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SOIL and water

THE JOURNAL ON SOIL CONDITION AND FERTILITY

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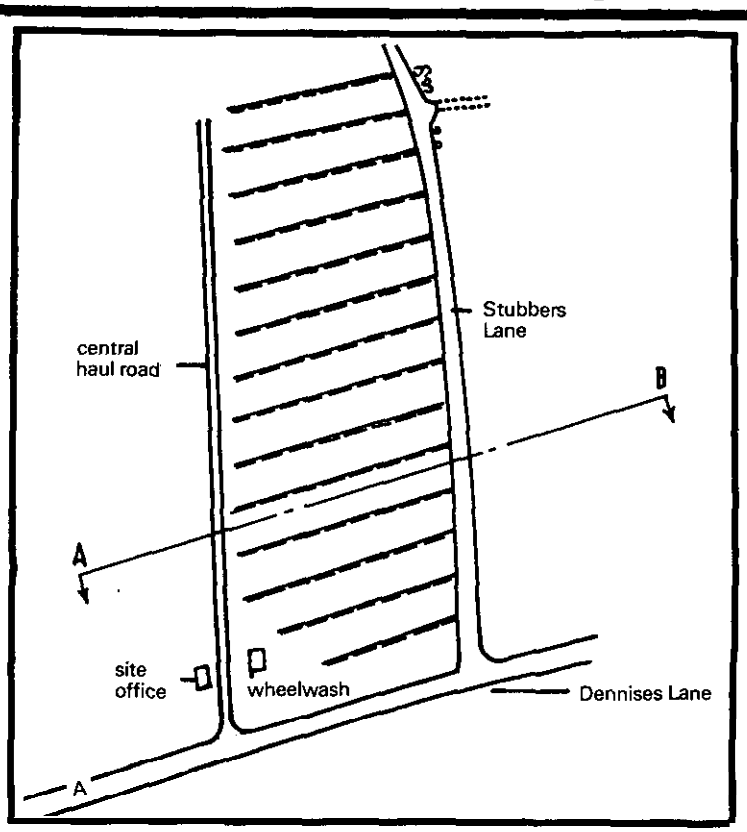
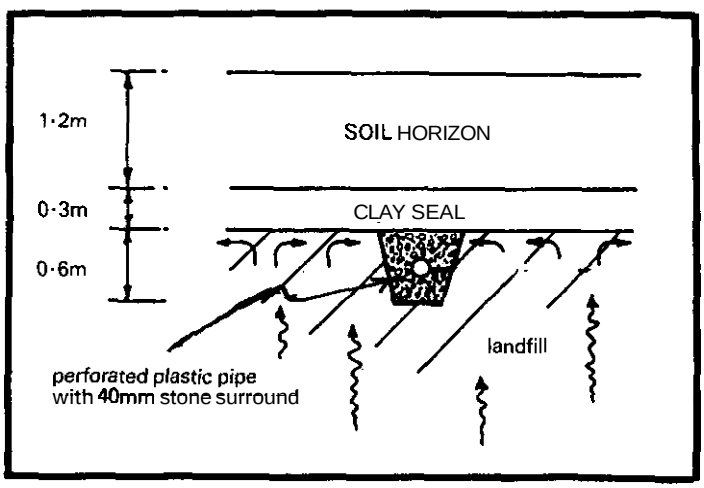
LAND RESTORATION – GAS VENTING SCHEME

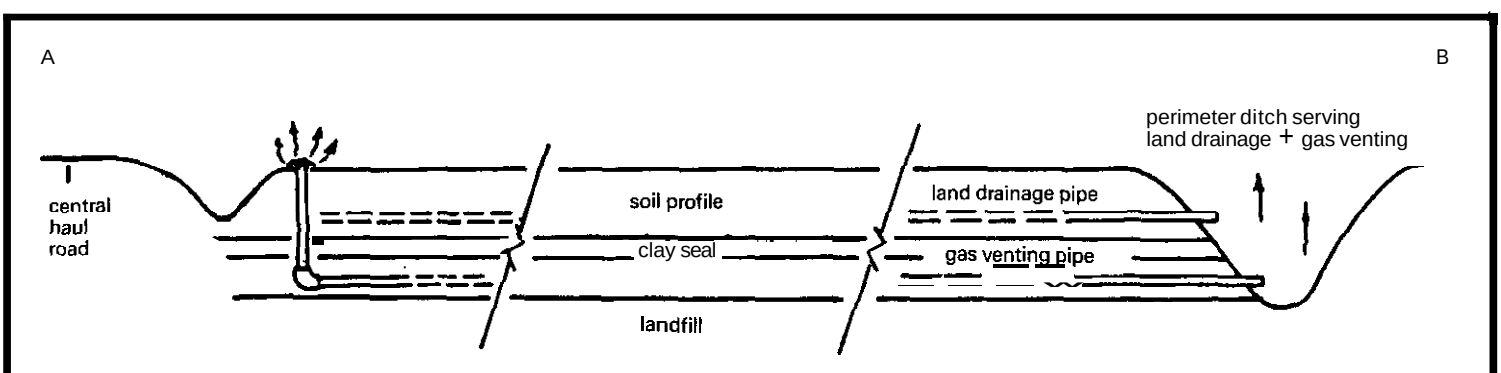
at St Albans Sand & Gravel Company's Great Sunnings site, Upminster, Essex



Plan of pipe layout (scale: 1:4000 approx)



General cross section



Cross section 'A'–'B'

SOIL and water

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Volume 15 Nos 3 & 4, Summer 1988

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SOIL AND WATER is the Journal of the Soil and Water Management Association. The views expressed in this publication are those of the contributors. The publishers disclaim any responsibility whatsoever arising from the use of the information contributed. The Association is a charity whose main objective is to promote the highest standards in the care of the soil: Britain's basic asset

Soil and Water is published quarterly and is SaWMA's principal means of promoting ever-improving standards of soil care and management, through the publication of research findings, scientific articles and practical information on the soil, its drainage, cultivation, irrigation and fertility. It is published for the benefit of the farmers and growers, researchers and advisers, consultants, manufacturers, contractors and others making up the membership of SaWMA.

Theeditor welcomes offers of editorial material and advertising requests; details on application. Soil and Water is generally available only to members of SaWMA or for promotional purposes, but extra back numbers can sometimes be supplied (£3.00 each plus p&p 30p UK). The annual UK SaWMA membership cubscription is £15.50 including VAT. (Overseas £18.00.)

Front cover: St Albans Sand and Gravel Company – gas venting system for land restoration. See pages 10-11.

MESSAGE TO MEMBERS

from the Chairman of Council

Dear Member

Firstly, a sincere thank you to all members who responded so generously to my appeal for donations to boost our funds and, as promised, this further issue of our Journal has been produced.

Looking to the future, and in discussions since our AGM, Council is now of the opinion that the interests of members would not be best served by continuing as an independent body. Meetings have therefore been arranged with various organisations who share interests similar to our own with a view to achieving a mutually acceptable arrangement to ensure that SaWMA's aims and objectives are fully realised in the future.

The most fruitful of our negotiations is currently taking place with the Institution of Agricultural Engineers, who themselves recognise the need to devote more attention to matters related to soil and water management.

In essence, SaWMA would become a specialist unit within the institution, with its own committee and responsible for its own programme of activities. Added to this, SaWMA would publish its own articles of special interest in the Institution's quarterly Journal and bi-monthly newsletter.

Whilst accepting the inevitability of a substantial increase in subscriptions and the loss of a degree of independence, this proposed union would offer advantages to both parties. The particular benefits to SaWMA would include:

- a close association with a professional body of high standing and international repute;
- a secure base for future development;
- regular publication of our own articles of special interest;
- improved access to a wider range of technical expertise.

Provided Council is satisfied that suitable arrangements can be worked out with the Institution of Agricultural Engineers, an extraordinary general meeting will be called, hopefully in late October, so that the necessary proposals can be put forward for discussion and final decision.

I have taken this opportunity to bring you up-to-date with our thinking and to let you know what we believe to be the best way forward for your Association. In the meantime, if you have any views or comments on these outline proposals, I and members of Council, would very much like to hear from you.

John Ray
Chairman of Council

CONTENTS

Permali Pultrusions help the grass grow

A strong, hygienic and corrosion-proof framework of Permali GRP pultrusions forms the core of the Harvest Hydroponics Grass Grower which can grow up to 500kg of animal feedstuff a day. The machine consists of a triple-glazed chamber in which trays of seed are cultivated under controlled conditions over a three to four day cycle.

Harvest Hydroponics Ltd of Aldermarston, markets the machine in four different sizes, the largest of which is capable of producing enough feed for 20 milk cows, 50 lactating mares or 500 fattening lambs every day. All models require only a clean water supply, 13 amp 220/240 V mains electricity and a level concrete standing under cover, with adequate drainage.

The machine is normally used for barley grass, hut is equally successful with any seed, and is designed to sustain continuous production all year round, regardless of weather conditions. Only unskilled labour is needed at an average input of 30 to 40 minutes a day. This is required mainly for pre-soaking the seed, removing the trays, cleaning and sterilising. Temperature, air circulation and water mist are all regulated by automatic controls.

Harvest Hydroponics has already sold its machines to racehorse breeders, including the Earl of Carnaervon, and for export – to Switzerland, where it grows culinary herbs on a commercial scale, to America for growing Kentucky Blue Grass to feed racehorses, and to several countries in the Middle East where it helps to feed camels, rabbits and goats as well as police horses.

CRP Pultrusions from Permaliform a strong corrosion resistant frame for the Harvest Hydroponics Grass Gmwer

Agricultural Engineers honour Gordon Spoor

SaWMA Council Member, Professor Gordon Spoor, has been honoured by the Institution of Agricultural Engineers with the presentation of the Douglas Bomford Trust Meeting Award for 1988.

The award to Professor Spoor is for his paper 'Developments in machinery and techniques for improved soil and water management' which he presented at the Annual Convention of the Institution, 12 May 1987.

Gordon Spoor is Professor of Applied Soil Physics at Silsoe College, Cranfield Institute of Technology.

The Award, in memory of the late Douglas Bomford, is made annually for the best technical paper presented at an Institution Conference and subsequently published in the journal "The Agricultural Engineer".

Priestman Mustang 2-11

Sanderson (Forklifts) Ltd, Croft, Skegness, announce a brand new wheelmounted addition to the Priestman range of 360° Excavators. The Mustang 2-11 has a 3.4:1 two speed gearbox mounted dimctly to the rigid rear axle and with pm-selector automatic gear change and variable displacement piston motor it matches tractive effort and speed to provide confident and relaxed driving on both mad and site. Features include Hydrostatic drive and a simple 3 mode electronic 'operation selector:

Irrigation Management Services

On page 8 of our Spring 1987 issue, we incorrectly referred to Irrigation Land Management Services. The correct title is Irrigation Management Services and the phone number is Cambridge (0223) 276002.

The new ADAS

ADAS needs no introduction as a service offering farmers the benefit of sound advice backed by experience and research.

However, now we have a new ADAS with changes in organisation and better equipped than every before to offer the professional advice and expertise necessary in today's fast moving business environment.

A special brochure is now available setting out the comprehensive range of the new ADAS services. Entitled 'The Challenge of Change' the brochure incorporates a tear-off slip inviting farmers, and others, to apply for more information on ADAS services on subjects such as:

– Livestock – Land Management – Cropping – Product Marketing – Business Management – Research and Development – Laboratory – Design.

Further details are available from any of the ADAS Regional Offices.

V15 - 304.

PIPELINE...PIPELINE...PIPELINE...PIPELINE...

A pack of 170 x 100mm (4 inch) Oakland clay land drains with shrink wrapping applied. Packs of 75mm (3 inch) diameter contain 298 pipes.

Added Protection

As an additional safeguard whilst in transit or in storage, packs of clay land drains are now available on request with protective shrink wrapping from Henry Oakland & Sons Ltd, of Escrick, York.

Packs are made up on base boards to facilitate fork-lift handling for the convenience of contractors. The pipes are firmly retained by strap banding, allowing the pack to be fully uncovered or exposed progressively as required.

Nitrogen losses down by 60 percent

Omex Agriculture Ltd, suppliers of 32% Alzone with nitrogen inhibitor report on user experience.

Last Spring, Paul Marris, who farms 515 acres at Harpswell, Lincs, and 122 acres near Scunthorpe in South Humberside, had samples of water taken from outfalls into one of his dykes and analysed by his regional water authority.

The results indicated that where the nitrogen inhibitor dicyandiamide (trade name Didin) had been used, nitrates in the water were reduced from 34.1 mgs per litre to 13.6 mg/litre.

"If leaching is being reduced so dramatically': says Mr Marris, "that should mean I can cut down by 30 units of N and save £5-£6 an acre, which will pay for the cost of the Didin, reduce leaching, and still maintain yields!'

Mr David Featherstone, Managing Director of Omex Agriculture Ltd, said Mr Marris's findings were in line with eight years of replicated lysimeter tests in Germany. He stresses that there is still a lot of research to be done in the UK.

Alleviation of soil compaction

News from Sachs-Dolmar (UK) Ltd of Denton, Manchester is that they are now launching on the UK market their remarkable new machine, the Robin Dagger soil ameliorator, developed to alleviate soil compaction.

The Dagger has a powered thrust of some 2ft into the soil, injecting a 35 litres blast of compressed air at 150psi. This gives a circle of aeration to the subsoil of up to 2 metres diameter.

A robust Robin 37.7cc two-stroke engine drives the compressor and also winds up the recoil spring which fires the injector into the ground.

Sachs-Dolmar see the Dagger as ideal for sports ground contractors, tree specialists, horticulturalists and farmers. "It improves drainage, stimulates root growth and effectively alleviates soil compaction in any ground situation where compaction has created fertility problems:' The Dagger can also be used to inject fertilizer and other plant care materials into the subsoil without any disturbance to the roots or the surface.

A company spokesman reports that the Dagger is expected to become widely available through the Sachs-Dolmar nationwide network of dealers, in July, at some £2,600 each. The first machines available in the UK are reportedly commanding hire fees of around £200 per week.

Bird Conservation

Threats to birds from land drainage, forestry, overgrazing, building developments, tidal barrages and the acidification of rivers, are highlighted in a major new publication from the Royal Society for the Protection of Birds.

The RSPB Conservation Review* provides, for the first time, a detailed look at the Society's conservation work. The first 96-page issue covers bird conservation and research on lowland wet grasslands, on estuaries, at sea, in the uplands and in broadleaved woodlands.

The Review is not a scientific journal. It is aimed at a wide audience, from the committed conservationist to the man in the street. Its contents will be of interest to bird-watchers, landowners, farmers, timber growers and water authorities, as well as RSPB members.

* Available from RSPB, The Lodge, Sandy, Beds SG19 2DL – £3.00 (including p&p).

Fertiliser Manufacturers appoint Scientific Adviser

Dr Denis Hardwick has been appointed to the newly created post of Scientific Adviser to the Fertiliser Manufacturers Association (FMA) with effect from 1st January 1988.

Dr Hardwick was formerly the Senior Pollution Adviser at the Ministry of Agriculture, Fisheries and Food.

At the FMA his responsibilities will include negotiating and overseeing FMA involvement in the new research projects which it is to fund. He will also represent the FMA at the scientific level at conferences and in its dealings with government and the European Commission.

Plea for sponsors

MSc Course – Conservation of Soil Fertility

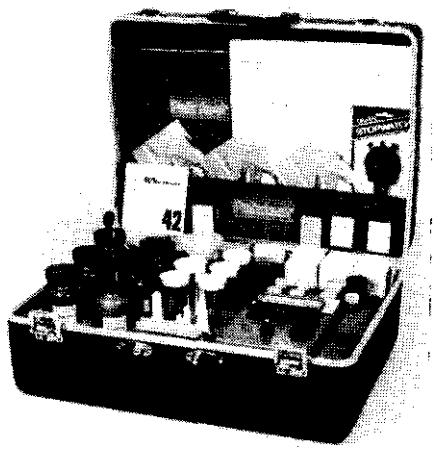
This one-year, post graduate course for study of soil fertility conservation attracted a considerable interest last year from a number of well qualified prospective students.

The only difficulty is that several students seeking to take the course last year were unable to do so for lack of funds.

Commercial sponsors are needed – firms with an interest in promoting and developing their expertise at home and abroad. There could be money in it – for the student and for the company.

If you think your firm could benefit by sponsoring a student on this Soil Fertility Conservation course, please contact Dr Burns, University of Kent, without delay. (See page 21, this issue of Soil and Water).

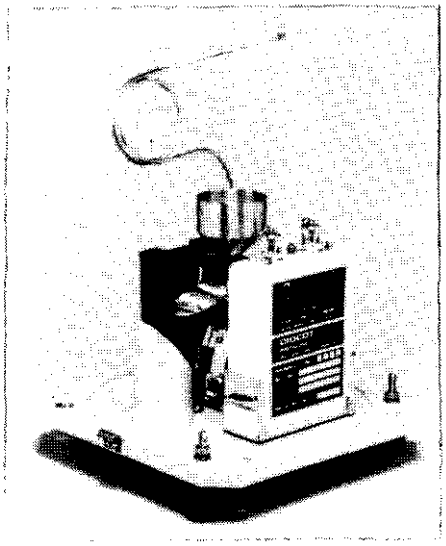
SIMPLIFIED **SOIL** TEST **KITS GIVE** QUICK RESULTS



A new mnge *of* simplified soil test kits, developed by Wilkinson & Simpson Limited under their *brand* name *Palintest, is* claimed to give *accurate,* on *the* spot results for farmers and growers.

Wilkinson *& Simpson* Limited, *Gateshead, 091 487 2164.*

Accurate precipitation monitoring with dedicated data logger and raingauge team



A Didcot Rainlog dala logger with a *tipping* bucket *assembly behind if, tipping* to *the* left.

The **Didcot Rainlog** is a standalone solid state data logger for use in conjunction with a Didcot tipping bucket raingauge. The resulting combination offers a highly accurate means of measuring precipitation.

Heart of the raingauge is a stainless steel bucket assembly with 'splash-out'-proof collecting funnel. Both are constructed for best possible corrosion protection, and maximum strength to avoid frost damage. They are enclosed within a stainless steel septum.

Three sizes of bucket are available in the tipping bucket raingauge – 0.5, 0.25 or 0.2mm/tip 1.0%. With a 0.5mm sized bucket, the Rainlog will record a minimum capacity of 800mm of rain over 4 years, and a maximum capacity of 3750mm over 5 days.

The Rainlog is connected to an Epson HX20 portable computer which is used for both setting up and data collection. Results can be stored on microcassettes or, if preferred, printed out via an Epson RX80 dot matrix printer.

Both the Rainlog and the tipping bucket raingauge are offered complete with 5 year guarantee and can be purchased directly from the Didcot Instrument Company, Thames View Industrial Park, Station Road, Abingdon, Oxon OX14 3LD. (Tel: 0235 22345.)

News of Mike Saull

Mike Saull

Mr Mike Saull has joined Agrafax Public Relations of Shrewsbury and Chislehurst as Arable Accounts Manager.

Following University, Mike had a nine month tour with the Forestry Commission in Scotland. He joined SaWMA as Technical Secretary in 1982 and later transferred to he manager of the NAC Arable Unit.

HRH the Princess Royal – Visit to farm waste digestion plant

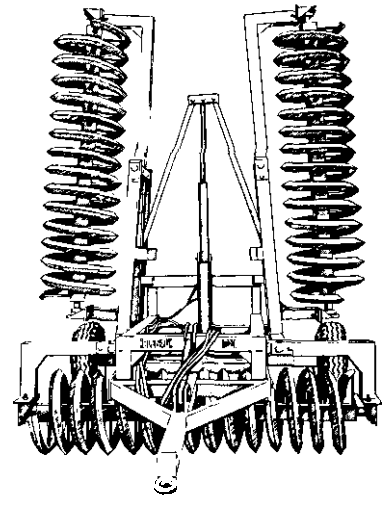
Once regarded as little more than an interesting possibility, anaerobic digesters are now being increasingly used to control pollution effect, smell and other problems associated with organic waste. This growth is becoming so rapid that the specialist digester building company, Farm Gas Ltd, has virtually doubled its workforce (to more than 80 people) in a single year, and their newly extended Shropshire factory was officially opened at the end of April by HRH The Princess Royal.

The Royal visit included a tour of a digestion and separation plant operating on a nearby farm, where HRH was shown how the process, in addition to its environmental benefits, refines the waste into three potentially valuable elements – methane gas, a nutrient rich liquid, and a compostable solid. The Princess Royal saw the liquid, which provides the sole fertilizer for the farm's grassland, being spread by irrigator; and also stopped for a cup of coffee prepared on the methane-fuelled Rayburn, which provides heat and cooking for the farmhouse.

On this particular farm, the solids are simply used by local gardeners; but on a cattle farm in Northern Ireland, which has a similar, but larger, FGB digestion plant, the solids are composted and sold; grossing £50,000 over three seasons.

Farm Gas have already built 50 prefabricated digesters on sewage treatment works, farms and abattoirs; and in addition to a number of new sewage sludge treatment plants, digesters are also currently under construction on a large pig farm, three dairy farms, including one in Holland, and three small abattoirs, where farm waste will also be treated.

Farm Gas address is Industrial Estate, Bishops Castle, Salop. Tel: (0588) 638577.)



With a working width of 20 *feet,* the new Blench hydraulic folding rolls are available *with* 24 *inch rim* or *as frames* only.

Plant growth rooms simulate any environmental conditions

A combined refrigeration and heating systems installation has recently been completed by General Refrigeration Ltd. The project consisted of the construction of four plant growth rooms. Each room is nine square metres in size and includes all the equipment needed to create a complete spectrum of environmental conditions.

It is necessary, within these plant growth rooms, to be able to simulate the climatic conditions of any particular country. This includes a twenty-four hour temperature variation cycle which is achieved by a combined heating and refrigeration system. In addition, the fluorescent lighting and Laminar Air Flow has been incorporated within this intricate project. The fluorescent lights create night and day, regulated by time switches, that establish dawn and dusk as well as winter and summer. The sophisticated control panel for this complex installation maintains the required light, heat, relative humidity and concentrations of each to simulate the actual conditions required.

Further information from Mr R B Dale, General Refrigeration Limited, Station Road, Woodbridge, Suffolk IP12 4AU.

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PIPELINE...PIPELINE...PIPELINE...PIPELINE...

Training for farmers in Conservation Management

An ATB training initiative in conservation management, to help improve the appearance of farmland and enhance its value as a habitat for wildlife, has been welcomed by the Minister of State for Agriculture, the Rt Hon John Selwyn Gummer.

Nine courses, designed to assist farmers and landowners integrate practical conservation into everyday farming activities through sympathetic management practices, were launched in March at ICI's Jealotts Hill Research Station in Berkshire.

Developed during the European Year of the Environment by the Agricultural Training Board with sponsorship from ICI Agrochemicals, the range of courses cover all aspects of conservation management on the farm.

The training has been welcomed by the Farming and Wildlife Trust with which the ATB has forged a close working partnership. Speaking at the launch their National Adviser, Eric Carter CBE, said: "The design and development of these training courses is a very good example of partnership in countryside management. The Farming and Wildlife Trust is delighted with the close co-operation between the ATB and the farm conservation advisers working with local FWAGs."

The invaluable role played by ICI Agrochemicals in sponsoring this particular project was highlighted by ATB Chairman, John Clayton CBE, who said: "With a growing demand on ATB time and resources for the development of new areas of training it would have been impossible for these courses to have been available so soon without the sponsorship of ICI Agrochemicals."

Nitrate removal filter

We are told that, for the very first time, a true nitrate removal filter is now available, specifically designed to remove selectively all nitrates from water. The new filters are based on a special ion exchange material which will remove all nitrates and most sulphates from a potable water supply while leaving all the beneficial minerals like calcium, magnesium, iron and sodium untouched.

The special filter medium is of 'food grade' quality, meaning that it has passed the stringent tests for use in treating waters for human consumption and, most importantly, this new filter medium is totally 'safe' for domestic and/or inexperienced use because, unlike previous materials the new material does not increase the nitrate levels on the output water when it is exhausted – it simply does not remove any more nitrate!

Three models of filter are now available from a range, manufactured by Aldous & Stamp Ltd, the Beckenham based water treatment specialists. (Tel: 01 659 1833.)

WELL-VOID Steel Drainage Culverts Tested and Approved

Tests of the WELL-VOID Extra Plus Culverts manufactured by Wells Spiral Tubes Limited have shown them to be suitable for all normal highway and agricultural installations subject to DTp and ADAS design standards.

The tests were conducted by ADAS Design Services on lengths of culvert installed in varying depths of cover and in varying bedding and load conditions.

Wells Spiral Tubes Limited (Airedale Road, Keighley, West Yorkshire BD21 4LW.) manufacture a complete range of corrugated and smooth bore tubing for applications such as heavy duty drainage culverts, pile liners, etc.

Underground piping systems protected from root intrusions

Technology originally perfected for use in radioactive waste disposal is now available to benefit farming.

The basic research was carried out by the Batelle Institute for the United States Department of Energy and involved the development of a 'biobarrier' to prevent roots growing into the waste disposal sites. Now that same technology is being used to stop roots from clogging buried drip irrigation systems.

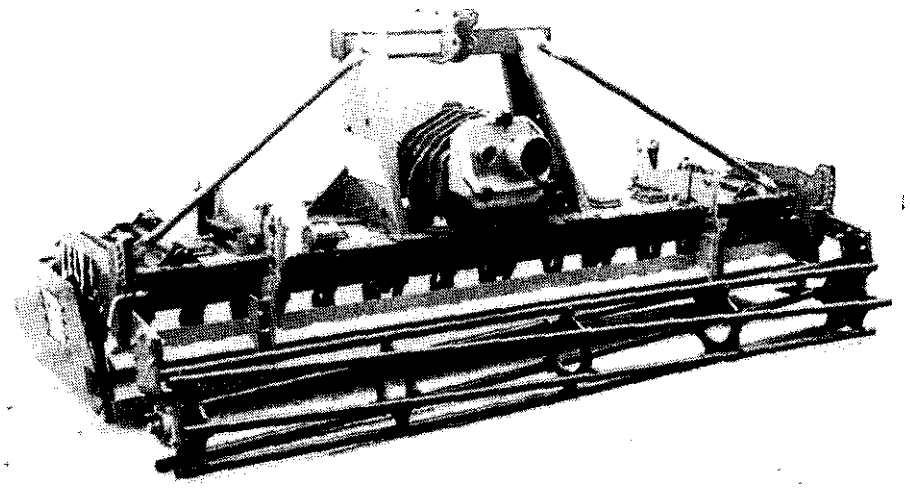
Working with the Batelle Institute under a technology transfer agreement, the US company Agrifim is to manufacture and market special drip emitters under the trade name Root Stop™.

The technology of the 'biobarrier' is the marrying of an existing root-growth inhibiting herbicide with rubber or polymer. The rubber or polymer acts as a reservoir for the herbicide which is slowly released at a uniform rate to a small zone of soil around the dripper. It can prevent roots and vegetation from growing into the drip emitter for up to 125 years while permitting the natural growth of above-ground vegetation.

The type of herbicide used has been available for more than 20 years and is approved for use by the US Environmental Protection Agency to control weeds in more than 50 crops and for certain landscape applications. It does not harm beneficial ground cover, birds, mammals or insects. In addition, the herbicide is not significantly water soluble and does not accumulate in plant tissues.

With modification, biobarrier-based products can prevent unwanted root growth or vegetation in areas such as sewer lines, roadways, sidewalks and driveways, building and house foundations, tunnels, dams, tennis courts and swimming pools.

PIPELINE...PIPELINE...PIPELINE...PIPELINE...



The *Lely* 33 Series *Roterra* power harrow

Recent introductions to the Lely range of Roterra power barrows are the 3 metre 20 series with 100 hp gearbox and the 3 or 4 metre 33 series with 160 hp rating.

Further information from Lely UK Ltd, St Neots. (Tel: 0480 76971.)

Major survey to check state of Rights of Way

The first-ever national survey of the state of footpaths, bridleways and byways in England and Wales will be carried out over the next six months.

The Countryside Commission has contracted consultants, the Travers Morgan Group, to organise the survey, which will cover some 150,000 square miles – based on 150 squares, randomly chosen by computer from the national grid.

Teams of volunteers will carry out most of the survey work, first of all checking the legal record of rights of way held by the highway authority. Then they will walk or ride all the footpaths and bridleways in their survey area, collecting information on the condition of each route, how easy it is to follow, the condition of gates, stiles and bridges, and any obstructions or hazards.

The Countryside Commission estimates from previous studies that up to half of all rights of way are currently difficult or impossible to use.

Survey methods, designed and tested for easy and consistent use by volunteers, are described in a manual which is also available to people wishing to carry out their own local surveys.

Water Retention Aid

A water retention aid that increases the water holding capacity of soils has been developed by Allied Colloids and is now being marketed by their agricultural division Atlas Interlates.

It is Alcosorb, a synthetic copolymer that is able to absorb more than 400 times its own mass of water, yet makes this water available for plant root uptake. It is non-toxic to plants, animals and humans and non-corrosive.

Alcosorb has been developed for use in agriculture, horticulture and arboriculture in areas where in addition to sunlight, the availability of water is the most important factor governing plant growth.

As well as increasing the water holding capacity of soils and other growing media, it reduces water loss and wastage, improves plant productivity, aids plant establishment, increases transplant survival and saves time and watering costs.

Atlas Interlates, Gladden Place, Skelmersdale, Lancs WN8 9SX. (0695) 33535.

Johnsons JR Range of Reclamation Mixtures

JOHNSONS SEEDS of Boston has issued a new colourful brochure for the JR range of Reclamation Mixtures based on the unique and versatile British bred red fescue Merlin. The eight page brochure lists 10 mixes carefully formulated to cater for extreme conditions which are beyond the capabilities of the conventional turfgrasses used for sports turf and amenity areas.

There are mixtures recommended for sites contaminated by the heavy metals lead, zinc and copper or simply infertile conditions that may be drought prone with very high or low pH's. Saline conditions relating to coastal regions or highway verges are also catered for together with Pioneer Mixes based on a paired array of 6 legumes – 2 annuals, 2 short and 2 long lived perennials with their specific bacterial inoculants.

Copies of the brochure are available free from Geoff Taylor, Johnsons Seeds, London Road, Boston, Lincs PE21 8AD.

Specialists in Pit, Reservoir and Tank Liners

A comprehensive illustrated brochure explains the integrated liner service – from consultancy to installation – offered by the Dunstable Rubber Company.

Two types of membrane liners are found to meet the majority of application needs. For the more demanding application the company recommends their liner based on Du Pont HYPALQN synthetic rubber. Features of this material include:

- resistance to an extremely wide range of agressive fluids
- outstanding resistance to weathering, oxidation and UV rich sunlight
- resistance to soil chemicals and micro-organisms
- high seam integrity.

Dunstable Rubber Company. (Tel: 0582 607718.)

BOOK NOW
the next
Soil Management Course

3rd –6th January 1989
Silsoe College, Beds MK45 4 M

Slurry into Compost and High Protein Feed

Comprostein Ltd of Calne, Wiltshire, aims to establish a number of processing units throughout the UK capable of converting animal wastes into composts and high protein feed.

The first such plant is planned for Humberside and will be able to handle the slurry from 100,000 pigs. The resulting products are expected to be priced competitively against industrial fertilisers (for the compost) and against imported soyabean and fish meal (for the feed).

Further benefits are seen for the pig producers – who will be able to sell the slurry to the processing plant, and for the countryside at large – with a reduction of the pollution hazard from field spreading of slurry.

Work is now in hand to dwelop a similar process for treatment of cattle slurry.

Dr Shaw, Director of Comprostein, sees the rapid establishment of such slurry processing plants as vital to the aim of reducing pollution in streams, rivers and water supply throughout the UK. "If entrepreneurial sponsors cannot be found quickly enough, then the national benefits warrant urgent Government support. Already Continental interests are taking up the process and large processing plants are being set up in Italy and the Netherlands:'

Further information from Dr R Shaw, Comprostein Ltd, 140 Lansdowne Crescent,-Derry Hill, Calne SN11 9NU. (Tel: 0249 813169.)

V15 - 3&4.

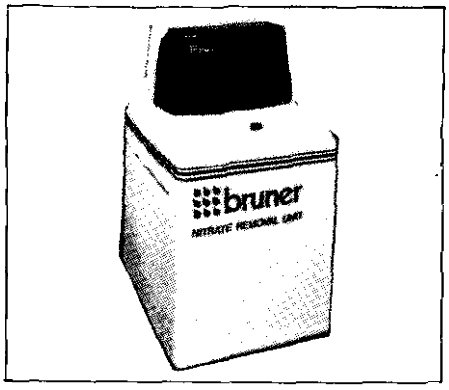
PIPELINE...PIPELINE...PIPELINE...PIPELINE...

Nitrate Removal Unit

An all new Nitrate Removal Unit has been developed by Bruner/Plaseuropa Limited.

t economic cost to the purchaser and with little maintenance requirement the unit will remove nitrate levels in excess of the EC danger level of 50ppm to well below the EC guide level of 25ppm.

Bruner/Plaseuropa Ltd, (0763 62197.)



The Bruner Nitrate Removal Unit

Applications library helps choice of analysis method

Devising the best method for carrying out an analysis is made easier through the latest service offered by Ciba Corning Sales and Technical Support Centre (STSC).

The new facility covers routine and unusual analyses using pH/ISE meters; flame photometers; colorimeters; and chloride meters. Through their method development scheme Ciba Corning has built up a large library of applications for their range of analytical instrumentation.

Dialling STSC (0787 474742) puts one in touch with qualified staff who can instantly call up relevant details from the database and despatch one of over 150 method sheets currently available. Should the application be one not previously encountered, a suitable method can be developed.

Ciba Corning has also incorporated this data into a number of detailed 'Guides' and easy reference Wallcharts.

Conference to promote environmentally acceptable techniques in agricultural water management

As noted in our Diary column on page 31, 25 September 1988 sees the start, at Dubrovnik, Yugoslavia, of a week's programme of Conference papers, working group sessions, exhibition and field outings concerned with irrigation and drainage.

The occasion is a coming together of the 39th meeting of the International Commission on Irrigation and Drainage (ICID) and the 15th European Regional Conference on Agricultural Water Management.

Keynote speakers at the ICID meeting and a range of papers to be presented at the European Conference will recognise the need for irrigation, drainage, flood control projects, etc, to take account of consequential environmental problems. The Conference will particularly be aimed at highlighting cost effective and environmentally acceptable techniques in agricultural water management.

Details of all events are available from: Dr Brane Matičič, ICID Organising Committee, Biotechnical Faculty, Jamnikarjeva 101, 61000 Llubljana, Yugoslavia.

'Take-Away' effluent disposal

Now available for industrial use is the LEIGH waste effluent 'take-away' facility.

The principle of operation is that appropriate columns of ion exchange cartridges are linked in to the waste water system. Toxic ions are removed from the waste water and collected in the cartridges. A colour indicator shows the state of the charge of each cartridge and, when fully loaded, the cartridge is replaced and sent to the Leigh central Regeneration Station. There it is processed, checked and then returned to the customer for re-use.

Capital costs for the system are said to be generally much lower than for conventional effluent treatment plant and other major benefits for the user include:

- no need for waste water test facilities nor for the skilled personnel to monitor them
- no purchasing or storage of treatment chemicals
- no sludge disposal problems.

"Putting it simply" says Mr Peter Young, Director of LEIGH POLLUTION CONTROL, "employing a central waste water treatment service such as LEIGH's can be compared to sending out washing to the laundry rather than doing it oneself in the back scullery."

Leigh Pollution Control are at Wolverhampton. (Tel: 0902 791616.)

Corporate Members

SaWMA gratefully acknowledges the support of the following towards its objective:

***Promolion** of the highest standards in the care of the soil*

ADAS Land and Water Service
Agricultural Training Board
British Gas South Eastern
J W Chafer Lld
Drinkwater **Sabey Ltd**
Geomorphological Services Ltd
ICI Plant **Protection**
Lord Rayleigh's Farms Incorporated
MAFF **ADAS** Soil Scientists
Henry **Oakland** and Sons Ltd
Pettifer Drainage and Water Services
Sand and Gravel Association **Ltd**
Silsoe College
Soil Survey and Land Resource Centre
Strutt and Parker (Farms) Ltd
Watkins Nayler and **Co Ltd**
West of Scotland Agricultural College
William Scott Abbot Trust

Liebherr Great Britain has recently delivered a third hydraulic excavator to Witham Third Internal Drainage Board for use on the Board's ongoing watercourse maintenance and improvement programme in Lincolnshire.

The latest addition is a long undercarriage version of Ihepmven R902 and carries extended reach equipment of an 8.20 metres boom and a 6.10 metres dipper: A Mastenbroek weedcutting bucket is fitted — similar to the kind of bucket also carried by two other Witham Liebherrs.

The hoard's drainage programme involves the clearance of river and dvke bed weeds and bank undergrowth; silt dredging and re-grading works.

Further information: Martyn Dadswell, Liebherr Great Britain Lld. (Tel: Hatfield 107072) 68161.)

Bringing a quarry back to life

Malcolm Reeve* reports on the SaWMA field meeting at Bush Farm and Amwell Nature Reserve–restoration sites of the St. Albans Sand and Gravel Company.

Significant areas of land are disturbed each year by aggregate workings and are eventually restored to a beneficial after-use. Often, the prior use was agriculture and restoration has been to agriculture but, increasingly, restoration to other after-uses is receiving attention.

It was with this background that a small party of SaWMA members visited two restorations in the Home Counties on a hot and humid day (yes, there were a few!) in July last year.

In our visit we were joined by a group from the North East Polytechnic and a member of the NERC. Our host was the St. Albans Sand and Gravel Company, more specifically John Spreull the director, their farm manager and two consultants, Stuart McRae and the Reverend Tom Gladwin.

Ploughing at Bush Farm showing the quality of soil texture

Variety of restoration treatments

Bush Farm is a well-known agricultural restoration set up in June 1974 by a steering group comprising representatives of the Department of the Environment, the Ministry of Agriculture, Fisheries and Food and the Sand and Gravel Association. The experiment, near Hornchorch in Essex, charts the soil stripping, storage, filling with waste and eventual reinstatement of a tract of mainly grade 2 agricultural land, successively quarried as four adjacent blocks (quarters).

A variety of treatments affecting soil handling, filling methods, cropping and post-reinstatement agricultural management have been applied to the quarters, the aim being to achieve a high standard of agricultural restoration under commercially acceptableconditions.

After an introductory video at the visitor's centre, Stuart McRae took us up to the restorations and explained the history of the experiment and problems in interpreting the results. Since reinstatement, the restorations have been peppered by auger holes drilled by a variety of MAFF agencies and consultants trying to agree on the final agricultural quality.

Apart from ensuring good vertical drainage, these augerings have not resolved the issue, though the site has achieved good arable yields since restoration.

At the time of the visit, the quarters carried a reasonable crop of wheat, though with some differential ripening visible in the first quarter as a result of landfill gas seepage.

Particular problems identified were the lack of detailed pre-working soil information for the site and the lack of experimental replication.

We were told that the Company now sows winter wheat (rather than a three-year grass ley) as a first crop following soil restoration. For a number of reasons this is considered to be more beneficial to the soil but it is recognised that the practice requires more farming expertise and equipment.

Amwell Quarry, now a nature reserve, and the winner of many awards for wildlife conservation. Tern rafts in distance.

*Soil Survey and Land Resource Centre, Derby.

Gas ventingpipes *be*ing in-rolled ar Great Sunnings.

Clay seal and gas venting for degradable fill

From the Bush Farm experimental restorations, we moved to the adjacent Sunnings Land restoration where a system of pipes has been installed under a 'clay' seal in order to achieve control where landfill gas is vented to the atmosphere. Our raconteurs explained the technicalities of the installation, but here they had to compete for our attention with a cloud of thunderflies which quickly descended upon us!

It was explained that all restored sites where degradable fill is used have a gas venting scheme similar to that evolved in the trials at Great Sunnings (see sketch–front cover). These venting systems are still being monitored. Some leakage has been detected but this is thought to be the result of damaging the sealing layer when in the process of installing the land drains.

Wildlife reserve attracts many species

After an excellent buffet lunch we moved onto the Amwell Quarry in the Lower Lea Valley near Ware. Here, former grazing meadows have been quarried and reinstated, not to agriculture, but as a wildlife reserve.

The Reverend Tom Gladwin, a keen amateur naturalist, has been retained by St. Albans Sand and Gravel to advise the company, and was on hand to show the visiting party around the reserve. With considerable enthusiasm, he explained just what they had achieved and the variety of wildlife attracted to the reserve–l69 species of bird (several scarce in Hertfordshire), 300 species of higher plant (15 of them scarce in Hertfordshire). 16 species dragonfly (the richest site in Hertfordshire), including the rare damselfly.

It was clear that restoring for wildlife is not just an easy option of leaving wet holes in the ground to re-colonize. Lake margins have been graded to form shallow, marshy areas and small pools have been created. Fly ash has been introduced to one area to produce a calcareous marsh 6–9" above water level, into which orchids have been introduced. Woodland, grassland and birdlife are managed to maintain a satisfactory balance of species.

All in all the day was thoroughly instructive and enjoyable, thanks to St. Albans Sand and Gravel.

Drilling and Straw

Bill Butterworth reviews the knowledge and experience to data

Drilling in the presence of straw is quite feasible. The toxins released from straw as it decomposes can be lived with. Costs can be reduced and yields, in some situations, lifted a little. It is certainly possible to direct drill into a stubble and produce top yields. It also looks as if drilling through chopped straw left by the combine is quite feasible and maybe even attractive.

We know that "trash" farming is practised in many countries. It is certainly possible to drill through trash and produce crops. In the UK the argument has been that we produce better yields and it is because we remove straw from the seedbed. The argument has been supported by Letcombe that showed that toxins, probably acetic acid, are released from the straw as it decomposes and these can, and do, affect germination and establishment.

The Three-disc drill

There is no doubt that these toxins exist, and the Letcombe work did help understand why direct drilling with a 3-disc drill sometimes produced patchy establishment. That observation is the key to understanding how to live with straw.

The 3-disc drill was a dramatic step forward. It opened up direct drilling as a world lead for UK farmers. Used under the right conditions it was, and still is, a very successful piece of equipment.

The phrase "under the right conditions" is, however, vital. The 3-disc drill has a problem – it creates a slit into which straw and seed are pressed.

The 3-disc drill creates a slit – it is a discrete, well defined slit. That, for a start, is hardly an ideal place to put a seed. Secondly, it would necessarily put straw, if present, next to the seed. If toxins arose (as they would) they would be next to the seed. The seed would suffer. It did.

Direct drilling with a 3-disc drill in the presence of straw was, and is, unreliable.

Seed must be separaled from straw

The problem was to separate the seed from the straw,. It now appears that this need be by only quite a small distance with soil put. between the two. This distance, on an absorbent clay, may be only a few millimetres.

The logic is to put seed in the soil with soil firmed round it and straw separated from it. This is a key realisation in drill design.

The German Horsche system uses a wide rotavator with a seed bar under the rotor. The machine is driven into chopped straw left behind the combine. High speed rotor work allows the seed bar to leave the seed on a shallow furrow bottom. Soil and straw mixed are thrown up behind the machine with soil falling first and straw on top. Inevitably there is also some soil/straw mix which helps surface stability, avoidance of capping and straw decomposition.

In general, this technique has been enough to stop major toxin problems. The system does work and is quite widely used in Germany. However, there are some limits. Fairly high rotor speeds are necessary to allow the seeder bar free travel and some soils do not respond well to such treatment for several years in succession. The system also demands power.

UK technique – nurse stubbles

Research in the UK has followed a different tack. A drill with a tine bursts the soil and tends to wipe straw from the track created. It has been observed that stubble will maintain a soil surface through the winter rather as will a coarse 'nurse' tilth. It will keep it stable, free from capping and able to breathe.

Drilling with a tine into a stubble can, and does, work remarkably well.

The ADAS results over several years show variable results but still, on average, remarkably good. If the results are variable, this means we need to learn more. If the results are on average good, we have very attractive economies.

The fact is that Nurse Stubble drilling is an attractive way forward. It does work and it can produce top yields. Most of the work done so far has been done with the drills that happened to be available rather than the best for the job. Nevertheless, the results are more than interesting, they are highly significant.

ADAS trials and results

Over the last four years on the heavy soils at Boxworth EHF direct drilling into stubble has given better results than drilling after burning. Best yields have followed shallow (15cm) straw incorporation, while ploughing has produced the poorest results.

These results back up earlier work by ADAS into the effects of straw incorporation (see Table 1A & B).

Two years work at Boxworth shows that drilling directly into chopped straw is perfectly possible, and we already have tools to do the job.

Whilst drilling into incorporated straw gave marginally better yields in 1985/86, there was little difference in 1986/87. Also successful incorporation spells extra work. At Boxworth this has involved a number of passes with a Soil Saver cultivator followed by discing/rotary harrowing and rolling.

	Yield *Range tonnes per* ha		
Burn and direct drill	7.04	to	11.05
	per cent *of direct* drill		
Plough to 20cm	96	to	107
Shallow tine	94	to	99
Other incorporation results	90	to	103
Direct drill into Nurse stubble	98	to	105

In only three cases did ploughing out yield direct drilling

Table 1A. Straw Incorporation – ADAS Trials *1984* (9 sites)

	Yield *(per* cent)			
Direct drill after burn	100	100	100	100
Plough with pre-incorporation	110	97	96	99
Plough without pre-incorporation	107	101	96	99

Table *1B.* Incorporation *before ploughing – ADAS Trials* 1984 (4 sites)

Bill Butterworth is well known as a broadcaster, writer and ex-Senior *Lecturer.* He is now *Director of* IF Research, the independent research *group.*

Whether the additional yield pays for all this is debatable.

Real benefit—fromfaster working

We may, however, be in danger of missing the real significance of such trials work.

Establishment through drilling into chopped straw is fast.

Adopting the technique for the whole of the farm may not be practicable; but if it saves enough time when used on some of the land to allow the more conventional methods to be used more efficiently on the rest, the scope and overall benefits may be considerable.

Timeliness is still a critical factor in achieving high yields.

There is still the problem of visual acceptance. This may be another barrier we have to crack before drilling into chopped straw is widely recognised as a useful alternative. Mr John Rule, in charge of the trials at Boxworth, admits that thechopped straw plots "didn't look too good" immediately after sowing.

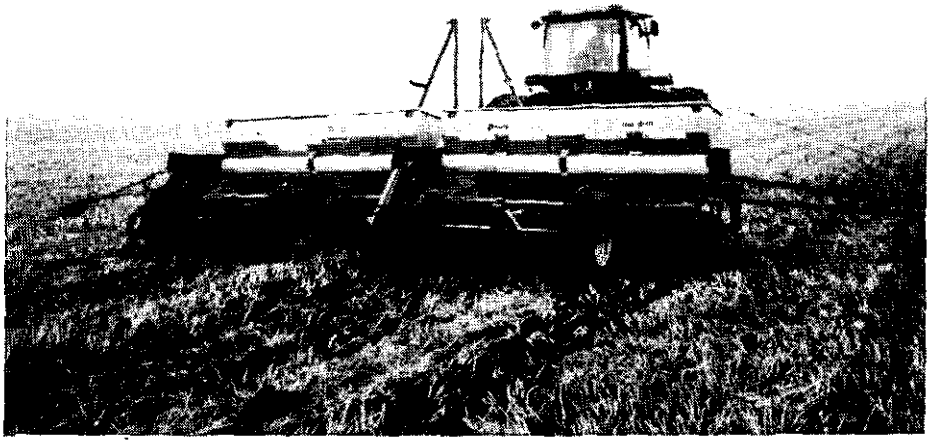
Studies of coulter performance

Studies of coulter performance carried out by IF Research on the Moore drill showed up a remarkable capability.

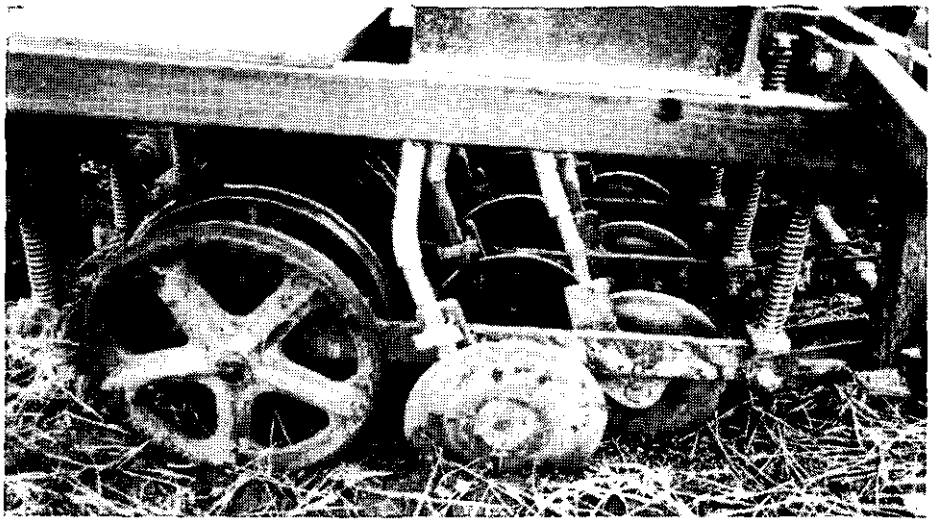
The drill can be used for conventional seedbeds but, when used as a direct drill, it treats straw on the surface in a logical way.

The single disc is rigidly mounted on a very heavy coulter arm assembly. That disc cuts a slit and forces some straw, uncut, into the slit. At the back of the disc is a coulter with a mini-plough shaped tip. That share travels up the slit, wipes out the straw, bursts the soil and deposits the seed. A very heavy depth wheel then presses the mini tilth round the seed.

IF Research studies* on the Moore drill have shown two facts—no straw next to the seed and better germination, emergence and early growth even in the presence of straw on or in the surface.



Sowing through straw trash with Moore Uni-drill.



Leading disc and mini seed coulter arefollowed by heavy ***press*** wheel on rhe *Moore* drill.

**Field Tests* and User Reports *by* IF Research.

Examination reveals constant sowing depth with no *straw* in rhe slit.

Direct drilling is faster—yields can be improved and overheads reduced

On the face of it "direct drilling" should be economically attractive.

However, the cost of the chemicals brings the initial cost of direct drilling up near the cost of conventional cultivations. Against this there are then a number of advantages, principally speed, which may push up yields. Also there is a dramatic reduction in tractor inputs and, hence, fixed machinery overheads.

An IF User Report published in 1986 showed that 26 farmers had, on average, cut one man and tractor out of their system by using a flexible system of machines (including ploughing) and direct drilling.

The main advantages were identified as a reduction in tractor inputs overall and (obviously, on reflection, because of that) an improvement in *yield* because o f speed and timeliness improvements.

In fact the more tractor power that is pushed into a system, the slower it is. This is horn out by the computer print-out figures in Table 2. Conventional cultivations with a standard man and tractor take a remarkably long time to do the job. We have

Operation	Direct Drilling into chopped straw: No. of Posses	Work Rate	Hours /Ha	Cost £/Ha	Energy Index	Direct Drilling into a Nurse Stubble: No. of Passes	Work Rate	Hours /Ha	Cost £/Ha	Energy Index
Bale and cart straw						1.0	0.4	2.50	50.0	
Chop straw	1.0	2.0	0.50	12.5						
Direct drill	1.0	1.4	0.71	15.0	15	1.0	1.4	0.71	15.0	15
Apply spray	1.0	6.0	0.16	5.0	5	1.0	6.0	0.16	5.0	5
Results per hectare			1.37	32.5	20			3.37	70.0	20
Plus cost of GRAMOXONE				17.4					17.4	
Less price of straw				–					25.0	
				49.9					62.4	
Totals for 100 Hectares			137.00	4990.0	2000			337.00	6240.0	2000
Number of days required to establish the given area			21.41					52.66		
Total hours available for field work			593 hrs					593 hrs		
divided by total hours needed per ha			1.37					3.37		
Hectares that can be established given the manpower available			432					175		

Table 2. Cost comparisons – various systems *tested* by *ICI computer programme.*

tended to do it because we could afford to do it with big tractors.

Table 3 is a summary of further alternatives from the ICI Cost Cutter Computer Programme based on Wye College/IF Research figures.

Recreational tillage is not the order of the day in the present climate.

System	Hours per *100* ha	Cost *(£)* per 100 ha	*Energy Index/100* ha *(cults* only)	No. of days to establish 100 ha *(1* tractor)
Direct drill into chopped straw	137	4990	2000	21.41
Direct drill into Nurse Stubble (bale straw costs included)	337	6240	*2000*	52.66
Scratch till (burn straw)	192	5940	2200	39.18
Plough & Power Harrow (chop straw)	753	9990	12700	153.67

Table 3. Systems *Summary* (Source *ICI* Cost Cutter Computer Programme)

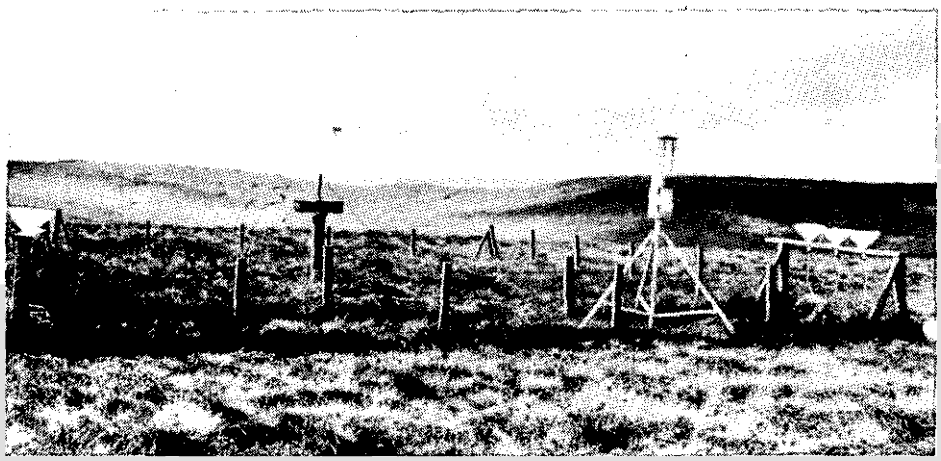
Peat Erosion Manchester University seeks causes and control

Peal erosion is a major environment problem in the southern Pennines. This area has been grossly polluted for two centuries and the vegetation of the region has been markedly affected.

An extensive investigation of the causes and possible control of this erosion is currently being pursued by the Department of Environmental Biology at the University of Manchester.

The erosion is particularly to be seen in the blanket bogs which cover the gently sloping hill tops at around the 1500 ft. level. An area of over 50,000 ha. has lost the cover of the major peat forming plants, Sphagnum mosses, and the erosion processes have accelerated.

Sulphur pollution probably caused the original disappearance of the Sphagnum–sulphur pollution having been much higher in the past than it is today–but new Sphagnum plants from other, less polluted parts of Britain, have been introduced into the bog surfaces of the southern Pennines and still show very poor growth.



An *experimental site* on the southern Pennines contains cloud and bulk deposition *collectors.*

Today's problem – nitrogen pollution

Today it is probably the deposition of nitrogen pollutants which is largely responsible for the continued poor performance of the Sphagnum. Measurement of this is one aspect of the detailed study of the problem now being undertaken at Manchester University.

Work in the Department of Environmental Biology examines the effects of nitrogen deposition on plant growth in sensitive upland ecosystems, not only in the southern Pennines, but also in North Wales. Monitoring studies include measurements of pollutants in cloud water. Mist droplets contain high acute concentrations and are an important form of pollution deposition in the uplands.

Investigation of the effect of pollutants complements other studies in the Department into the causes and control of this major environmental problem.

The Economics of Tillage

Professor John Nix* argues that on the right soil type direct drilling can greatly improve returns and give substantial cost savings.

In continuing our reporting of the Association's 1987 Conference, 'Tillage–what now and what next?' we are pleased to present the full text of the contribution from Wye College Economist, John Nix, on the subject of tillage costs.

Professor John Nix

Tillage costs **are an element of total farm** costs. In discussing them it is logical to start broadly – to look first at the complete picture – to get the items in context – and then to zoom in and look at more and more detail.

We need, first of all, to consider the fixed costs, and the proportion of these made up by labour and machinery costs.

	£ per ha	£ per acre
Total fixed costs (incl. casual and Contract)	445	(180)
– of which, Labour costs (incl. unpaid and casual)	120	(48)
Machinery costs (inc Contract)	165	(67)
L & M Costs	285	(115)
L & M Costs as per cent of TFC	64 per cent	
Total variable costs	200	(80)
Total costs	645	(260)
L & M Costs as per cent of TC	44 per cent	

Table 1: Labour and machinery (L &M) *costs as percentage of Total Fixed* Cost *(TFC)* and *of* Total Costs *(TC)* – Medium *to* large *cereal* farms

Table 1 refers to a typical medium to large cereal farm. The figures of total fixed costs are represented in the gross margin sense except that included are not only unpaid manual labour from the farmer and his family, but also casual labour and contractors. Such items, of course, are not normally included in fixed costs – but, in the context of this comparison they should be considered.

The figures in Table I show that labour and machinery costs stand at almost two thirds of total fixed costs and are getting towards half of the total costs of the farm. They are obviously a very major item.

Table 2 gives a typical breakdown between items of machinery costs. The big item is depreciation – on the current, or replacement, cost. Do not use the historic cost; that is irrelevant, pointless and misleading. On the typical farm, depreciation represents nearly half the machinery cost.

After depreciation the next highest item is repairs at 20 per cent, then fuel and contract about equal around 15 per cent with, finally, vehicle tax and insurance a relatively small proportion at 5 per cent.

Professor of Farm Business Management and Head *of the Farm Business* Unit, *Wye College, University* of *London*

For farms not employing contractors (column two of Table 2) the other cost elements naturally go up and represent a greater share of the total – with depreciation for example then at over 50 per cent.

Scope for savings on machinery costs

Considerable time could be spent on how to save on these machinery costs. Other factors, however, demand attention and I will just list briefly some areas where there is particular scope for savings:.

- less capacity – we might have to do with less capacity, to take a risk, to lose out now and thin in difficult seasons.
- later replacement; keeping machinery longer – this is another way to keep down the big depreciation item; many farmers are already having these decisions forced on them – that is quite clear from all the data that is coming through.
- more careful maintenance – to reduce repairs and also, probably, to reduce the depreciation costs on the machines.
- more careful consideration of whether to have your own machine or have the work done by contractors.

	AN farms	No *contract*
Depreciation (on current cost)	45	55
Repairs	20	22.5
Fuel	15	17.5
Contract	15	–
Vehicle tax and insurance	5	5
	100	100

Table 2 Breakdown of Machinery Costs (by *percentages)*

The next table, Table 3, gives a breakdown of total direct labour and machinery costs – £172 per hectare. The figures have been averaged out to encompass all the many variations on individual farms; especially with regard to seedbed cultivations.

	£/ha	%
Plough, Cultivate, Harrow	61	35
Seedbed Fertilise, Drill, Roll, Top dress, Spray	39	23
Combine harvesting, Carting	72	42
Total	172	100

Table *3:* Breakdown of total direct labour and *machinery* costs *(with* 'Iraditional' cultivations – *i.e.* including ploughing).

The figures do not include barn expenses. We are talking only about field work. So you can see that the ploughing and cultivating, etc (the traditional method) is something like a third of total field work costs; drilling, fertilising, etc, about a quarter and the combine harvesting and carting about 40 per cent.

Direct drilling for maximum saving

Extending the last set of results, Table 4 compares direct labour and machinery costs of four different establishment systems.

System	£ per ha. SBP	FD+	Total
Ploughing	61	39	100
No ploughing	35	39	74
Minimal cultivation (reduced cultivation)	17	39	56
Direct drilling	5	45	50

Note:
SBP = seedbed preparation
FD+ =applying fertiliser, drilling, post-drilling cultivations etc (cost of sward/stubble sprays excluded).

Table 4: Comparative direct labour and machinery costs *of* ploughing, *no-*ploughing, minimal *cultivation* and *direct* drilling.

The no ploughing system is, as it says, no actual ploughing hut still a couple of cultivations and a harrowing; the minimal cultivation or reduced cultivation would he just one cultivation along with probably a spray whilst the direct drilling would just have a spray. As far as the post seed bed work is concerned, all systems are, of course, similar but I have included a slightly higher cost for direct drilling compared with ordinary drilling.

Direct drilling shows a really big saving in cost of seed bed preparation and still a substantial saving when considering total costs of crop establishment. It must be stressed that these are purely labour and machinery costs – they do not include cost of seeds and fertilisers nor of the spray material – and that might add another £20 per hectare.

Savings on labour

Some might say that that is all very well but what they are more interested in is the saving in labour at peak times.

System	Hours per *hectare* SBP	FD+	Total
Ploughing	5.0	4.7	9.7
	(3.4)	(3.3)	(6.7)
No ploughing	3.0	4.7	7.7
	(2.0)	(3.3)	(5.3)
Minimal cultivation	1.4	4.7	6.1
(reduced cultivation)	(0.9)	(3.3)	(4.2)
Direct drilling	0.5	4.9	5.4
	(0.3)	(3.4)	(3.7)

Note: SBP = seedbed preparation
FD+ =applying fertiliser, drilling, post-drilling cultivations etc

Table 5: Comparative direct labour *hours per hectare of ploughing, no-ploughing, minimal cultivation and direct drilling. (Data from Farm Management Pocketbook – average rates* of work: *'premium' rates* in *brackets).*

In Table 5 are some figures on labour cost per hectare for each of the four systems we are considering. The figures are based on data in the Farm Management Pocketbook and show average hours per hectare (all farms) and, in brackets, the 'premium' hours (the average of hours taken by the top 25 percent – the farmers with bigger tractors and bigger implements). Obviously, farmers with very big implements will work quicker still.

As can be seen the big saving is to be found in seedbed preparation.

The *SaWMA* Tillage Conference *attracted* near *200* delegates

Again, however, one might say that this is all very well but what matters is the effect on the whole, individual farm. These relative labour requirements, these relative costs – they are relevant to the whole of the country, to all of farming. For the individual farm they may be of some use but they may not give anything like the full picture.

For the individual farm the seasonal requirements – for labour, tractor, machines, implements – are as, or more, important than simply the overall requirements. If one practises reduced cultivations or say direct drilling – a man, maybe more than one man, may be saved on a very big farm (and by very big I mean over 1000 acres) and there could be a saving of one or more tractors, one or more ploughs.

Of course, it may not save a plough at all if one retains rotational ploughing – but even then, perhaps, only one plough may be needed instead of two or three.

Also, one must surely consider the yield effects of a change in cultivation system – the direct effect on actual crop yields and the indirect effects of timeliness in date of drilling and in other operations. Inevitably these points have been mentioned by the farmer speakers of the conference and by Dr Davies in particular in their excellent papers.

Another relevant factor is the percentage of winter wheat and winter barley out of the total cereal acreage.

Individual consideration needed for each farm

What we have to consider are the effects of a change in cultivation system on the total labour and machinery costs and on the total gross margin.

To answer that we have to look at the individual farm; it cannot be done by a load of generalisations. Just as in farm management, you cannot give any worthwhile advice until you go to the farm, look around, talk with the farmer for a long time and talk with his wife for even longer.

Only after such detailed study can you begin to form a picture of the particular farm and take into account such factors as:

- size of farm
- labour and machinery complement
- soil type } together affecting
- weather/seasons } soil conditions
- rotations/cropping sequence

Other speakers at the conference have discussed these factors. All have had different experiences: they have learnt different things from their experiences; and in consequence all ate now doing something different. One cannot generalise. No general conclusion is valid for all farms, nor for all seasons.

However, savings in total labour and machinery costs can be achieved by adopting an alternative cultivation system if the farmer can then:

- with the same labour, tractors etc
  - increase the percentage of tillage
  - farm more land, or
- with less labour, tractors etc
  - farm the same area of tillage

Savings through reduced cultivations – study of specific farms

The effects can be studied by means of gangwork day charts, these are compiled by putting together the number of workers, the different operations and the days in each particular week, fortnight, or month when the work needs to be done.

The results in Table 6 are from a study sponsored by ICI which we did about a year ago. The report 'The Economics of Reduced Cultivations' (May 1986) was not

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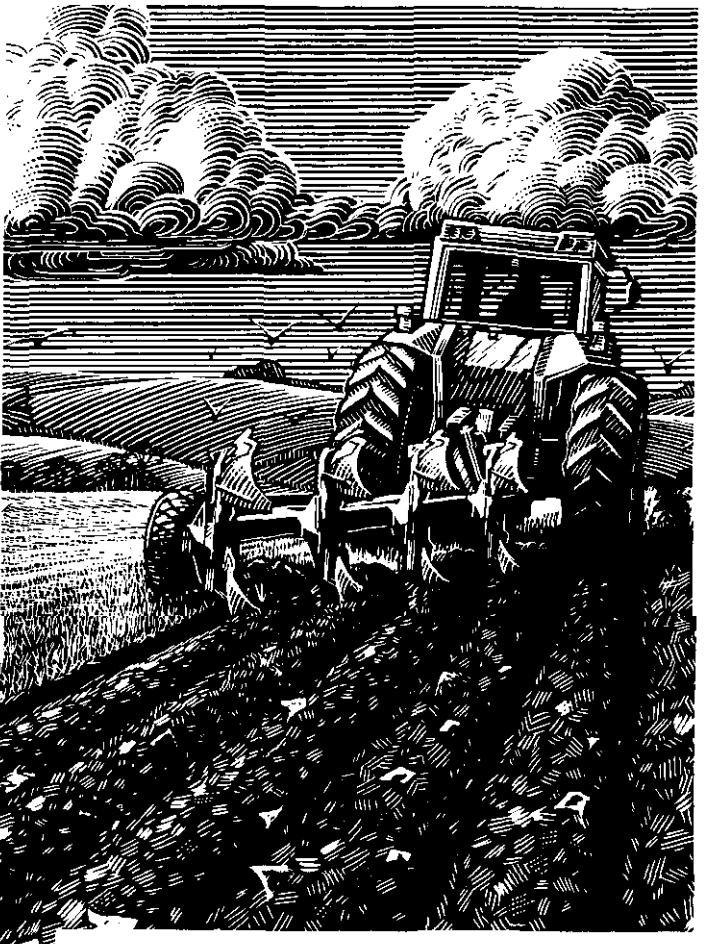
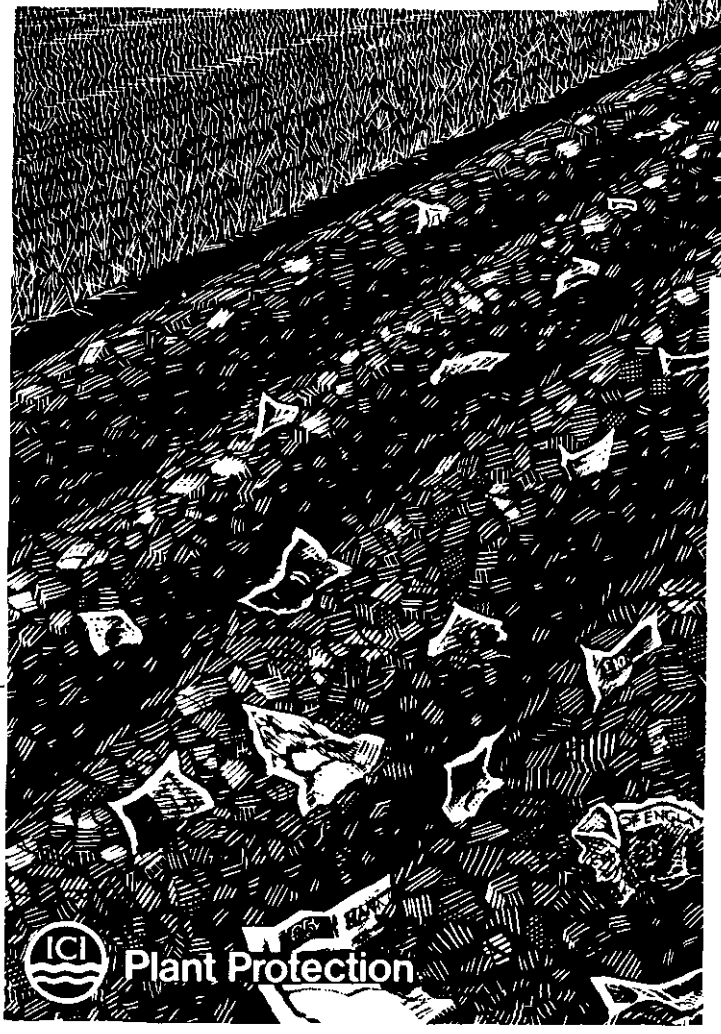
HOW MUCH CAN YOU AFFORD TO PLOUGH-IN THIS YEAR?





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Farm Type	Farm Size (ha)	Capital per ha f	Deprec. & Interest f	Labour £	Operat'l Costs £	Total f
Mainly Cereals	120	1,300	2.3	2.8	8.5	14
	240	20,800	18.2	4.3	5.5	28
	600	32,100	11.2	20.5	4.9	36
Cereals and Roots	120	1,300	2.3		7.0	9
	240	2,800	2.5	3.4	4.6	10.5
	600	18,800	6.6	4.1	4.0	15

N.B. No allowance for: I) Cost of chemicals 2) Timeliness benefits 3) other yield effects

Table 6 Savings through *reduced* cultivations (Source: Results of Gang work day charts *study)*

published for general circulation. The work was done by Charles Course under my supervision at Wye College.

In his study, Charles Course compared a reduced cultivation system of one cultivation and a spray against a 'traditional' system of ploughing and a couple of cultivations. Two farm types were considered–'Mainly cereals' and 'Cereals and roots' and three farm sizes within each farm type–a total of six separate situations

Under the heading 'capital' is shown the value of savings assumed through having less tractors and less machinery, including ploughs, from changing the reduced cultivation system. Similarly, the savings are assessed in depreciation and interest, labour cost and operational costs (the costs of repairs, fuel and so on). Note that in the labour costs there is little or no saving on the smaller farms but big savings start to come in on the larger farms, where a full-time worker might be saved. There was no labour saving at all on the small cereals and roots farm becauseof the work required for the root crops.

The final column of the table shows the total savings possible according to each farm type and size.

The savings are quite substantial–but, again, notice there has been no allowance made for the cost of the chemicals. At the time the study was done this was between £18 and £20–say f19–per hectare for the mainly cereal farms and about £14 to f15 for the cereals and roots farms. Taking account of the chemicals therefore one must deduct these costs from the savings shown in the final column of the table.

Also–and this is extremely important to remember–no allowance has been made in Table 6 for any timeliness benefit nor for other yield effects.

Reduced cultivations–no obvious effect on yields

As far as concerns any direct effect of the system on yield, Charles Course looked at all the evidence he could find on the effect of reduced cultivations and direct drilling and he found that overall, there did not seem to be much in it, plus or minus.

There were some cases where one system gave a better result and then other cases where another system was better but, of course, on individual farms there would be this variation anyway according to soil type, season and so on. In the end we just left it out, as we couldn't get any actual evidence to say there definitely was a certain effect one way or the other.

To	From	Increase in Gross *Margin* per hectare *transferred* £	10% cereal transfer *Improvement* in *Gross Margin* per hectare of farm f
Winter wheat (mill)	Spring barley (feed)	175	17.5
Winter wheat (mill)	Spring barley (malt)	130	13.0
Winter wheat (feed)	Spring barley (feed)	110	11.0
Winter wheat (feed)	Spring barley (malt)	65	6.5
Winter barley (malt)	Spring barley (feed)	100	10.0
Winter barley (malt)	Springbarley (malt)	55	5.5
Winter barley (feed)	Spring barley (feed)	45	4.5
Winter barley (feed)	Spring barley (malt)	0	0

Table 7 *Effect* of higherpercentage of winter cereals

Earlier drilling brings substantial yield benefit

Then there is the question of drilling date. We could not find any definitive data–no results of surveys–to show how much the drilling date could be brought forward by adopting a reduced cultivation system. But there is quite a lot of evidence to say that the yield benefit by earlier drilling is quite substantial–about 2 tonnes per hectare per week (1.5 cwt per acre per week) and that is worth about £17.50 per hectare (£7 per acre). So, on the basis that the reduced cultivation system can advance drilling date by say, two weeks we're talking of f35 per hectare (£14 per acre) benefit.

Benefits from switch to winter cereals

Finally there is the question of to what extent the system can allow a higher percentage of winter cereals and, if so, with what effect on gross margins. That, of course, depends on what you are changing, from what into what. Table 7 lists a whole range of options of switching from spring barley to winter wheat or to winter barley.

Considering a change from spring barley to winter wheat, the biggest benefit–line 'one' of the table–is if there is a switch from spring barley for feed to winter wheat for bread making, whilst at the bottom end of the scale is the switching from spring barley for malting to winter wheat for feed. It is not just a question of yield; it is also a question of price.

Table 7 also shows the effects of a switch from spring barley to winter barley. For both sets of options the table shows the difference (the improvement, the benefit) in gross margin per hectare resulting from any particular switch.

Obviously, though, we cannot assume that a move to direct drilling or reduced cultivation means a shift of all cereals from spring to winter sowing–it is only a marginal effect. So, for a simple calculation, let us just say 10 per cent were shifted, i.e. 10 per cent more winter cereals compared with spring. (It might be a lot more than that of course) In that case the benefit per hectare, spread over the whole farm, will be as shown in the last column of the table–a range from nothing to £17.50 per hectare (f7 per acre). This is not very much, but bear in mind again that we have only considered a 10 per cent shift and when added to other effects, like higher yields from earlier drilling and possible savings in labour and machinery the case strengthens.

Factors favouring reduced cultivation, direct drilling

Finally, to summarize all that I have said: the factors especially favouring systems of reduced cultivation and direct drilling are as follows:-

- Large farm
- Large percentage of cereals
- Limited autumn labour available
- Wish to minimise labour force
- Wish to minimise capital investment
- Heavy/medium heavy soil (timeliness)
- Suitable soil type generally (for direct' drilling)
- Autumn cereal yields well above spring cereals
- Not much barley going for malting; much of the wheat goes for milling
- OK to burn (most of) the straw
- If chemical costs fall (in real terms)
- If cereal prices *(do)* fall (in real terms)

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Conservation in Soil and Water Management

'Times have changed' says Eric Carter? Farming is no longer regarded as being concerned solely with food production. In this special report for Soil and Water he reviews some of the ways in which good management can combine economic farming along with a care for wildlife and the landscape.

The *basis* of *all* plant *growth* whether 'natural' or cultivated is the soil. The soil, together with the climate, influences the vegetation and man's crops. Apart from a few mountain tops and very remote areas there are no pans of the UK which are not influenced to some degree by man's activities (his management) as a grazier or arable farmer.

Nature Reserves and Sites of Special Scientific Interest also have to be managed in order to retain those features which make them important.

The emphasis is on management – which implies clear objectives and a policy for the farm which is designed to meet these objectives.

To start with record the existing features

Times have changed. No longer is farming regarded as being c d solely with food production. Farmers and landowners are expected and encouraged to have regard for the ider countryside and to include care for wildlife and landscape features i rhcir management of the farm.

There arc a number of ways in which this may be done – a good beginning is a survey of the farm to record what is already there. Nc ll l wet areas, ponds d watercourses, l margins, yards and c d buildings all have an important part to play. It is also worthwhile to look at field shapes and identify those areas where cultivations and harvesting operations are difficult.

Awkward corner, may be planted to trees and shrubs providing habitat for wildlife and game and making cultivations easier and more straight forward. Wet areas, difficult and expensive to drain, may be converted to ponds or small lakes, again of value to wildlife whilst saving costs in drainage or delays and frustration with cultivations and harvest.

Guidance to making the best use of land may be found in the Soil Survey maps which identify soil types with known characteristics.

*Eric Carte6 CBE, National Advise6 Farming and Wildlife Trust, Sandy, Beds

Good drainage not a threat

There is an old saying that 'no one can farm against water' and, in managing any land for food production, control of water must be a primary objective. This usually means drainage, removal of surplus water through major drainage schemes and, over a large area of the country, through field under-drainage.

Much concern has been expressed in recent years over the drainage of wetlands and the impression has been created in the public mind that all land drainage reduces the area of wetland available for those species, particularly birds, which rely on wetland areas.

Whilst it is true that wetlands have been drained through major schemes, large areas still remain and, given the current agricultural climate, they are unlikely to be under any very great threat from farmers. Even during the years of greatest drainage activity the largest expenditure was on under-drainage and the improvement and maintenance of field systems.

Financial pressures will slow down the rate at which drainage work is carried out but maintaining effective under-drainage must remain an essential part of soil management if costs are to be kept at a reasonable level and the best use made of expensive inputs.

However, as a result of farm land drainage, piped water supplies, pollution and other influences many open water areas have disappeared or become degraded. On many farms the only water available for wildlifeis in ditches. A ditch can be of great importance and in some respects should be regarded as an 'upside down hedge'. Ditches provide rich wildlife habitats because of the combination of water and fringe vegetation which provides a variety of plants and shelter, and food and breeding grounds for many creatures. The greater the diversity of plant species the more ecologically valuable the habitat becomes.

Treesplanted on land difficult* to *manage on an intensive arable farm

Avoid pollution: plan maintenance

Water pollution is a serious problem. Most aquatic life is very susceptible to pollution and it must be remembered that water eventually reaches points where abstraction takes place for human or stock consumption and crop irrigation. Drainage water will contain nitrogen leached from the soil and this can be fed into sensitive lakes and other water bodies and water courses providing a contributory factor in their eutrophication.

Hedge and bank trimmings left to decay will cause pollution by lowering the oxygen

content of the water in the ditch. Lesser known sources of pollution arise from vegetable washings, disposal of waste oil or unwanted spray material, yard washings and spent sheep dip. Silage effluent and farm slurry are highly toxic and should never be allowed to reach ditches. Silt run-off from land can be exacerbated by careless cultivations too close to ditch verges. This can be very damaging to fish and invertebrates.

As with hedges, the timing of ditch maintenance is very important. Birds, including game-birds, will be nesting from March to July. At the same time, plants will be flowering and setting seed and so maintaining hank vegetation and stability.

Where spoil is removed from the ditch avoid smothering vegetation or creating any accumulation around trees and shrubs – it may kill them. Where spoil has to be removed and disposed of elsewhere then avoid damaging areas of known botanical interest and avoid filling in damp hollows which are known to he used by breeding waders and wildfowl.

It is tempting to straighten ditches but meanders add to wildlife and landscape interest and value and are as hydraulically efficient in removing all but bank-full flood flows.

The spraying of bank side plant life will drastically reduce the wildlife value of the ditch and make the bank less stable. Selective weed wiping may be used to remove tall plants where this is necessary. Mechanical control favours ecological stability and can be fitted into a pattern of maintenance needs.

A good example of successful integration of ditch maintenance and preservation of habitats has been shown by recent studies carried out with a grant from The Environmental Research Fund. In the arable drainage systems of South Lincolnshire there is a wide diversity of common species of water beetle despite the fact that the surrounding land is intensively managed for arable use. 114 species were recorded representing just over a 1/3 of the British fauna of water beetles and including many new records for Lincolnshire.

A wet area difficult to drain has been made into a pond for *wildlife.*

Although soil erosion is not generally considered to be a problem in the UK there is evidence that increasing attention should be given to measures to prevent soil erosion. The amount of erosion varies greatly from year to year and a field that erodes in one year may not erode in other years.

The increase in field sizes since the last war has implications both for wind and water erosion because of the increase in the fetch of the wind. Removal of hedges also facilitates water erosion through increased opportunity for water flow and surface run-off. Long uninterrupted slopes results in high rates of erosion. The use of tram-lines particularly on sloping land, can lead to quite serious erosion as compaction in the tram-lines prevents water from penetrating into the soil and provides an ideal pathway for the water to movedown.

Silt and any vegetation which impedes the flow of water must be removed periodically but it is only when the ditch fails to carry off surplus water that really drastic action needs to be taken. Vegetation, the basis of wildlife, stabilizes ditch banks so reducing crumbling and minimising the risk of slippage. Wherever possible one bank only should be excavated. If both banks have to be graded then leave areas of vegetation. It is not good practice to cultivate to the very edge of the ditch bank and care should be taken to avoid slippage of soil into the ditch and the squeezing effect of heavy machinery turning and working nearby.

A reservoir and conservation headlands

The construction of a reservoir and its attendant work provides an excellent opportunity to enhance the landscape and the wildlife value of what may well be a feature-less area.

It is impossible to re-create destroyed habitats hut a carefully planned reservoir provides an opportunity to increase the conservation value of an area and help compensate for features lost elsewhere. The reservoir and its surroundings should always be considered together and attempts made to provide as diverse a range of habitat types as possible.

A wetland area can be exciting in its sheer diversity of wildlife, much of which can be readily seen and appreciated.

Field boundaries are very important for wildlife and on some large arable farms may he the only remaining un-disturbed areas. Some insect predators which over-winter in field banks and hedgerows can have a considerable influence on the incidence of insect pests particularly aphids.

Ponds create interest and are valuable jor wildlije.

A great deal of interest has been shown recently in the idea of a conservation headland. Here, by witholding pesticide applications during spring and combining this with a sterile strip between hedge bottom and the crop, there has been a considerable increase in wildlife including numbers of Grev Partridge.

Another variation is the establishment of grass headlands which contribute to the appearance of the countryside and assist wildlife; they also bring crops away from the shading effect of the hedges and trees and provide easy access to the field.

Grass headlands make access to fields easy and prevent soil compaction on the cropped areas.

Old grassland now a variety

During the past thirty to forty years the countryside has lost one of its most interesting features – old grassland. It has been estimated that only some **3%** of unimproved grassland remains. This makes such areas of particular interest and any such features should be carefully managed.

Old grassland should receive only very low levels of nitrogen at long intervals and chemical weed killers should never be used. Any drainage of such land could also exert a considerable influence and indeed special care should *be* taken even when carrying out drainage works in adjoining areas in order to maintain the water level and so retain the interesting flora.

Good drainage and good management

There can be no doubt at all about the strains and stresses which will be placed on farming and the supporting industries through the need to control excess production. There are bound to be changes in farming systems and the crops which are grown on particular soil types. It seems likely that there will be a concentration of arable farming on those soils best suited for this purpose and that some land at present growing cereals will revert to grass.

Land drainage and soil management must continue to play a vital part in the economy of farms. Well drained and well managed land will be the sound basis on which' arable and grassland farming systems depend.

Farmers are under pressure, not only to produce food and other raw materials but in doing so to maintain a pleasant and well managed countryside. To do this effectively means planning the whole farm, not just crop and animal production but the management of drainage and watercourses, water areas such as ponds and irrigation reservoirs, field margins, hedges and all the other features.

Major initiative to help urban fringe farmers

A major new initiative, providing a link to help urban fringe farmers improve their chances of prosperity, was launched at Rossendale, Lancs in June.

The initiative, which is seeking commercial sponsors, is the result of a partnership between the Groundwork Foundation, which specialises in bringing together urban and rural fringe environmental partnerships, and the Ministry of Agriculture's ADAS farm advisory service.

Groundwork's chairman, the Rt Hon Christopher Chataway, says, "I look forward to some imaginative schemes, skilfully integrated with the countryside environment, coming out of this partnership.

Officially launched at Rossendale Groundwork Trust in Rawtenstall, Lancashire the initiative takes in three pilot schemes, based in the Groundwork Trust areas of East Durham, Rossendale and St Helens and Knowsley.

A team in each area will collate information about existing farm businesses and assess how some farmers can adapt methods or start new enterprises to augment their incomes. Grants will be available to help eligible farmers wanting to invest in new farm business projects.

Farmgate sales, tourism and forestry will be among options looked at for farmers and Groundwork's expertise in landscaping, ecology and tourism will complement the ADAS services to be used on the Farm Diversification Project.

Soil management of the cricket pitch

Soil assessment and soil management are not the concern only of farmers and growers. They are matters of vital importance also to those responsible for our sports fields and pitches.
Victor Stewart* is a soil scientist who has made a particular study of the requirements of sports surfaces and the soil qualities needed to satisfy them.

*Dr. V.I. Stewart, formerly senior lecturer in charge of Soil Science Unit, University College of Wales, Aberystwyth. Took early retirement in 1982 and now works as a consultant and freelance lecturer in applied soil science.
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The professionals, whose skills have created our spectator sports, sometimes find it difficult to acknowledge the extent to which chance has contributed to their successes as well as their failures.

Would Laker have taken nineteen wickets against Australia in the 1956 Test Match at Old Trafford had the pitch been perfect at the time? Would Warwickshire, batting first at Edgbaston in 1967 against the Pakistan tourists, have scored 439 for six wickets then skittled out the opposition twice for a total of 338 if the turf, relaid some thirty-two months previously, had not progressively opened up at the seams as the surface dried out? M.J.K. Smith who scored over 200 said it was 'a good grafting wicket'.

If you want to know the truth, don't ask the players, ask the groundsman.

The Test and Counties Cricket Board has been concerned over the years that first class cricket should be played under conditions that will encourage the more exciting skills of the game, aggressive stroke play, fast and wrist spin bowling. They believe this requires the game to be played on fast, true pitches. Trueness in this sense is a matter of consistency; pace a matter of bounce.

Critical factors – clay content, moisture content and good pitch preparation.

In the period 1965-66 I developed with a colleague, Dr. W.A. Adams, a method for assessing the quality of pitches that involved measuring the height and consistency with which a ball, dropped vertically from a fixed height of sixteen feet. rebounded off the surface.

The rebound height off concrete is fifty-two inches but many pitches used by amateur clubs do not achieve fifteen inches.

Our initial measurements were concentrated within an area two-to-five yards in front of each wicket. Subsequently they were related to soil characteristics derived from core samples, three-quarters of an inch deep, taken from the same areas.

Some of the results of these tests are shown in Tables I and 2 and based on this work we were able to show both how consistent and how variable the performance could be, and the type of factor responsible.

Our main conclusion from this study is summarized in Table 3. This shows how pace potential is related to the strength of the soil as determined by clay content. However, actual performance on any particular occasion will vary according to the moisture content of the soil and the efficiency of pitch preparation.

1966

	Bounce ins A	Bounce ins B	Clay %
Edgbaston (Old Square) 6.7.66	14	15	37
Leicester 27.6.66	17	18	32
Swansea 27.5.66	17	20	35
Lord's 26.8.66	19	20	36
Northampton 4.7.66	19	21	29
Derby 23.8.66	22	23	29
Oval 26.8.66	23	23	32
Cardiff (Arms Park) 22.7.66	23	26	29
Trent Bridge 19.8.66	27	28	34
Worcester 1.7.66	30	31	42

1967

	Bounce ins A	Bounce ins B	Clay %
Old Trafford 20.7.67	11	13	19
Gloucester 10.7.67	15	19	42
Cardiff (Sophia Gdns) 1.8.67	15	17	31
Hove 19.8.67	16	22	26
Swansea 13.6.67	19	21	30
Worcester 18.7.67	19	26	32
Chelmsford 28.8.67	21	26	21
Edgbaston (New Square) 25.7.67	21	27	36
Taunton 30.6.67	22	24	29
Leicester 14.8.67	23	24	27

Notes 1 A = General average bounce for the pitch
B = Average of four highest bounces, two from each end.
The extent of the difference between A and B is a measure of the general variability in bounce of the pitch.
2 Clay percentage is measured in the mineral fraction of the top 2cm.
3 Bare solid concrete under equivalent conditions gives a bounce of 52 inches.

Table I *Average* bounce in inches of a cricket ball *dropped from* a height of *16ft for* single pitches assessed after close *of play* on *the final* day. Measurement taken in *areas* 2 to 5 yards in front *of each* wicket.

Ground	Sampling date	Bounce in inches
		New Road End
Worcester	18.6.67	9121314182219311717 1616
		Scoreboard End
		25 17202024232420222211 10
		Pavilion End
Edgbaston	25.7.67	17232826162813211828 1617
		Constance Road End
		21222214221815262423 1317
		Pavilion End
Oval*	26.8.66	25 25 24 25 25
		Vauxhall End
		20 21 20 18 19

* Fewer measurements made at wider spacing on some pitches in 1966 survey.

Table 2: Bounce *(inches)* of *a* cricket ball dmpped vertically *from 16ft* onto *areas 2-5yds* in *front* of each wicket. *Measurements made after* close of play on *the final* day

Worcester An *aberrant* pitch on which *Freddie Trueman* prospered as rhe *surface* hroke up. Note, in *Table* I, the *1966 pitch is* more typical *of* Worcester at its *best.*

Edgbaston Pitch re-turfed 32 months previous. Warwickshire, *batting* first while *pitch still* moist, *scored 439 for* six wickets. *Pakistan skittled* out *twice for* a combined *total of* only *338.* Bounce values *reflect* conditions *at the* end *of the* game. Irregular *bounce* caused by turfseams opening up as pitch dried our.

Oval Surrey *V Gloucestershire.* 957 runs scored in three days *of play* vet *match* still ended in *a* draw. *Note individual* ends very *consistent. Difference* in puce between Pavilion and *Vauxhall* ends *was well* known *to Laker* and Lock.

Benefit of earthworms

From the display of soil cores, shown in vertical section in the photograph, Fig. I, it is evident that there is no standard approach to square management.

Though most of the cores are made up of clearly defined layers representing the succession of top-dressings applied annually some, like those at Taunton and Worcester, are much more homogeneous.

This more homogenous soil reflects the important distinction between those who favour the retention of an active earthworm population on the square and those who, for one reason or another, now have to work without them.

Presence or absence of earthworms is, I believe, responsible for a major dichotomy in the development of soils which has far-reaching significance for soil fertilitv. It is of particular significance for cricket in so far as surface integration, or the lack of it, affects pitch performance and is bound to be a greater hazard in a layered system than in a surface that is maintained homogeneous by earthworm churning.

Despite the problem of surface casting, which some groundsmen seem to find insuperable, there would seem to be much to be said for learning to work with earthworms rather than eliminating them by acidity or poisons.

This is especially true if the cast material thal the worms bring to the surface is of an adequate clay content to act as a top-dressing for the promotion of pace.

It is worth noting that, when we started our work on cricket pitches, a gathering of ex-England captains indicated to us that three County grounds stood out as being renowned for their pace over the years: these were Worcester, Portsmouth and Taunton. On completing our survey of most of the County grounds we were interested to find that, despite a general prejudice against the presence of earthworms on cricket squares, at Worcester, Portsmouth and Taunton they were considered useful and had been retained.

Soil Characteristics

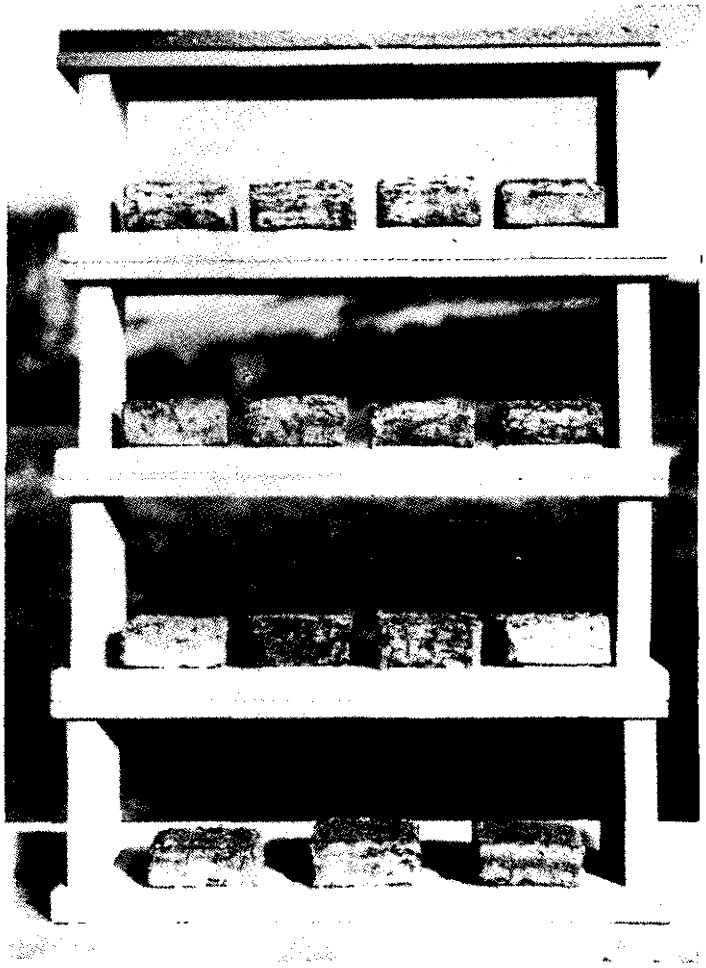
When going for pace in Britain it appears to be necessary to choose a soil with a clay content around thirty-five percent and, a clay type that is not markedly swelling in character.

Also, if a pitch is to be successfully rolled out moist and then steadily dried in depth to a firm cohesive state, any soil top-dressing must be applied to a clean, mineral surface. Additionally, the applied soil should be matched in its swelling and shrinking characteristics to the soil already in place. Otherwise on drying, the two may separate.

To many, cricket is a game played on grass but, at County standard and above, a pitch, when ready for play, is ninety percent bare soil.

However, grass does have a role to play apart from just blending with the outfield when out of use. If the grass is well rooted in depth it can not only help with surface integration but it can greatly assist in achieving the uniform drying out in depth that is so essential for a cohesive, solid top-soil.

Without the assistance of extra water loss through the grass a strong sun will have desiccated only a thin surface layer of soil before this then dissociates from the moist soil beneath. The result can be the sort of



Soil *cores, 2* cm *deep, taken from the pitches* assessed for *bounce in 1966 and 1967. Worcester – extreme left, second row Taunton – extreme left, third row*

cracked, wobbly surface that the spinner, John Mortimer, once demonstrated to me on a pitch at Gloucester (10.7.67).

The stronger the soil and the more layered it is initially, the more difficult it is to avoid this sort of surface deterioration.

Rolling – a temporary affect

It could have been something like this that upset last season's Test pitch at Headingley. Especially could this have been so if the groundsman had felt it necessary to re-wet the surface because of premature drying out during preparation. Alternatively it could have been that the pitch was still moist at the start of the first day's play and was then desiccated too rapidly in the brilliant sunshine.

It would not be at all unusual to find the soil dissociating in a layered manner under any square denied the soil churning and rooting benefits that earthworms can achieve under grass.

Heavy rolling may temporarily achieve a measure of consolidation but the mere act of rolling will itself exacerbate the problem.

Roller or wheel action is well-known in agriculture to contribute to the development of platy structures. This happens even in a uniform soil, let alone one that begins already strongly layered because of the build-up over the years of successive layers of top-dressing.

The highest, consistent set of bounce values that I personally have recorded in Britain varied only two-or-three inches either side of an average of thirty-seven inches. They were recorded on the pitch at Abbeydale Park, Sheffield which was used for the Yorkshire/Middlesex game in 1977.

This same Sheffield pitch had also been used for the Yorkshire/West Indies game the year before when the bounce values were clustered around thirty-five inches.

The experience of the Yorkshire players injured on both these occasions suggests to me that the standard of pace indicated by these bounce values is faster than all but the most talented batsmen can cope with and certainly when it is encountered unexpectedly and the fast bowlers are West Indians.

The soil at Abbeydale Park had a clay content of thirty-five percent. However the type of soil considered necessary for top class cricket in Australia generally exceeds a clay content of fifty percent! In addition, the Australian preference is for a type of clay which, by comparison with that used in Britain, is markedly swelling in character, it is a clay that will expand and contract a great deal in response to wetting and drying and, by this means will readily crack itself open.

The use of self-mulching, clay soils on cricket squares only begins to make sense when it is realized that cricket squares in Australia form part of pitches used for various types of football during the winter.

Strange though this practice may seem to those used to the hallowed turf being protected from use out of season, there is some reason to believe that it is more the winter game than the summer game that suffers most from this pattern of continuous use.

Studded footwear probably achieves a useful amount of churning to homogenize the top-soil, and any cracking will not only assist drainage but will also enable any summer accumulation of salts to be effectively leached away. Also, in the cricket season, the abundance of fine surface cracks will assist the strongly rhizomatous Australian couchgrass (*Cynodon dactylon*) to recover from below, providing a suitably, deep-rooted sward

Clay content percent	*Bounce (Cricket ball droppedfmm 16ft) inches*		*Pace*
	over	30	Very fast
34		25	Fast
22		20	Mod. fast
10		15	Easy paced
	less than	15	Slow

General relationship: Potential bounce. ins (within range of clay contents listed) $= \frac{\%\ \text{clay}}{2.3} + 11$

Table 3: Potentialfor bounce (inches) when pitch prepared to the best 1966-67 standards. Bounce values probably conservative as based on averages. Pace descriptions based on player opinion.

Australians prefer higher clay content

Just how pitches are prepared on these potentially tricky, Australian soils, in a climate far more desiccating than ours, could have relevance to the problem that struck the groundsman at Headingley, Keith Boyce, last summer. But that is part of another story.

Meantime I think that any groundsman who takes up the challenge to meet the T.C.C.B. requirement for pace, equivalent to that which our test players must face when they go to do battle in Australia, deserves our sympathetic support.

It would be a great pity if a groundsman's response to unsympathetic, uniformed criticism was to give up the effort and to revert only to the much simpler task of satisfying the mediocre performers – offering a steady diet of that contradiction in terms, the commentator's 'good easy pace'.

Land drainage to be promoted

An extremely active year in the promotion of land drainage to farmers was promised to members of the Land Drainage Contractors Association by its newly elected chairman, Mr Derrick Clark, of Shipston on Stour, Warks.

"Good drainage is as vital to farmers as the land itself," said Mr Clark after his inauguration as chairman, "and it is still an outstandingly good investment in today's farming budgets, paying for itself in three years and continuing to be effective for at least fifty years.

Derrick Clark, the new chairman of the Land Drainage Conlractors Association.

"We understand the uncertainty that farmers feel about spending:' he said, "but ADAS figures show that neglecting drainage on land that is growing crops is as classic a case of false economy as can be imagined. It leads to waste of money on cultivations, seed and fertiliser, to the loss of timeliness and depression of yields!'

During 1988, the LDCA will not only be putting these messages across in talks, at shows and demonstrations and through advertising, but it will also he promoting the expertise and standards of its members to the owners of sports fields, courses and recreational areas.

A Sports Turf Section of the Association has already been formed and a separate, specialised code of practice for LDCA members carrying out this type of work is in the course of preparation.

Farmers Weekly Drainage Event

We are very pleased to note that Farmers Weekly are again staging their important Drainage Event. It is particularly gratifying to learn that their decision to do this has been prompted by the pressure of interest shown both by the trade and by the potential 'end users'.

The message is being heeded. Chris Stansfield, ADAS, in our last issue wrote that field drainage is a fundamental investment, necessary for good land management. It should not be neglected as a short term way of cost cutting. The Farmers Weekly Drainage Event in 1988 combines with field boundary demonstrations and conservation activities.

The place is Finningley, near Doncaster – the date 22nd October 1988 (see page 2). It will be well worth a visit.

Getting the best out of your soil

Five farmers discuss their soil management problems and practices

Acting on members' suggestions it was arranged this year to hold a half day Conference in conjunction with the Annual General Meeting of the Association.

The theme chosen: 'Getting the hest out of your soil' was planned to form a logical follow on from the very successful SaWMA 1987 Conference 'Tillage, What now and What next?'

The venue was again Rothamsted Experimental Station and those attending were given also a conducted tour of the Broadbalk classical experiment site exploring soil nutrition.

Chairman of the Conference, Mr A E **(Johnny)** Johnson, Head of Soils and Crop **Production** at Rothamsted, spoke briefly about the relevance of the Broadbalk work to the day's topic of 'Getting the best out of your soil: He explained how, in setting up the Broadbalk trials Laws and Gilbert had laid the foundations to our understanding of the nutrient requirements of crops and how those needs could be met by the use of fertilisers and manures.

"A major problem facing Laws and Gilbert – the problem of weed control – was not solved in their lifetime, but now we have a wide range of weed killers so that, with a few notable exceptions, weeds nowadays need not be a real competitor with the crop':

Simple soil tests still needed

"Today a soil's nutrient status can be assessed and defined by a variety of simple laboratory tests. However, there are still no such simple tests to tell us ahout the physical state of the soil. There is still much useful research to he done and it is a matter for serious concern that the number of staff at Rothamsted has been reduced by nearly 40 per cent in the seven years since 1981".

Introducing the Conference speakers Mr Johnson pointed out that delegates would not be hearing generalities, but rather they would be hearing about specific cases from individual farmers.

The farmer speakers were:

Mr Richard Elliot, Cokenach Estates, Royston – – – – – Boulder clay
Mr Ted Grant, Fold Hill Farm, Boston – – – – – – – – Silt
Mr John Martindale, Gleadthorpe EHF, Mansfield – – – Sand
Mr John Ray, Brasenose Farm, Oxford – – – – – – – – ,Oxford clay, brash
Mr Guy Shropshire, Hainey Farm, Ely– – – – – – – – Fen

In presenting this abbreviated report of the Conference we have grouped together some of the points made by these farmers on different aspects of how they are 'getting the best **out** of their **soil!**

SOILS AND CROPS

Richard Elliott: Cokenach Estate covers two farms, one of 1800 acres and another, newly acquired, around 600 acres. The larger farm has 1500 acres in arable crops and the remainder is mature woodland and parkland.

The soil type is Hanslope Series boulder clay made wen heavier owing to the large amount of woodland. Along the Western side, over an area of about 250 acres, there is a variation to Oak series – a mixture of decalcified boulder clay overlying chalk.

We try to grow mainly winter crops. The rotation we now try to follow is three wheats, one winter barley and then into winter oil seed rape or spring beans. Spring beans have become one of the most profitable crops to grow over the last two years – I have built up from 50 to 150 acres.

Ted **Grant:** I have a farm which goes from the lightest silt to quite heavy silt, even running to a silty clay loam. I have very few fields that are either uniformly light or uniformly strong.

Our major crop, now and for the past twenty years, is spinach for processing. There is no other crop that has a shorter growing life nor has a higher transpiration rate. It requires the best conditions and critical control over soil moisture.

Around the spinach we grow cauliflowers, onions, daffodils, wheat and peas – almost as fill-in crops. We are essentially horticultural. We have no root crops.

As soon as we have any crops cleared – and we start spinach about 27th May – we may put in a second crop but otherwise we put it into ryegrass as a short term crop, or if we are later, July or August, into corn rye as a cover crop. The aim is always to maintain and improve the structure and fertility. The grass is sheafed off and we will plough all land before the Christmas break.

John **Martindale:** Gleadthorpe Farm is 180ha of nice compact design. We run two rotations – a four course rotation of potatoes, cereals, sugar beet, cereals and a six course of seed rape, two cereals, sugar beet or fodder beet, twocereals.

Broadly speaking, we are on sandy loams to perhaps loamy sand and whilst

Two groups of delegates receiving comprehensive explanation of the Broadbalk experiments.

these can be cultivated at almost any time we do have other nroblems which make sand just as difficult – but in other ways – as the other soil types we are hearing about.

Stones are a problem. For one thing, stones reduce the water holding capacity of the soil. We can carry out de-stoning, a slow job, but for potatoes we have to do this because we want to produce a quality product.

Wind erosion – that is something we certainly have – and we also have water erosion.

At the end of the day, if you can cope with those problems, I reckon that sand has got everything going for it. If you can water it well enough and if you can cope with the nutrient problems you have such a tremendous range of crops you can grow.

John Ray: On the eastern edge of the Cotswolds, the farm is gently rolling country running uphill from East to West – roughly 500 acres in three main blocks – basically limestone brash with Oxford clay, some sand and some sand with ironstone.

Originally we were a dairy farm, 60 or 70 cows. Then, in 1976 we sold the cows and we are now arable and I am single-handed. Rotation used to be winter barley and winter wheat, we burnt all the straw and scratched the surface and drilled again. It worked very well, very low on labour input and quite cheap on cultivations, but it did all rely on good autumns for burning. The main advantage was that we got on top of a very serious wild oat and couch problem. It eradicated that.

In 1979 we bought 120 acres in the next village. This increased the work load and the load on the finances, so we had to do something about it.

We started by spreading the harvest and the drilling peak labour period – spring wheat for milling, then we introduced oil seed rape. The rape, we always found difficult to plant in time because there was only a limited labour force – and barley was a problem in that we got it in the wheat, which was all milling.

Spring crops introduced

So now we have introduced some spring crops to minimise the grass weeds and hopefully introduce a sort of mini-fallow.

The first crop we chose was linseed – now in its fourth year – it is very cheap to grow and these days we are looking for crops that give you the cheapest loss in a bad year! Beans are the other crop – we grow them for seed as well – on contract – they are cheap to grow, very good for the soil, put the nitrogen back, but they do push the harvest later and they leave the combine very dirty for the winter lay-up.

Guy Shropshire: G S Shropshire and Sons is a family farming business and packing business founded by me in 1952. We farm 3,000 acres in Cambridgeshire and Norfolk – and about two thirds of our land is black

Mr John *Ray,* Oxfordshire farmer and Chairman *of SaWMA* Council. One *of* the speakers a! *the AGM* Conference.

fen, the remainder being clay loams and some silt soils.

We have a great difference in our soil types – there are areas of very deep acid peats and a stretch of 800 acres of very light peat. Our best land is along the sides of the rivers where silt deposits have been mixed into the peat during its formation.

Our cropping is sugar beet 250 acres, cereals 300 acres, potatoes 500 acres, onions 300 acres, celery 350 acres, lettuce 1200 acres, leeks 50 acres, chinese cabbage 70 acres – other salad and vegetable crops about 100 acres.

We are a member of a co-operative called Gee's Growers Ltd in which 28 other farmers contribute to a further 1200 acres of vegetables and salad crops. We do the packing and the marketing for the whole co-operative. We employ over 1000 people on a seasonal basis, being mainly a summer producer. We use techniques such as polythene covering to extend our seasons.

DRAINAGE & IRRIGATION

Richard Elliott: At Cokenach, the Hanslope series covers approximately 85% of the estate and extends to a depth of 30 to 50 feet. The natural drainage is very poor, the plough layer is a clay loam. The drainage management has been developed over the years. The heads are installed at approximately 80 metres apart at a depth of 32 inches and covered with an overlay of *10* to I2 inches of one and a half washed gravel. This system is moled over at not less than 24 inches deep.

An essential aid to the efficiency and maintenance of the drainage is the continuous attention to outfalls, ditches and *outfall* pipes. These are checked periodically through the winter by one man. Conditions within the field are also periodically checked at moling depth to ascertain the degree of compaction and fluctuation of the water table in this region, and also the build up of ferric oxides. If these are excessive, moling is carried out as soon as conditions permit.

The Oak series needs very little drainage attention.

Ted Grant: We have a typical fenland farm drainage system. Mainly 20 metre drains all put in in my time – clay tiles and with very little gravel fill. The tiles – 'red bank' tiles are very close fitting and have done an excellent job in all classes of silt – and continue to do so as long as we maintain them well.

Most of the fields are 20 acres or more and the field drains run into the main drains maintained by the Inland Drainage Board. I am a member of the Drainage Board – it is a 90,000 acre svstem with the whole area pumped once (and some of it even pumped twice) to get it into the Witham at the neck of the Wash.

We can also use the ditches for an irrigation system – pumping water from some retention level in the stronger fen and leading it either through our own ditch channels or the main drain channels to give an irrigation point to all the fields.

I do not usually use irrigation other than for something that is going to fail. There is always the prospect of a capping problem no matter how good is the irrigation.

John Martindale: As for drains, of course, I have almost forgotten what a drain looks like on the sand. Our problem is water retention in the soil. With our soil we would normally reckon to have around one millimetre available water per ten millimetres of soil depth – and where we have stones we are down to 0.8mm available water. Richard Elliott and Ted Grant will have levels almost double ours.

Aerial photography helps to solve soil problems

Members attending the SaWMA AGM and Conference at Rothamsted (9th March 1988) had the opportunity to learn something about the way in which aerial photography can be used in good farm management.

A small display was mounted at the Conference by the ADAS Aerial Photography Unit based at Brooklands Avenue, Cambridge (0223 358911). Examples were presented of how aerial photography can help in matters such as:

- Mapping soils for land management purposes
- Identification of poor soil structure
- monitoring the effects of husbandry operations
- identification of underlying features – for example stream beds; drains; old field boundaries
- identification and measurement of crop growth problems

The ADAS aerial photography service is primarily intended for farmers, farm managers and land agents. However, the Unit can offer similar services to others involved in the agricultural industry.

The *Sampo* harrow - *a* useful tillage *tool* for *Ted Grant* and John *Ray.*

Of course, to overcome drought we can irrigate; one might also consider alternative crops or out of season sowing. We have a nice river flowing through the middle of our farm. We irrigate from that, monitoring regularly the water quality as everyone should with irrigation water.

John Ray: We have done a lot of drainage ourselves this year. Plastic pipes are great because they give the opportunity of doing it oneself a bit. We cannot afford to do a full drainage scheme, but where we have problems along springlines, as in the brash, we put in herringbone just along the hanks.

We have quite a lot of problems panning with heavy machinery – we do have to be extremely careful. Good farming and a flat lift have made a big improvement. Also we find that a dry year will crack our soil down to 18 inches – no expense to us – so we get away many years without any flatlifting at all.

Irrigation – that would be nice. The brash dries out and burns very easily. With all the sand along the stream we thought of digging that out, selling the sand for building, then creating a reservoir for irrigation.

Guy Shropshire: We have had to invest heavily in tile drainage with gravel to cope with our intensive cropping and to enable us to make the fields larger. Ochre is a problem for us and we regularly jet out the pipes.

Benefit of land levelling

Some of the land has enough peat to allow land levelling which enables us to hold water tables by using overhead irrigation and control by a network of dams. With modern machinery we can level now to one or two inches difference from one side of the field to the other. Then, when we hold water levels to around 24 to 30 inches accurately (to have an accurate distance from surface to levels), we can give every plant in the field an equal opportunity to get the same amount of water. You get a more uniform crop.

The water level required depends on the type of crop, but where we have a reasonable pH the crop will get down to the water level quite well. Even with water table control we are still applying 10 inches of sprinkler irrigation to our celery crops.

Holding water tables at around that kind of level it is essential to have adequate drainage. Should you have two or three inches of rain you could have a rise of water levels of one foot. So, on the light peats where we are holding that kind of level, mole draining can be useful. I have just designed a machine which puts gravel in the moles as we are mole draining.

A major problem, of course, on all our peat soils is blowing or wind erosion. This has been made worse by making fields larger and by better weed control. About 15 years ago I invented a machine to plant straw into the crops – this has been very successful in combating blowing.

The peat is continuously shrinking through oxidisation and we are having to change and adapt our farming practice as our soils become progressively heavier. If we are to maintain our Dresent cropping, we will have to invest ir further gravelled drainage, rely more on sprinkler irrigation, stop holding water tables and change soil management practice, such as timing of cultivations.

NUTRIENTS

Richard Elliott: With our Hanslope soil – pH levels are about 7.7; Phosphate indices at 2 or 3 with potash at 3. Liquid fertiliser is used because I find it fits in best with my system. A Chafer self-propelled tramline sprayer does the hulk of the fertiliser and spraying on the estate.

Ted Grant: We are very typical of silts with quite high phosphates; medium potashes. Nitrogen is what you put on to it. Talking of nitrates there is no doubt we are going to see a lot more problems. We never try to put on more than 50 units at any one application on anv one crop. We are held with the spinach crop to a nitrate level which has been tested for the last three years. We are doing what a lot of people should be doing in the future.

John **Martindale:** On sand the problem always is that the crop is hungry – it needs nitrogen. You have great difficulty in giving crops the optimum amount and not wasting nitrogen nor polluting. Water drains through the soil and leaches nitrogen very rapidly.

Now we are interested in residual soil nitrogen tests done in the spring. We have a great deal of interest in leaching models such as the one here at Rothamsted. We need a leaching model to tell us how we put nitrogen on through the season after we have done our rainfall measurements. Lime leaches badly too and so does potash. We are constantly having to replenish with potash. Also, something often forgotten, the trace elements, copper, boron, magnesium and, of course, manganese. A quick leaf test for manganese to tell when problems are arising would help a lot of farmers including ourselves.

Placement of fertiliser is also important, particularly for potatoes. Liquid fertiliser and bed systems probably give the chance of more accurate application.

John Ray: Chemically, the main problem

Crop establishment

Aspects of *Applied* Biology 7. *1984*

Produced by the Association of Biologists, AAB Office, National Vegetable Research Station, Wellesbourne, Warwick CV35 9EF. Price £10.00.

This paperback volume of 376 pages is subtitled "Biological Requirements and Engineering Solutions". It is a detailed and well produced account of a meeting which took place over 4 days in September 1982.

At the meeting, the biologists were asked firstly to review specific topics quantifying requirements for successful crop establishment and also to indicate what happens if such targets are not met. This information was then to be used as guidelines for identifying necessary improvements in design and equipment for seed bed preparation and crop establishment – with engineers being asked to describe the options open to them as designers, the constraints they faced, and the information they needed to make progress.

As pointed out by the editor, M K V Carr, it was impossible to meet some of these requests (no doubt because in practice such steps are not the ones normally relied on to realise successful systems) but the meeting did provide a rare-opportunity for biologists, soils scientists, agricultural engineers and farmers to come together and exchange views on subjects which are fundamental to agriculture. This well justified the support given by SaWMA. The resulting volume also justifies itself as a review of the current state of the art, and is well laid out and packed with information divided into five sections.

Section 1 deals with the seed and soil, with a notable contribution by J A Currie of Rothamsted on the physical environment in the seed bed. Section 2, chaired by SaWMA Council member J B Finney, deals with seedling establishment, with two papers on establishment factors and possible solutions, and two on mechanisation of seed sowing, both cereals and rowcrops. Section 3, chaired by Professor R L Bell covers plant establishment, specifically transplanting and fluid drilling, and potato planting. Section 4 deals with seedling protection, including weed pest and disease control, chemical applications, irrigation, wind shelter and the avoidance of capping by means of synthetic soil conditioning.

The final section rwiews crop establishment within the farming system with the views of experts on crop residues, compaction avoidance – very detailed, selection of tractors and equipment for spring cereals and the views of a wheat gmwer, R G Dawson, who points out where his yields could be improved by no less than 19% through better crop establishment. The concluding paper gives an overview of the conference proceedings.

This volume may be found to be most useful as a source of detailed facts.

A.N.E.

Land application of sludge

by A. L. Page, T. G. Logan and J. A. Ryan *Lewis*, Michigan
John Wiley & Sons Ltd, I Oldlands Wav. Bognor Regis, West Sussex PO22 9SA.
1987, 168pp, £31.70

Recognising the need to manage safely the land applications of municipal sludge, the US Environmental Protection Agency, in co-operation with the Universities of California and Ohio State, sponsored a workshop on 'Effects of Sewage Sludge Quality and Soil Properties on Plant Uptake of Sludge-applied Trace Constituents'.

The workshop brought together 31 scientists to examine critically the currently available published and unpublished information and to produce an assessment of the current knowledge about factors known to affect the impact of trace constituents on crops and consumers when applied to lands in the form of municipal sludge.

This book presents the findings of the workshop.

Apart from the introduction, there are five chapters dealing with the effects on accumulation of trace elements by crops. The chapters deal successively with the effects of ● soil . . sludge properties ● long-term applications ● the transfer of these trace elements to the food chain ● the effects of trace organics in sludges on soil-plant systems.

At the end of each chapter there is a useful set of conclusions and a reference list – although the references are inevitably biased towards American published material.

The subject matter is inwitably complex. Page and colleagues have made a valuable contribution with a clearly written and argued review of a subject that is topical on this side of the Atlantic as well.

T.R.E.T.

Twenty five years of drainage experience

Proceedings of Symposium

The International Institute for Land Reclamation and Improvement (ILRI) has published the proceedings of the Silver Jubilee Symposium held in 1986 at Wageningen, The Netherlands.

Priced at *D.fl* 85.00 (US $34.00) the publication (353 pages) is available from ILRI, PO Box 45, 6700 AA Wageningen, The Netherlands.

for us is lime, -- here not enough, there far too much – we range from pH 4.5 up to 8.5. Nitrogen is obviously acidifying, especially on the clay, but even on the limestone land we have had to put a ton an acre in certain places to try to keep a level crop. We get leaching on the spring lines – low on P and not helped by continually taking off the seed, but we are very good on K, somewhere up in the twos. We are beginning to find after straw incorporation since '79 on some of the land that we can drop the rates of nitrogen.

Trace elements; manganese can be a problem on the high pH soils particularly with barley and magnesium was a problem with the rape. Manganese and copper are a problem with the linseed and sulphur is becoming a problem all over now that pollution is controlled. We get the fertiliser people to test and I have a home test kit which we use but it is time consuming, it takes care and cleanliness, but it does give you an idea.

We use liquid fertiliser because one sprayer will do the spreading and the spraying; and it does save my back.

Next winter we are looking to winter oats, there is a new variety we are going to try – 25 acres – cheaper inputs and earlier harvest – half thenitrogen of winter wheat – and we do genuinely look at these things because of nitrates in the water situation.

Guy Shropshire: On the light peats of our Norfolk farm the peat can be up to five feet in depth and has a higher percentage of organic matter. This gives both advantages and disadvantages. Weed control is very difficult on this type of soil and also it is such a fertile soil that crops grow too fast and too lush – which results in vast top growth and poor quality. For this reason we cannot grow onions, iceberg lettuce, early celery, or cereals on this land. Liming may be necessary for some crops but it can cause manganese deficiency and scabbing in potatoes.

Some soils can also develop an acid layer – we call it a drummy layer – perhaps from over-draining or a very dry year. To overcome this it is possible to inject lime through a machine – but if the water table is kept up continually then you do not get this problem.

TILLAGE

Many more useful points were made at the Conference, not only on the subjects we have dealt with here, but also on the wide subject of tillage practices.

We hope there may be opportunity to report more fully on this in a later issue.

Our warmest thanks are extended to Johnny Johnson for his very able chairing of the Conference and his knowledgeable additions to the discussion and in summing up. We are also grateful to the other members of Rothamsted staff for their welcome and particularly for the guided tour of the Broadbalk experiment.

Nitrates in the human diet

Dr David Forman, Imperial Cancer Research Fund, Oxford

The EC has set a stringent maximum of 50 mgm per litre nitrate in drinking water. Dr Forman recognises that we do not yet have all the answers so it is important to play safe – but, he says, currently there is no medical evidence of harmful effects from drinking water with nitrate content even up to 100 mgm per litre.

'Water Pollution – the Farming Perspective' was the subject of an important Conference organised in November 1987 by ADAS and the RASE together with the Water Authorities Association.

The first part of the conference was concerned mainly with various aspects of nitrogen usage and this was then followed by examination of possible pollution from other sources such as animal manures, silage effluent and pesticides.

The full set of papers from the conference is available from the RASE at Kenilworth. Here, we report the contribution by Dr David Forman of the Imperial Cancer Research Fund.

Nitrate in food

Each of us consumes, on average, about a tenth of a gram of nitrate every day. The majority of this nitrate is usually derived from vegetables which take up nitrates from the soil in which they are grown.

Different types of vegetable differ to an enormous extent in the amount of nitrate that they contain. There are no general rules. Thus beetroot, spinach, and celery tend to contain a lot of nitrate (about 2000 mg per kg) whereas carrots, sprouts and onions contain very little (under *200* mg per kg). The nitrate content of any one vegetable may also vary to a considerable extent depending on the variety, the growing conditions, and the cooking procedures.

It is therefore difficult to be precise about individual consumption of nitrate. We have estimated that any one person rakes from his daily diet of vegetables between 80 and 90 milligrams of nitrate, but this is a very crude approximation and will vary from individual to individual. About half of this vegetable nitrate will come from foods such as potatoes, cabbage and lettuce, which, although only containing moderate amounts of nitrate, are consumed in large quantities.

The other food items which contribute to nitrate intake are negligible in comparison with vegetables. They may provide a further 5 milligrams per day. Most of this will be the nitrate which is deliberately added to bacon and other "cured meats" as an anti-bacterial agent. Nitrate and nitrite are both very effective curing agents and have certainly helped prevent serious epidemics of food poisoning from contaminated meat. The amount permitted to be added to meat is very carefully regulated and is now set close to the minimum level necessary.

Nitrate in drinking water

Over and above food nitrate, the other major source we must consider is nitrate in the drinking water. If it is assumed, not unreasonably, that we drink the equivalent of one litre of water a day, and if the nitrate content of water is x milligrams per litre, then x has to be added to the day's intake from food. Thus as the nitratecontent rises, so does the contribution of nitrate derived from drinking water.

There is clearly much concern at the present time about the health implications of this dietary exposure to nitrates. If it could be unequivocally demonstrated that there is a straightforward cause and effect relationship between nitrate intake and the development of disease, then no effort would be spared to limit the level of nitrates in both vegetables and water exposure. The present state of the evidence is, however, very far from unequivocal.

Nitrate itself is not toxic nor is it associated with the development of cancer. The problem is however, that, to varying degrees, we are all capable of changing the structure of dietary nitrate to that of nitrite – and nitrite is a much more reactive chemical which has two potentially harmful effects.

Firstly, nitrite can combine with haemoglobin in the blood and impair the circulation of oxygen throughout the body. This disease is called methaemoglobinaemia and can particularly affect babies and has been commonly referred to as 'the blue baby syndrome: The second concern with nitrite is that it can, under certain circumstances, react with other dietary components to form a group of chemicals called N-nitrosocompounds – and many of these compounds have an extremely potent ability to induce cancer when tested in animals.

Nitrate changes to nitrite – the real trouble maker

The underlying challenge facing those dealing with this problem is to determine the extent to which these harmful effects actually occur as a consequence of nitrate exposure.

There is no doubt that most European populations have been consuming increasing quantities of nitrate in both food and 'drinking water over the past few decades, as a result of the dramatic rise in the use of nitrogen fertilisers. It is therefore reassuring that there has been no noticeable increase in the 'blue baby syndrome' in this period and indeed this condition is largely non-existent in several countries. At first sight, the same can be said about stomach cancer, which is the type of cancer that has usually been associated with nitrate intake.

Stomach cancer has been declining in incidence over exactly the same time period that fertiliser use has been increasing. It is, however, still a major cause of death in the UK and there are reasons to believe that once a stomach cancer has started it might take *20* or 30 years before it is diagnosed. Thus some people have argued that the present decline might halt, and in the future we might see the results of recent increases in nitrate usage. This is the origin of the term, favoured by the media, of 'the nitrate time-bomb'.

Evidence suggests UK nitrate levels no problem – hut still many unknowns

The current balance of evidence would suggest that the range of nitrate intake which we face in the UK is unlikely to be associated with an increased stomach cancer risk.

However, our understanding of the problem is still at a rudimentary stage and there are numerous gaps in the medical evidence.

It is possible that nitrate might represent a problem, but only at very high intake levels with which we have, as yet, no experience.

It has also been argued that we do not need to worry about nitrate in vegetables as vitamin C, also found in vegetables, inhibits the formation of N-nitroso compounds. Thus it may be only when the water nitrate intake becomes high that we should be concerned.

A further complicating factor is that some people have an increased capacity for converting nitrate into nitrite and it might only be this subgroup who are at risk from nitrate.

Sensible limits – generous safety margins

There is no doubt, therefore, that we need sensible limitations on the amount of nitrate permitted in drinking water and such regulations should have a generous safety margin built into them. The current EC legislation recommending *25* mgm per litre with *a* maximum of *50* mgm should be interpreted in this light. These levels are undoubtedly stringent and will have considerable economic consequences.

It is necessary therefore, to realise that currently there is no medical evidence for harmful effects of water supplied with up to 100 mgm nitrate per litre and thus alarm bells need not ring every time the levels go over *50* mgm.

However, we need also to be prudent and recognisethat, as we do not have all the answers, it is important to play safe.

DIARY

AUGUST 1988

21-22 Plant roots and their environment—Symposium of International Society for root research—Uppsala, Sweden.

SEPTEMBER **1988**

5-8 Telford—a ease for soil development– BSSS Conference and Workshop—Harper Adams College, Newport, Shropshire.

25-2 Oct Irrigation and Drainage—Conference and Exhibition—Dubrovnik, Yugoslavia (see page 9).

27-29 Maintaining a balance in water and environment management—Conference– Institution of Water and Environmental Management—Eastbourne.

OCTOBER **1988**

22 Field Boundaries Drainage and Conservation Event—Farmers Weekly – Finningley, Doncaster

DECEMBER **1988**

4 days Field Management for Effective Drainage—Short Course, Silsoe College.

JANUARY 1989

3-6 Soil Management—Short Course, Silsoe College.

ADVERTISERS INDEX