongly influenced the design.

The implications for bird welfare of any proposed mechanical handling system must be given careful consideration. Work at SRI on the mechanisation of broiler handling (Berry *et al*, 1990) has indicated that it is possible to improve poultry welfare with the use of a well designed machine. However there is little scientific information available to the designer of conveyor systems for poultry. Reed (1974) investigated how chickens can be transferred from one conveyor to another, redirected through a 90° corner and conveyed up inclines on belts. However the implications for bird welfare were not stated.

The engineering development of the conveyor system and of other poultry handling equipment at SRI is complemented by research which uses live poultry and a range of behavioural tests to assess the welfare acceptability of novel mechanisms.

A 24m long sectional conveyor will be used in a number of experiments to assess its potential for improving hen welfare in the depopulation of battery houses. Given the consideration for animal welfare in the design, the authors are confident that the results will be encouraging. However, in the event that this conveyor can make a positive contribution to poultry welfare, it must be clearly understood that the machine's performance is due to its specific design attributes. It could be inappropriate to assume by extrapolation that other hen conveying systems, no matter how similar, would have a similar performance in welfare terms.

Conclusion

It has been possible to design a relatively simple mechanised handling system for laying hens. Since bird welfare was of prime importance in the design, the authors are confident that this system will be an improvement on manual handling in terms of bird damage and stress levels. In the event that this proves to be the case, it must be understood that the machine's performance in terms of animal welfare is due to its specific design attributes and as such cannot be extrapolated to other similar machines.

Acknowledgements

The authors gratefully acknowledge the Ministry of Agriculture Fisheries and Food for their financial support of this work. They also acknowledge the contribution of Dr. G B Scott to several of the experiments referred to in this paper and which will be reported elsewhere in the near future.

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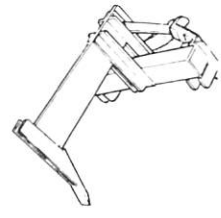

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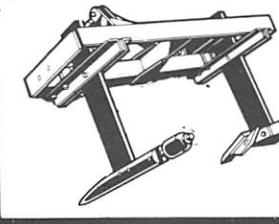

We SAVE you and GET THE BENDS OUT OF THEM FIRST.

Wall ventilated building

A West Midlands sheep farmer was one of the first in the country to house sheep in plastic tunnels. Success with that system has increased flock profits and allowed him to pioneer another type of housing. Eoin Martyn reports on the project.

In 1976, John Parry of Donington House Farm, Albrighton near Wolverhampton was running a flock of 200 North Country Mules. Until then they had been lambed in open yards and any other available spaces. That year he installed one of the first plastic tunnel houses as a lambing shed. By 1982 his flock had expanded to 295 ewes and he had erected four tunnels.

At the end of the 1990 season it was decided that either the tunnels had to be replaced with new ones or a more permanent structure should be erected. However any new building had to meet two essential requirements:

- it had to have an excellent internal environment for the sheep and
- it should be flexible in design.

In order to provide the necessary internal conditions it was decided to follow the same principle for ventilation as with the plastic tunnels, being screened openings at ground level. Such a system had proved to be totally effective and satisfactory. The tunnels were free from condensation and the flock was subjected to far less stress at turn-out as temperature variance was minimal. It was decided that the new building should meet the same criteria.

Stock management

Before housing the stock, at the end of December, they are scanned and then fed concentrates accordingly for 8 weeks prior to lambing. They are also fed ad-lib silage.

Management of the lambing house is based on 24 hour supervision with the requirement for comfortable conditions for the staff.

After lambing, the ewe and lambs are secured in central nursery pens for 48 hours. From there they are moved into groups of ten ewes and lambs and later transferred outside into paddocks around the building.

The building

The decision was taken to construct a general purpose steel framed building at about 50% above the cost of replacement tunnels and to site it at Mr Parry's own farm at Donington House.

The fact that the flock has performed so well in the tunnels meant that the increased margins justified the extra cost with the hope of promoting still further increases in performance and margins.

The new building is a Phillips structure 48m long by 24m wide and 4.8m to eaves. The logic behind the building is that initially it will house the flock of 330 ewes with the scope to increase to between 350 and 400. At 400 ewes the building will provide 1.4m per ewe with approximately 450mm per ewe feed space, together with a central nursery area.

The layout, as illustrated (Figs 1 and 2), has central nursery pens, two rows of lambing pens either side with a central passage and an elevated watch-tower with floodlights.

The housing pen arrangement is of particular interest in that Mr. Parry has developed 'reversible' hurdles – when inverted they become a feed barrier. He also has an unusual system for providing water to the nursery area. This simply involves the use of plastic guttering supplying a constant supply of fresh water.

The building is clad with space boarding from eaves to within 1.8m of the ground on both sides. Across both gable ends it is clad with space boarding from eaves to the ridge. Below the eaves the ends are clad with steel sheeting together with sheeted gates at each passageway with a Rollerblind above each gate to provide flexible ventilation and easy access.

New ventilation system

The erection of the building and the insistence on flexibility coincided with a new development which appeared to suit the requirements. Based on Galebreaker 'Bayscreen' ratchet tension system, a new stockproof product was, at the time, in the final stages of development. 'Stockscreen', is designed to be used instead of block walling for sheep or cattle, this revolutionary new product was ideal for providing the total flexibility required of the building.

Manufactured from black pvc-coated polyester and being 6% permeable this product has provided a 1.6m high wall which will retain the stock and can be fitted in minutes. The permeability causes no draught but maintains an internal temperature close to that of outside, which was found to be satisfactory in the tunnels. Being flexible it will not harm livestock; it is non-toxic and it can be pressure washed at 30bar which means the walls can be thoroughly cleaned.

The closeness of the mesh also keeps out the rain 100% which means that there have been no foot problems for the sheep or knee problems for the labour force as the bedding remains dry throughout, irrespective of weather conditions.

All sixteen bays were installed in under six hours which reduced time considerably on preparing a building to receive livestock. The nature of the product allows for the change of shape, or configuration of the building to suit any new requirement. With block walls, change is time consuming and expensive.

'Stockscreen' is therefore quick and easy to remove, it keeps the weather out, is

concluded at foot of page 124

Fig 1. Good light, good ventilation, peace and tranquility provided by 'Stockscreen'.

E H Martyn is with Reading Agricultural Consultants, Races Farm, Aston Street, Aston Tirrold, Nr Didcot, Oxon.

Machine vision and spectral imaging

Andrew Muir

Scottish Branch Meeting held at SCAE on 13 October, 1993

Andrew Muir presented an overview of some of the applications that are contemplated for machine (or industrial) vision within agriculture. Examples of how machine vision and spectral imaging can be combined to allow the detection and discrimination of plants and of diseased and defective produce were indicated. A range of hardware was displayed to demonstrate the possibilities of both machine vision and spectral imaging systems. In addition, a demonstration of endoscopy instruments, including fibre bundles, which can be used with the above systems to analyse 'difficult to get at' areas, was given. The contents of Jim Pascal's pocket revealed three Polo mints, a 1947 farthing and a used bus ticket!

Agricultural applications of these systems involve tasks which are repetitive, labour-intensive and/or require a human decision-making input. Crop sizing, inspection for disease and blemishes, animal grading and weed control are suitable cases for treatment. All these applications involve biological objects which have a natural variability and any automatic system must be sufficiently flexible to cope with this variability. Present methods, using human discrimination, for example on potato grading lines, can have an efficiency as low as 8%.

Dr A Muir is a Research Engineer at the Scottish Centre of Agricultural Engineering.

Machine Vision

Andrew outlined the processes involved which allow computer interpretation of an object. The system requires a video camera or other data collector and a digitiser to convert the signals from the camera into information which a computer can process. Individual objects can be scanned for linear dimensions and to a limited extent colour. By using an algorithm which correlates volume to weight, the system can be used as a weight grader, as, for example, on a potato grading line.

Spectral Imaging

This technique involves measuring the intensity of diffusely reflected light from a surface. The reflected light contains information about the absorbers near the surface of the material which modifies the reflection. By using different wavelengths across a waveband, it is possible to construct a characteristic spectral fingerprint for the material (eg healthy v diseased tissue). Eight specific wavebands ranging from 650-1650nm were found to be required to enable different diseases to be separated. For commercial application, detection time is a major problem. To analyse a complete fruit or vegetable, it is estimated that 1500 surface points would require imaging in up to eight wavelengths. With each discriminant algorithm consisting of perhaps 15 functions and 10-15 diseases/defects being scanned at a time, a high-capacity computing system is necessary if a product throughput of 10-20 units per second is to be achieved.

Andrew finally commented on the use of the system for weed recognition and demonstrated that there were opportunities for distinguishing weeds from a crop and either mechanically removing or accurately spraying the patches of weed.

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Continued from previous page

hygienic and will benefit the sheep so they will not be damaged if they run into it. Also this product provides good light and vision. A result of this appears to be that the flock enters and settles in the building very quickly with little stress.

The overall effect has been total calmness and freshness which effectively has reduced the workload during the lambing period due to easier management and handling of the ewes.

Conclusion

This building will allow Mr Parry to house his sheep in the right environment and in accordance with the farm's requirements. It will allow him to alter it instantly as far as the layout for the sheep is concerned and for other uses. For instance, the building could be used to house beef cattle or, should the situation warrant it, the building could be used for diversification outside agriculture.

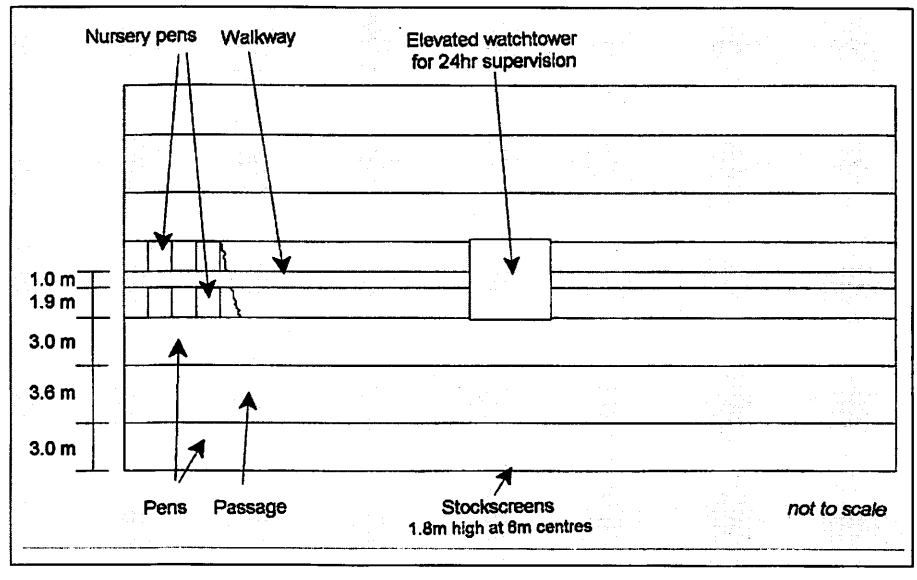

Fig 2. Layout plan of the sheep shed.

DIARY

January

25–29 Exhibition — **Agromek '94 Danish Agricultural Machinery Show**, Herning, Denmark. *Poul Pederson, Agromek, Hoejkolvej 24, DK 8210, Aarhus V, Denmark (Tel: +45 86 15 68 22; Fax: +45 86 15 19 51).*

26–27 Exhibition — **LAMMA '94 (Lincs Agric Manufacturers' Assn Exhibition).** Lincolnshire Showground, Lincoln *J R Marshall (Tel: 0522 750327).*

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21–26 Exhibition — **Industrial Production Technology Trade Fair,** Ulrecht, Holland. *John Gorton, Overseas Trade Show Agencies Ltd, 11 Manchester Square, London W1M 5AB (Tel: 071 486 1951).*

22–24 Exhibition — **Environmental Technology 1994;** Exhibition and Conference, National Exhibition Centre, Birmingham.

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23 Convention — **Appropriate postharvest technology for Third World development,** *Postharvest Technology Department, Silsoe College, Cranfield University, Silsoe, Bedford MK45 4DT (Tel: 0525 860428; Fax: 0525 861527).*

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April	**5–9**	**2nd European Congress on economics and management of energy in industry** – Lisbon.
	12	**The Environment and the Professions** – Seminar – London.
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	11	**Grassland South West,** Shepton Mallet, Somerset.
August	**21–24**	**Conference on Engineering in Agriculture,** Lincoln University, Christchurch, New Zealand.

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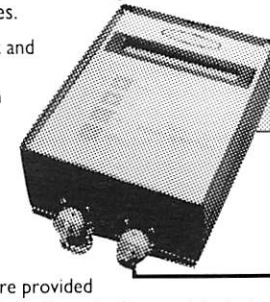

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