SOIL and water

Published by the Soil and Water Management Association Ltd. October 1983

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SOIL and water
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Editor
M. R. Saull

Editorial **Committee**
M. S. Darbishire (Farmer, Norfolk)
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T. H. Horsefield (NFU)
I. Duncan (AEA)
A. E. T. Forsyth (Farmer/Contractor, Warks)
F. D. Moore (Howard Rotavator)

Editorial **office**
SAWMA,
NAC, Stoneleigh,
Warwickshire, CV8 2LZ,
England.
Telephone: Coventry (0203) 555100

Production & advertisement **office**
AP Magazines,
61B High Street, Banbury,
Oxon, OX16 8JJ, England.
Telephone: Banbury (0295) 57571

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The Association is a charity whose main objectives are to further the condition, fertility and management of the soil and its resources.

The next issue will be published in January and will feature land drainage, waterway and ditch maintenance.

COMMENT

INCORPORATION LESSONS

THERE WAS a marked change in interest by the farmer visitor to the NAC's Autumn Cultivation demonstration compared with the RASE's first such event in 1981.

At the 1981 demo, held in Shropshire, farmers turned their attention to subsoiling — but this year, which in theory following a long dry summer should have seen the pan busters out in force. visitors showed more interest in methods of incorporating straw. It is probable that an event held in early September comes too late for the farmer to select, purchase and take delivery of a new piece of tackle and many may already have correctly loosened soils damaged during the wet spring, but most are obviously anxious to keep abreast of incorporation methods should — heaven forbid — legislation make it more difficult and perhaps impossible to burn.

As the organiser of the straw incorporation forum held twice daily at the two day event, it was interesting to note that of the 600 to 700 people who listened and participated in the discussions only half a dozen or so actually incorporated straw to any significant extent on their farms. Perhaps the 'tinder box' conditions and the widely reported number of 'burn accidents' have made many question their approach to crop residue management and hence cause a 'panic' interest.

However, one hopes the interest is not due to the results of last year's trials at EHF's and other research stations which indicated little difference in final yield between different incorporation methods and traditional burn and plough techniques.

Last year was exceptional. Toxins were continuously being diluted and the warm temperature and moist soil environment encouraged straw breakdown. This year could be different. During September, there were many reports of farmers who had experienced great difficulty in getting into the ground with their cultivations equipment and, when they did, clods were brought to the surface requiring more 'breakdown' passes than normal to produce a suitable tilth for drilling.

Such rock-hard conditions also means that initial shallow incorporation by disc or tined implements will not have reached any depth nor produced satisfactory mixing. Although drilling conditions have been good, and the soil moist. since late September. crops drilled earlier into a straw-incormrated seedbed may experience a sudden'flush of toxins likely to inhibit germination.

For the heavy land or shallow soil farmer, incorporation, while normally difficult, will have been virtually impossible this year, and a ban on burning would be most unacceptable.

Although it is healthy that the industry is looking at the alternatives, there is, for many, no other method, as yet, which would prove either practical or economic.

MARKETING LINES

EQUIPMENT manufactured by BKW Engineering, Ribblesdale Mill, Ribchester, Preston, Lancs, for the water, agricultural and energyindustries is now marketed by newly formed company, BKW Engineering Sales & Service Ltd, based at the same address.

The product line-up includes slurry tankers and soil injectors now in use with Water Authorities, a range of pumps for liquids and semi-solids, irrigation equipment and straw choppers. BKW Engineering also offers a specialised fabrication, shotblasting and paint spraying service.

Enquiries to either Chairman, Mr Brian Walker, or Sales Director, Mr John Conroy, on 025 484 621.

SPRAY-ON SOIL TREATMENT

A NON-TOXIC, bio-degradable chemical soil conditioner, claimed to improve soil structure, promoting better drainage, easier cultivations and enhanced root growth, is now available in Britain. Agri-SC was developed in North America and can be applied to the soil after harvest or prior to drilling by conventional crop sprayer. Recommended application rate is 4oz an acre, and incorporation is advised for best results. The treatment is said to break up hard, cloddy soil and flocculate small particles to give increased permeability and reduced plasticity. Cost is about £7.50 an acre.

Illustrated literature from importers, Minting Farm Supplies, on Baumber (065 86) 220.

ELECTROFILTER

DRAINAGE pipes for use in unstable ground conditions, such as running sands or silts, can have an envelope material applied during manufacture at the flick of a switch, utilizing electrostatics. The idea has been developed by a former director of Big 'O' Filters. Brian Lewis, from a process used for flock coating in the automotive component industry, where it is used to give surfaces a fur-like finish.

This development is designed to enable pipe manufacturers to place a filter envelope onto a corrugated plastic pipe and on the end wall of clay tiles as and when it is needed. Traditional filter materials such as coir (coco fibre) and synthetic fabrics are wrapped as a subsequent operation to the pipe manufacture. This new method enables the pipe maker to provide a filter envelope of chopped nylon or polypropylene downstream of the corrugating machine.

An epoxy derivative photosensitive adhesive is sprayed onto the pipe which then passes along the process where straight lengths of fibre are charged electrically and deposited onto its surface. The phenomena ensures that fibre particles are vertical. The final step is to cure the adhesive by light source.

The result is a very fine brush-like surface which is extremely durable with a similar life expectancy to other synthetic filters by virtue of the material used.

The equipment takes up about 1.5m length and can be adaoted to anv extruding system or pipe diameter.

Mr Lewis is carrying out further tests on the product, but those interested in this new idea should contact him direct at Castlebourne Lodge, Belbroughton, Worcs. Tel: 0562 730709.

World patents on the process are pending, options for worldwide manufacturing licences will be made available to interested parties.

CLAYMEN MOVE

THE British Clayware Land Drain Industry has a new address: Federation House, Station Road, Stoke-on-Trent, ST4 2SA. Telephone: 0782 416256. Telex: 367446.

JIMMY ELLIOTT

On Sunday, 28 August, Jimmy Elliott, head of the weed control department and director of the commercial farming unit at the Weed Research Organisation, died suddenly at the age of 59. A founder member of the WRO, he was a great supporter of agricultural research and its practical applications. Jimmy Elliott will be greatly missed by his many colleagues and friends in the agricultural industry.

PUMPING OUT

FIVE submersible pumps introduced by Stuart Turner have flow rates from 2730 to 15,900 litres an hour (600 to 3500 gph) at pressure heads up to 30.5m (100ft).

Applications of the new range, known as the Type 300-800 series, include drainage, water transfer and well pumping. Each has automatic float control switching, overload protection and a stainless steel shaft spindle. The Dumps are designed to operate in temperatures up to 35 dec *C* and prices start at £56.

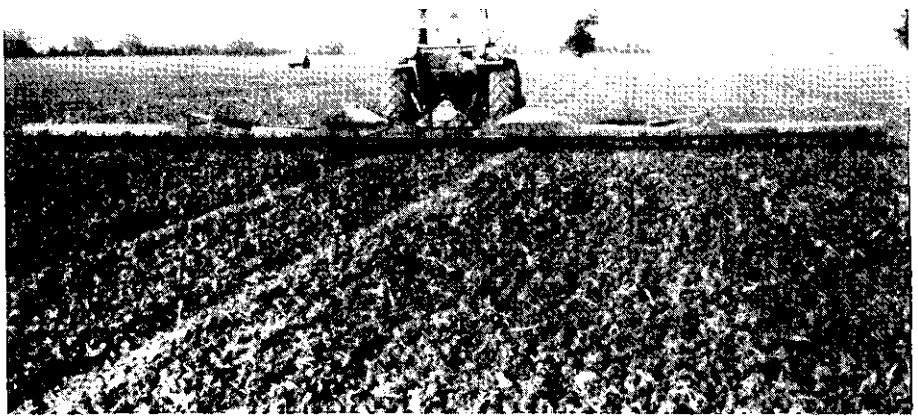
Further information is available from Stuart Turner Ltd, Market Place, Henley-on-Thames, Oxon. Tel: 04912 2655.

MULTI-FUNCTIONAL

AN ALL-SEASON. multi-purpose harrow, based on a prototype built by Norfolk farmer, Mike Darbishire, has been developed by King's Lynn firm, Harpley Engineering Ltd. The CTM Harrier is primarily designed to cover broadcast cereal seed at high speed and with minimum wheelings. Other applications include effective aeration of capped soils, grassland renovation, inter-row weed control, chemical incorporation, light seedbed work and stubble stirring to germinate weed seeds prior to spraying.

The CTM Harrier consists of a 2.5m pressed steel plate main frame with spring steel tines clamped to invidually-sprung 1.25m long extension bars. These bars can be assembled in various configurations to suit application. Maximum working width, from a base size of 2.5m, is 12.5m. Price is expected to be in the region of £2900. Further information from Harpley Engineering on 048 524 355.

Spanning 12.5m, the CTM Harrier is suitable for a full range of light seedbed and topsoil applications at speed.



GIVE ME WATER

AVAILABLE in various sizes to suit a range of root depths, the Aquameter is a British-made instrument designed to show farmers and growers when crop irrigation is needed. Inserted into the ground, the Aquameter soil tensiometer constantly measures the effort required by roots to extract moisture from the soil. As water is drawn away from the instrument by roots searching for moisture, a vacuum is created around the Aquameter's probe. This is converted into a reading which, depending on the crop, indicates when extra water is required.

Prices range from f25.70 to f28.10 for 300mm and 900mm probe lengths respectively. More details from Soil Instruments Ltd, Bell Lane, Uckfield, East Sussex. Telephone 0825 5044.

DRIVE ON FILTERS

WITH THE appointment of a new General Manager, Big 'O' Filters UK Ltd say they are poised to launch an expansion programme throughout the United Kingdom, Europe and the Middle East.

The new man at the helm is Mr 'Rick' Burjaw from the Big 'O' Canadian parent company. He plans to introduce three shift working by the end of the year to produce the extensive range of patented filters specifically designed for land drainage pipes. The marketing drive will be aimed towards farmers, contractors, civil engineers and pipe makers.

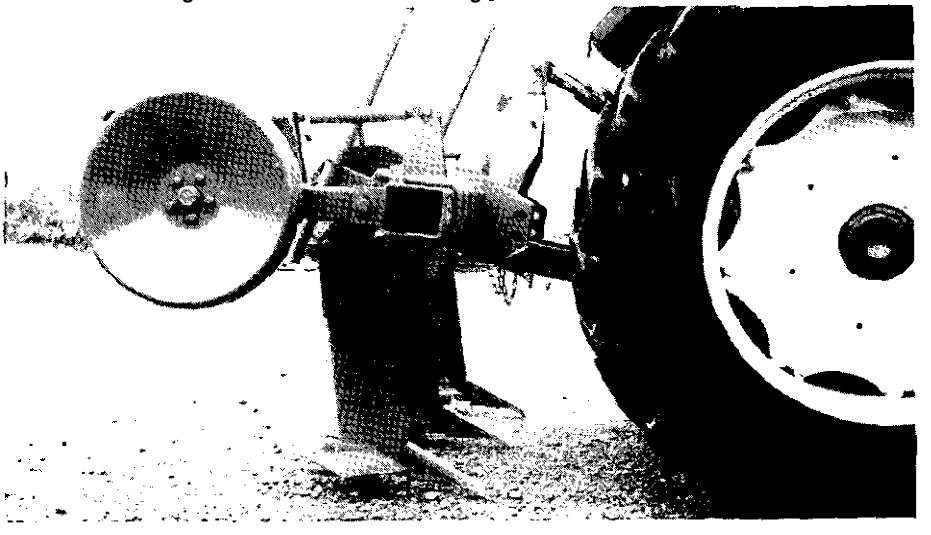
Full details of the knitted polyester filters from the company on Redditch (0527) 402646.

HEAD IN THE SOIL

MADE IN Germany and now on sale in Britain is the Ostrich range of subsoilers from Rabe. Five models are available — 2, 3, and 4 leg versions with shearbolt protection and 2 and 3 leg versions with auto-reset, called the Ostrich Avant. Maximum working depth is 50cm (20in) and legs are individually adjustable.

Reversible. hardened points are standard on each leg and optional wings can be fitted to increase shatter. Prices range from £1392 to £2260. Further information from distributor, Watveare Overseas, on Westbury (Wilts) 0373 823701.

Rabe Ostrich 3 leg subsoiler with shearbolt leg protection.



RETITLED

ON 1 AUGUST, the National College of Agricultural Engineering, Silsoe, Beds, changed its title to Silsoe College. The letters NCAE will, as a result, no longer be used. Greater opportunity for development of the College's work in collaboration with the agricultural, food and allied industries is expected and three departments have been formed within Silsoe College to further this aim. They cover Agricultural Engineering, Food Production and Marketing and Management.

Brian May continues as Head of College and Professor of Agricultural Engineering.

More on straw — the debate continues

HOW TO incorporate straw in the soil during post-harvest cultivations was the burning topic at the NAC Autumn Cultivations Demonstration at the NAC in September. The RASE-organised event provided interim conclusion from ADAS studies of the subject, advice from an NIAE research worker and an opportunity to see in action the technique and the machine used by a progressive cereal grower from West Germany. **Mike Saull** ***reports.***

INCORPORATION of straw in trials at five Experimental Husbandry Farms and the Wheat '83 site proved that the '82-83 season was good for the microbes but definitely not for the straw. Mr John Rule from Boxworth EHF, who chaired a straw incorporation forum at the event, gave the results of a series of trials monitored since 1982 by the Ministry at the EHF's. These results should be treated with caution, he stressed, because the season has been exceptional.

There were yield reductions on heavy land sites when compared with a burn-and-direct-drill or minimal cultivation system, but these, for example at Boxworth, were only down by 0.10 to 0.28 t/ha on a highest yield of 9.67 tlha from direct drilling.

The response to nitrogen applied in the autumn showed little benefit in adding seedbed N. It was not as important, Mr Rule concluded, as had been thought. But further results were needed before a firm statement concerning hest method of incorporation could he made.

Mr David Patterson of the NIAE gave practical guidelines on methods of straw incorporation using existing tackle.

- Chop straw as short as possible off the combine and consider using a second cutter bar to reduce stubble length.
- Start shallow and work deeper.
- Consider ploughing, if necessary, after initial shallow tine/disc cultivations.

Both Mr Patterson and Mr Brian Sanders from Cambridge ADAS considered that trailed disc and tine implements were the tools of the future. Too much energy was needed by power-driven implements and work rates were often too slow. The chisel disc, they suggested would give better penetration, weight for weight, when compared with traditional types.

Both speakers indicated that they would want further research on the wav combines feed straw to choppers, and on how choppers cooed with straw. Mr Patterson revealed · that the NIAE were working on a test rig to incorporate straw.

Ferranti-Horsch direct seeder buries seed, broadcast beneath an enclosed housing, under a mulch of soil, straw and fertiliser.

McConnel's Shakaerator/Tillaerator combination displayed good straw incorporation capabilities.

Welcome visitor Mr Michael Mackeprang, who farms on organic sandy soils in northern West Germany has been incorporating straw for over 10 years, initially using two cultivator passes to clean stubble, working progressively deeper, with a final deep mixing. He has now reduced the number of passes and uses the Ferranti Horsch-Accord direct seeder, which is based on a heavy duty 4n1 rotary cultivator capable of incorporating loose straw and stubble in 75 to 100mm of soil.

Fertiliser is broadcast in front of the cultivator while behind the rotary tines is a vee-shaped housing with 16 outlets to broadcast seed under the mulch of soil, straw and fertiliser. The fertiliser, soil and straw are thrown as high as 8ft from the ground by the rotary cultivator, and cover the seed as they fall. The whole direct seeder unit is mounted on an Accord coupler on a three-point linkage behind a 3,200-litre trailer, two thirds of which is devoted to fertiliser.

Mr Mackeprang has complete confidence in the machine, but many farmer visitors were sceptical — there are still some safety questions to be answered. One hopes its progress will be monitored because it could be a useful tool for the light land farmer with a high horse power availability.

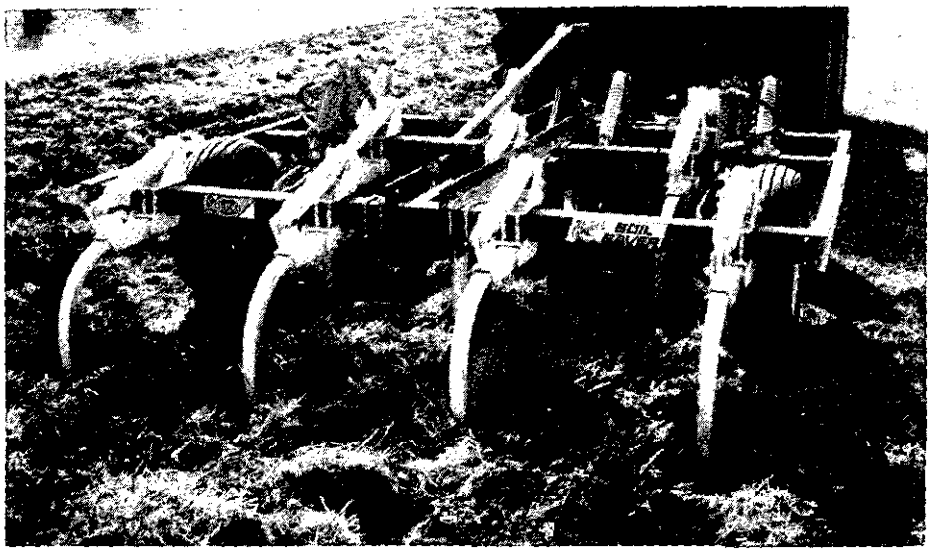
Mr Peter Hepworth from N. Yorkshire and Mr William Ward from Bedfordshire faced a barrage of questions from farmers at the forum which was part of the event. Their system uses the Glencoe Soil-Saver, which ridges the land, mixing soil and straw as they pass upwards and sideways over a helical share mounted on a tine.

Both stressed the imporatance of following the combine into the field with the cultivator and keeping the best tractor driver off the combine. They normally carry out three passes with the Glencoe before adding either seedbed N, or in the case of Mr Hepworth, pig slurry, to aid breakdown.

Mr Ward's experiences were particularly interesting because he works on heavy Bedfordshire clay, where he considers chopping straw and ploughing, without any primary cultivations, to be a recipe for disaster.

There is obviously a lot yet to be learned in the field of straw incorporation and farmer-interest is quite overwhelming. However, one wonders whether such enthusiasm would be better channelled into the mechanics and control of a good burn which cuts down smuts.

Glencoe Soil Saver from Opico combines discs and helically-bladed fines to produce a chopping/mixing soil action.



*HAVING raisedugreat deal of interest, andafew eyebrows, at the Royal Show, **Bomford's Earthquake** soil **loosener** has been doing the demonstration round this **autumn**. At the **Autumn** Cultivations event at Stoneleigh, the implement **certainly** lived up to the claims of the manufacturer. Thin, backward-raking legs kept surface **disturbance** to a minimum, so the Earthquake appears ideally suited to **both** arable andgrassland operations. Below ground, the **exceptionally thin** trailing legs **(8mm thick)** of tempered alloy steel are able to castor, keeping them in line without permanent distortion, despite the immense forces imposed by the soil. Ground is moved upwards by **an** adjustable plate on the rear of each **leg**, breaking the soil in the direction of least resistance and low-cost, replaceable wearparts are **fitted** to **both** the legs and the points of the Earthquake.*

*Available in both 3 and S **tine configuration**, the **Bomford** Earthquake has a **3m** maximum working width, **375mm** working depth and requires **about 25hp** per leg. Price is from **£1424**, with **depth** wheels.*

CROPPING

Putting grass in its class

IN HIS recent article on Agricultural Land Classification (Soil and Water Volume 10, No. 2 p.34), Tom Worthington pointed to the relatively low grading given to some of the country's better grassland and suggested that a separate classification for this crop was needed. Such a system does indeed exist, having been drawn up for the 1976 Soil Survey conference on Soil Survey Applications. Here the Scheme is described by its author, Dr Tim Harrod, Soil Survey, Starcross. Devon.

AS WITH other land classifications, the starting point is that the environment, (soil, climate and ground form), influences land use. For intensive grassland this operates in two ways. Firstly, potential production of grass in this country largely reflects moisture balance when temperatures are high enough for plant growth.

Over most of Britain, at some stage, grass growth is checked by water shortage. The size of soil-available water reselves controls how well potential production is buffered against weather and climatic dryness in summer.

Secondly, management and the use of grass are strongly influenced by ground conditions. Wet soils and wet weather encourage soiling and wasting of grass and damage to the sward by stock or wheels. Steeper hanks also place their restrictions on the grass farmer.

Taking a measure

Environmental influences can be quantified using basic information collected by the Soil Survey and using climatic data from meterological records.

To gauge moisture limitations on potential yield, the scheme relies on, with slight modification, summer soil dryness (rated as dryness subclasses in the Soil *Survey* Field Handbook, Hodgson 1976 p.90). In this method, soil-available water is set against local average potential soil moisture deficit to give a four point (a-d) scale of increasing dryness.

For grassland suitability, land in the western half of England and Wales is arbitrarily raised one point on the scale to allow for better growing conditions, notably the return to moist conditions well before the end of the growing season and greater frequency of sporadic returns to field capacity during summer.

A 5 point scale of trafficability and poaching risk is used to express the ease or otherwise of access and stocking of land, in order to manage, graze or conserve the crop. Duration and depth of waterlogging (Soil *Survey* Field *Handbook* wetness class, p.87), depth of impermeable horizons and topsoil retained water capacity (moisture held by the topsoil after drainage hasceased), determine placing on this scale. Again, land in the moist zone of the west is set one point higher than comparable land in eastern districts.

Grassland classification

For intensive grassland in Britain, some land may be almost ideal with high yield potential and excellent ground conditions. At the other end of the scale marked difficulties will be encountered.

In the Soil Survey scheme, class A is well suited, class B has minor shortcomings, while class C has more severe and varied restrictions, confining use or growth to limited seasons. Class D is ill-suited by virtue of soil, climate, slope, rockiness or flood risk.

Since the potential yield and trafficabilitylpoaching risk categories together give 20 possible combinations, for the sake of simplification in classification, some amalgamations are required (see table 1).

On class A land, potential yields are high with ample growth throughout the season. Poaching risk is low and the land is readily trafficked. High stock densities are readily sustained and the land tolerates reasonable winter use.

Small imbalances of yield and trafficabilitylpoaching risk slightly restrict suitability of class B. Some soils, particularly in drier areas, experience summer drought and limited autumn growth.

The imbalances of yield and trafficability/poaching risk characterising class C take several forms (see table 1):

C(i) Many traditional pastures have good potential yield but provide poor trafficability and are a serious poaching risk. Grass is the best crop, but high stock densities are most readily sustained when farmed in conjunction with drier land. Winter use is severely restricted.

C(ii) On soils with low potential yield but good trafficability and small poaching risk, growth is confined to spring and early summer. Winter use is possible except in very wet weather.

C(iii) Potential yield is low while trafficability is poor with high poaching risk when conditions favour growth. Winter use is limited.

C(iv) Although not shown in the table, moderately steep slopes can provide useful pasture although mechanised management is difficult and poaching risk is greater than on less steep land.

In 1979, this grassland classification was applied to the 1:1 million soil map of England and Wales. The country's more extensive grasslandsoilseries will be classified in the explanatory bulletins being published in 1984 to accompany the 1:250,000 soil maps of the regions of England and Wales.

Class A land is largely in western districts on slopes of less than 11 deg. The soils are deep, well drained. loamy or silty brown soils or brown podzolic soils or artificially drained lowland peats or loamy sails formerlv affected by groundwater.

Land in class B'includes brown and podzolic soils with slight risk of drought, lithomorphic (shallow) soils in moist districts and soils in gleyic and stagnogleyic subgroups of the Soil Survev's classification (Avery 1980).

Class C covers a wide range of soils and

Table I
Grassland classification derived from yield and **trafficability** categories

Increasing dryness category (decreasing yield)		1	2	3	4	5
↑	d	C(ii)	C(ii)	C(iii)	C(iii)	C(iii) or D
	c	B	B	C(iii)	C(iii)	C(iii) or D
	b	A	B	B	C(i)	C(i) or D
	a	A	A	B	C(i)	C(i)

Increasing poaching risk category →
(Decreasing access)

situations. C(i) includes surface-water gley soils in moist districts and some ground-water gley soils in basins and tloodplains. C(ii) occurs on droughty, coarse loamy, sandy, stony or shallow brown soils, podzolic soils and lithomorphic soils in drier districts. C(iii) covers many traditional grassland areas of the Midlands, the south and east on clayey surface-water gley soils and pelosols. Slopes between 11 and 25 deg, usually on free draining brown, podzolic or lithomorphic soils, are placed in class C(iv).

Class D is mainly in the uplands with raw peat soils, clayey stagnohumic gley soils and humic gley soils and slopes steeper than 25 degrees. In the lowlands, class D land occurs on raw soils of dunes, shingle bars and saltings.

Although initially a desk exercise, subsequent mapping of the scheme confirms its validity, while research not available in 1976 has since lent support. The results of the joint GRI-ADAS GM20 experiments (GRI Technical Report No. 27, 1980), show a close link between soil-available water, summer rain and nitrogen response for dry matter production, giving reasonable confirmation of the scheme so far as yield categories are concerned.

Efficiency of grass utilisation has been measured by Peel and Matkin (1982) in Buckinghamshire on contrasting farms. On dry chalkland, about 65 per cent of herbage produced was consumed. On wet land, with difficult trafficability and high poaching risk, only 40 per cent was used. This work is being extended into Devon.

As anticipated by Tom Worthington, much land given a low grading by the Agricultural Land and Land Use Capability Classifications is given a higher rating on Grassland Suitability. Comparison of maps 1 to 3 demonstrate this.

Future developments

While I feel the approach of this classification is broadly right, the scheme is capable of some refinement. Thomasson (1969) has produced water extraction and rooting models for various common crops. For grass it appears that 1 metre soil-available water requires slight adjustment. His paper also offers an improvement on Hodgson (1976) when assessing climatic and soil dryness for yield category.

Some investigation of rates of water use on contrasting soils seems worthwhile. In mid-Devon the well-drained Neath series has only slightly less water available to grass than the clayey Tedburn series, yet growth on the latter ceases much later in a drought, even on drained land. The answer may he in the higher suctions needed to remove water from the clayey soils with less transpiration, particularly early in the season.

Mapping of the meterorological field capacity period by Jones and Thomasson (N.D.) enables improved prediction of climatic contributions to poaching risk. In areas with substantial intensive grassland farming, this period averages less than 150 days in the south Midlands, approaching 300 days on the upland fringes.

Different soils obviously drastically temper the risk of poaching during and outside of the meteorogical field capacity "wet season". The broad scope of the poaching period relative to the field capacity period can be estimated by experience. Clearly free-draining soils, particularly those of coarse texture, will be at risk only at very wet times while poorly-drained clayey soils will remain susceptible well beyond the meterological field capacity period. However it would be useful to quantify these weightings relative to the soil properties already used in poaching risk assessment.

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CORRECTIONS

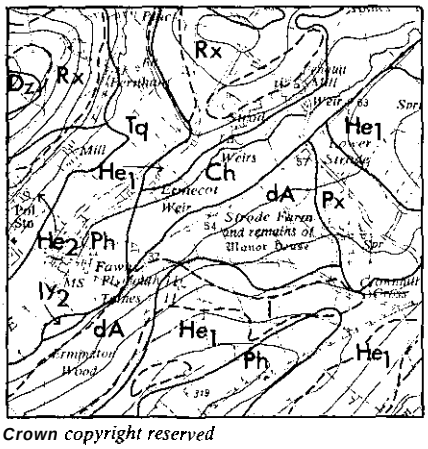
Erosion article

In the July issue of Sail and Water, page 31, the 8th line of the 3rd paragraph should have read: '10mm (approx 0.4in).'

And the 7th line **of** the 2nd paragraph on page **33** should have **read:** '1:10,000 registers rill and gully erosion.'

Determining ***grassland*** suitability from soil type and land ***classification***.

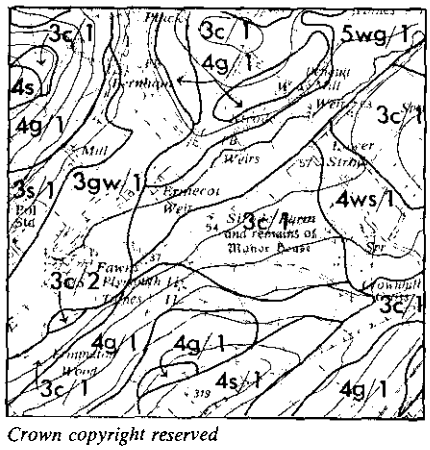
Map 1 SOIL



Key to soil type units on map 1:

He — Highweek Rx— Rydon **dA** — Dartington	Well-drained, fine loamy soils of moderate depth
Ph — Powys **Dz**— Dunwell	Well-drained, fine loamy soils less than 30cm deep
Iy — Ivybridge	Moderately well-drained fine loamy soils

Map 2 LAND CLASSIFICATION

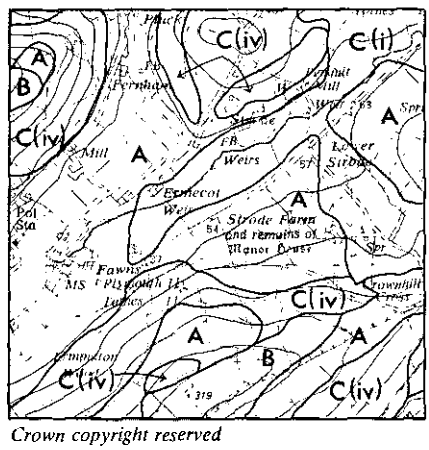


Tq — Teign	Well-drained, coarse loamy soils
Px — Pulsford	Clayey, impermeable soil
Ch — Conway	Fine silty soils with high watertable

Area within dashed lines indicates slopes steeper than 11 deg.

Key to **land** classification on map **2:**
c = climate

Map 3 GRASSLAND SUITABILITY



g = gradient (11 to 15 deg) or soil pattern
s = soil. **Texture**, depth etc
w = wetness. Impermeable layers, high watertable, flood risk
The numbers denote the class or grade, the letters the subclass or kind of limitation(s).

On map **3,** the letters denote **the** classes described in **the** text.

Pressure on the soil

A special report on compaction avoidance and the ideas, methods and equipment designed to help maintain peak soil condition all-year-round.

Soil compaction — what it is and how to avoid it

COMPACTION is the process in which air is expelled from a soil causing the soil particles to pack more closely together. The final packing state depends on the soil water content. Very dry soils do not compact readily but moist soils are in the optimum condition for compaction. Very wet soils will not readily compact but will suffer loss of structure and sometimes form deep ruts when loaded and will subsequently dry out to form strong clods.

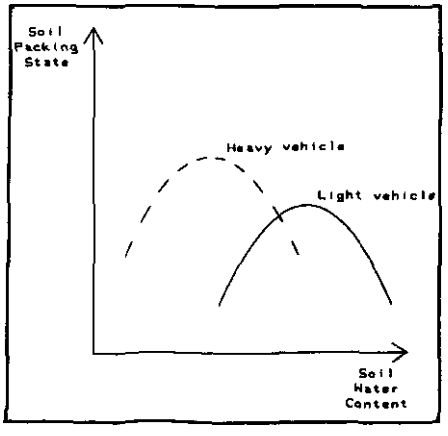
The relation between soil water content and packing state for a given wheel is summarised in the curve in Fig 1. As the wheel load increases, the position of the curve moves towards lower water contents and greater packing states. Thus heavier vehicles not only produce more compaction but produce maximum soil compaction at lower water contents than lighter vehicles.

The peak of the curve is sharper for lighter soils reflecting their pronounced change in compactability following changes in water content. This is in contrast to the more flat-topped curve of heavier soils for which compactability can remain largely unchanged over a range of water contents.

How to avoid compaction

Excess compaction can reduce drainage, soil aeration and water availability to the plant, and consequently can affect the fertiliser response, quality and yield of crops. However, the effect can he minimised by conforming to three basic rules when selecting and subsequently operating an agricultural vehicle.

Fig 1.
Variation of *compaction* with water *content.*



First and foremost, the lightest possible vehicle should be used without the addition of any unnecessary ballast. Very high vehicle loads can compact the soil below the plough layer even when the vehicle is fitted with wide or multiple tyres.

Secondly, the soil/tyre contact area should he maximised by increasing the number, width and diameter of the tyres and by using them at the minimum recommended inflation pressures. Remember, however, that such modifications are an advantage only for a given wheel load and that load per *se* is very important.

Thirdly, excessive wheelslip should he avoided, especially with ballasted wheels. Wheelslip causes shear stresses in the soil and the combination of shearing and vertical loading is ideal for compaction.

SIAE developments

The traditional tractor rear tyre can produce considerable compaction in many farming operations and consequently many alternatives have been considered which might overcome the problem.

Increasing the width of tyres can reduce the contact pressure and hence the intensity of compaction. Increases can he fairly small, as in wide-section tyres, or very large, as in low ground pressure tyres. Such tyres, can he expensive and a cheaper alternative may he dual conventional tyres or a conventional tyre fitted witt. a cage wheel.

Although these alternatives may produce a slightly smaller maximum increase in soil bulk density, the volume of soil compacted may be greater than for a single tyre. This effect is reflected in the ruts produced by the two wheel systems in that while the rut produced by the dual system is shallower, its cross-section area is greater. Such wide but shallow ruts may he preferable where a uniform soil surface is desirable.

Use of a rear wheel such as the recently introduced Yieldwheel, an open flat-lugged wheel which produces little compaction, has meant that the tractor front wheel, which previously contributed little to the total compaction produced by the tractor, becomes proportionately much more important.

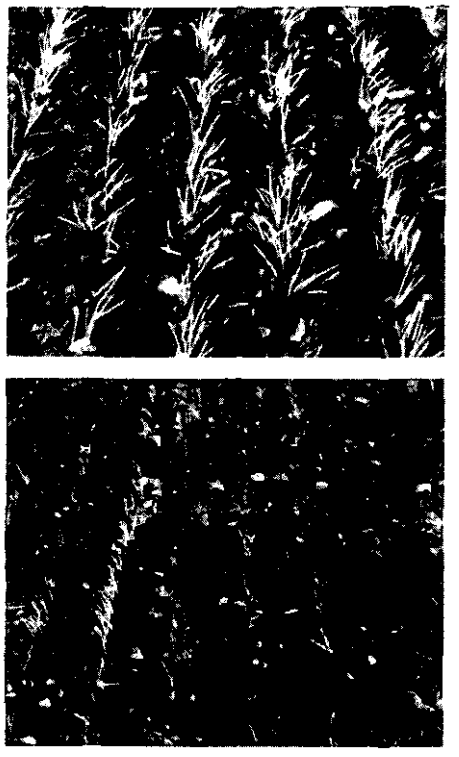


Fig 2.
Effect of zero traffic (top) and one pass of a tractor wheel *(bottom)* across the whole seedbed prior to sowing winter barley on a *sandy* clay *loam.*

Comparative tests using a "Yieldwheel" on the rear, showed that, in comparison with a conventional cross-ply front tyre, considerable improvements in rut depth and soil porosity were achieved with either a radial tyre or a wide low pressure tyre.

Rather than try to minimise the compaction produced by wheels, an alternative approach is to restrict all traffic to permanent wheeltracks. To assess the potential of such a system, experimental machinery has been used to grow winter barley in beds subjected to various levels of seedbed traffic, including zero traffic, applied uniformly over the whole width of the bed.

Results showed that even one pass of a tractor wheel can substantially reduce both aeration and water movement as a result of changes in soil pore size and continuity. In one season, compaction of the top 4cm of soil reduced crop establish-

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PRESSURE ON THE SOIL

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ment from 315 to 131 plants/m^2 and grain yield from 6.7 to 3.9 t/ha on a sandy clay loam (fig. 2) but the effect was less marked in other seasons.

Broadcasting winter barley on to stubble and subsequently burying the seed by shallow cultivation has been examined as a means of getting the crop in quickly before the soil wets up and becomes more susceptible to compaction. Using standard seed rates, field experiments showed that, compared to ploughing and conventional drilling, energy is saved and both crop establishment and grain yield are satisfactory.

D. J. **Campbell**
Scottish Institute **of** Agricultural Engineering

The hub of the matter

DUAL wheels, cage wheels and extra wide tyres are just three of the solutions offered by manufacturers to help reduce the problem of soil compaction. All have their advocates, and, depending on the job in hand, there is a place for each of them.

However, few farmers will want to fit out all of their tractors with a full suit of conventional tyres on single and dual wheels, wide low ground pressure tyres and cage-type wheels. So it is a matter of deciding where in the farming system most of the compaction is caused and choosing appropriate wheel equipment.

The cage wheel has been a firm favourite for many years, particularly for seedbed preparation and drilling operations. Recent work suggests that when used in conjunction with the tractor's normal wheels, cage wheels do little to reduce rutting or compaction. When used as a replacement for normal wheel equipment, cage wheels reduce wheel ruts and compaction to a certain extent.

A development from the NIAE and Cabcraft, along the lines of a traditional cage, is the Yieldwheel. Although at first glance the Yieldwheel appears little different from conventional cage wheels, tests conducted at the SIAE suggest that it is far superior.

The Yieldwheel was developed as a low ground pressure wheel specifically to minimise compaction while carrying out secondary cultivations on the seedbed. It replaces the tractor rear wheels and is intended for high speed, low draught uses such as rotary cultivating, harrowing, discing, drilling and light ballast rolling.

The design of the wheel ensures that the lugs have a cultivating action to remove their own compaction. SIAE tests showed that the Yieldwheel left shallower ruts than conventional wheels, cage wheels, dual wheels and a conventional wheel and cage wheel combined.

Cabcraft, which makes the Yieldwheel, admits that it is not the universal answer to soil compaction. Some farmers have attempted to use the wheel when pulling heavy draught implements at low speeds on heavy soils with no depth control. That is a recipe for disaster, says Cabcraft.

The company says that some of the best results have been obtained where both the seedbed preparation tractor and the drilling tractor have been fitted with Yieldwheels.

There is an enormous range of dual wheels available with almost as many fitting systems as there are wheel sizes.

Hestair Farm Equipment Ltd, which produce the Bettinson ranges of Molfit duals and Clampson heavy duty duals, says that dual wheels improve traction, reduce compaction, increase flotation, improve stability and reduce wheelslip.

The SIAE recommends that dual wheels should be separated by at least one wheel's width.

The design of the Bettinson Clampon duals allows variable spacing. Each wheel consists of an inner frame which bolts permanently to the tractor wheel. The outer frame is bolted to the outer wheel rim, and clamps to the inner frame. The spacing between the tractor wheel and the dual wheel can be varied by the way in which the outer frame is fitted to its wheel.

Outer frames come in a number of sizes which allows the distance between the wheels to be varied further. The wheels can be spaced up to 32in apart from rowcrop work. By using wheels widely spaced, there is no zone of double compaction, as occurs when the wheels are close together.

While much effort is put into reducing compaction from tractor rear wheels, front wheels are often forgotten. ADAS lists tractor front wheels as one of the worst offenders in damaging the soil.

Dual wheels for the front of the tractor are gaining in popularity, says Opico UK Ltd. The Lincolnshire-based company introduced a range of front wheel duals last year.

Sizes are available for most tractors — 6.00-16, 6.50-16 and 7.50-18 for two-wheel-drive models and 10-24 and 11-28 for four-wheel-drive.

"Compaction from the front wheels. especially when the tractor is fitted with weights, can be considerably greater than from the rear wheels, especially when the rear wheels are fitted with duals," says

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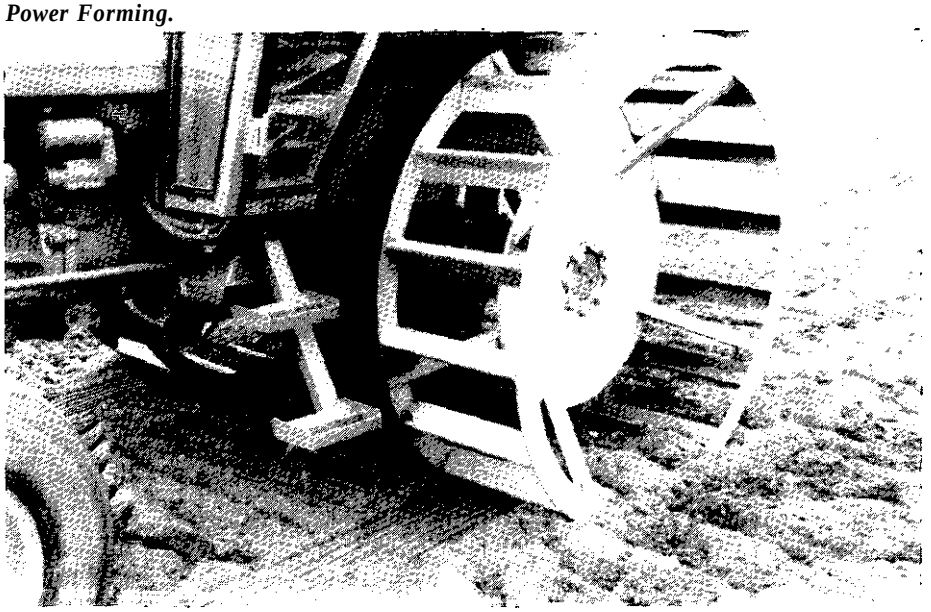
Yieldwheel: Ideal for low-draught, secondary cultivations at speed. Picture courtesy of Power Forming.



Mike Harley, Opico sales director. "That is why the front duals are becoming popular, especially for drilling."

Wide tyres can also be used to reduce soil compaction. They come in different shapes and sizes and the tyre manufacturer should always be consulted to ensure that the correct type is purchased. Matching the tyre to the job in hand is important — some wide tyres are not designed for work where there is a high draught requirement.

The Trelleborg Twin range is designed to reduce compaction by allowing the fitting of a single wide tyre to carry the same load as dual wheels. Trelleborg says that the advantages of a single tyre include:

- Less strain in axle bearings.
- In most cases, the tractor remains within the legal road width.
- Better manoeuvrability in narrow passages and on headlands.
- Longer wear life.
- Better fuel consumption.
- Less wheel slip, hence less soil smearing.
- Better cleaning.
- Improved traction.

As well as reducing compaction, leading to higher crop yields, wide tyres give the ability to work in conditions where it would not be possible with standard tyres, says Trelleborg. This is particularly important when drilling, spraying and fertilising.

The company says that tests have demonstrated that more effective use of engine power can be achieved by fitting correctly inflated wide tyres — particularly with heavier tractors. The problem facing the farmer is not necessarily using the biggest tractor available, but in getting tyres large enough to convert the power into effective tractive effort.

According to Undergear Equipment, the UK distributor of Goodyear Terra-Tires, more farmers are using wide low ground pressure tyres on four-wheel-drive tractors.

When the Terra-Tire was first introduced, it was mainly used on light two-wheel-drive tractors for spraying operations. But last autumn's wet weather made farmers appreciate their use on large tractors for seedbed operations.

Heavy-duly front dual wheels from Opico help spread the load.

Terra-Tires are not suitable for heavy draught operations. But once the heavy autumn cultivations have been completed, tractors can be fitted with the wide tyres for seedbed cultivations, drilling, spraying, fertilising and all field work until the crop gets too high.

Undergear's Mr John Edwards points out that farmers should remember that the ground pressure below a vehicle can never be less than the pressure in the tyre. Although the AEA, NIAE and the SIAE have established a definition of ground pressure, many vehicle manufacturers have not yet adopted the recommended system of measurement.

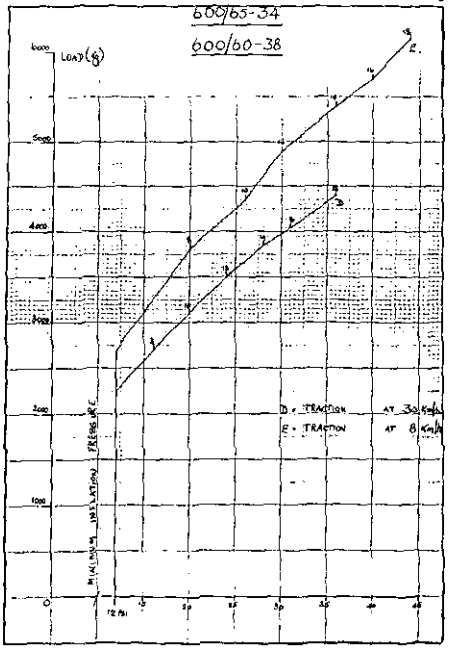
Farmers should treat with suspicion any claims made where ground pressure is said to be less than tyre inflation pressure, he says.

EVEN as printing was being completed for the July issue of Soil and Water, in which we wrote that, until recently, farmers had received little help in matching tyres and machines, one tyre manufacturer at least was taking a step forward in supplying more information to users.

Trelleborg Ltd now provides its dealers with graphs showing the correct inflation pressures for its Trelleborg Twin tyres under differing loads at road and at field work speeds. Farmer-customers should receive a copy of the appropriate graph every time they purchase a Trelleborg Twin tyre.

The graphs (an example is shown here) have the wheel load on the vertical axis and inflation pressure on the horizontal axis. The minimum inflation pressure for the tyre is marked, and figures along the graph curve show the appropriate tyre ply rating.

Now we know the correct inflation pressures all we need now is to be able to measure the wheel load easily and to have tractors fitted with a pump to inflate the tyres correctly!



Tyre construction and selection for all-year working

THERE are three main types of tyre available to the agricultural user: Cross ply, textile-braced radial and steel-braced radial.

Cross ply tyres are constructed by laying strips of fabric over each other at 90 deg to form a wafer effect. These alternating strips are called the plies. The more plies a cross ply has the more weight it can carry, but this reduces the flexibility of the tyre.

The cross ply tyre was introduced in the 1890's and, apart from improvements in the materials used to make them, little has changed. When the sidewall of a cross ply tyre is deflected, the movement is transmitted into the tread area, causing it to lift off the ground in the centre which reduces the ground pressure in this area, but dramatically increases it on the edges. The lower the inflation pressures, more marked is this effect.

When the tread bar or cleat of the cross ply tyre meets the ground, it tries to bend, but because it is a very strong piece of rubber, and the area of casing behind the cleat is much weaker than the cleat itself, the casing distorts allowing the cleat to move backwards. As the tyre continues its rotation and the cleat leaves the ground it flicks back into its original position. This movement combinedwith the concaving of the centre of the tread, not only causes mechanical soil damage, but is also the reason for the irregular wear on the treads of cross ply tyres.

Textile-braced radial tyres are constructed by taking a single layer of textile cords and laying it radially from bead to bead. (The bead area of the tyre being the area that sits on the rim). This is known as the tyre carcass and is a very strong flexible bag used as a container (inner tube) for the air. Over the top of the radial cords is placed a belt of textile cords called the bracing.

This form of construction gives a flexible carcass running on a belt which helps to reduce movement within the tread area, and therefore combats some of the disadvantages of the cross ply by separating the functions of sidewall, which needs to be flexible, from the tread area, which needs to have more physical support.

The carcass of a steel braced radial is similar to that of a textile radial, but the significant difference is that that the bracing plies under the tread are made of steel. This type of construction was introduced by Michelin in 1946 initially to build car tyres, and subsequently most categories of tyre, including more recently a comprehensive range of agricultural tyres.

Steel bracing works in the manner of a tank track with pneumatic suspension, and hence movement of the tread is virtually eliminated and the load is spread very evenly over the contact area of the tread.

Selecting tyres for LGP work

Most tyres currently on sale for LGP work are cross plies. The varieties which can transmit torque and cope with road work are high ply rated, "stiff" walled tyres, which cannot be run at low inflation pressures, and hence, for the reasons stated above are not very effective for this application.

The only cross ply tyres which are in any way effective for LGP work obtain their flexibility by having a very low ply rating and therefore their application is very restricted as they cannot successfully transmit torque or be used for road work due to their susceptibility to damage and punctures and poor wearing characteristics. They also have the drawback of being very expensive.

They achieve a large contact area in part bv having a very wide cross section, so although they reduce crop damage and compaction compared with narrower cross ply tyres, such damage that they do inflict is over a substantially greater area. They also have the disadvantage of substantially increasing the width of the machine to a point where it can exceed the legal limits when on the road.

Textile radials potentially have a number of advantages over cross ply tyres for LGP work, but as none of the manufacturers of this category of tyre will sanction inflation pressures below 12 psi, this effectively precludes them from consideration for LGP work.

With the advent of steel-braced radials, it has now become possible to consider the radial tyre for LGP use. Because of the steel radial's capacity to carry more weight size-for-size than the textile radial, careful selection of the right tyre for the machine has enabled many farmers and contractors to use steel radials at single figure inflation pressures. This enables them to produce ground pressure figures comparable with the specialised LGP cross ply tyres but without the disadvantages of the mechanical compaction. Furthermore, the steel radial achieves a large contact area with the ground by having an extended contact patch rather than the case of a cross ply, which relies on its exceptional width.

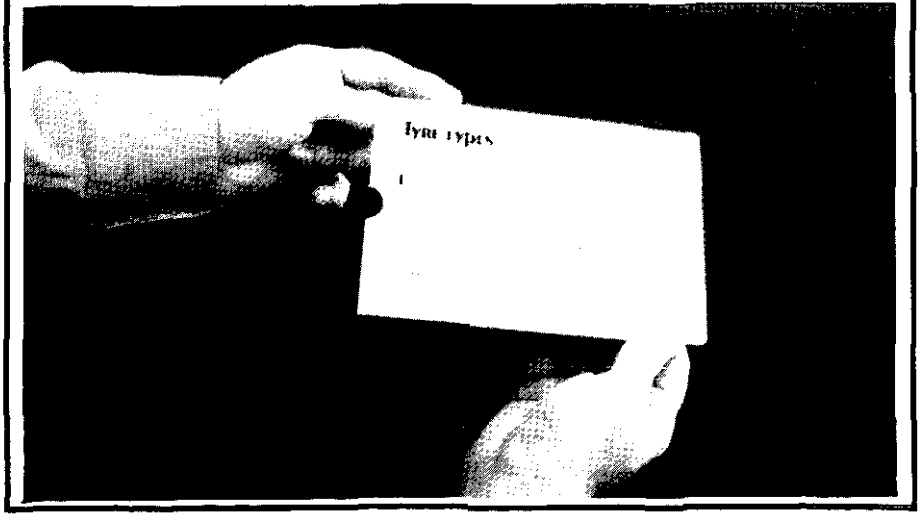
Low ground pressures can be achieved with a steel-braced radial of substantially smaller cross section than its cross ply counterpart, thereby increasing the versatility of the machine enabling it to be used on the same tyres all-year-round. With a suitable adjustment of pressures, a spraying tractor can also be used for cultivations and trailer work without the expense and inconvenience of changing tyres and wheels.

A further advantage to this system of obtaining low ground pressure is the low cost. In addition to the versatility of the steel radial system their initial purchase price is often substantially less than specialised cross ply tyres.

THE ADAS tyre calculator makes the job of matching the tractor, trailer or implement to the best tyre size to reduce soil damage, a simple one. Not only does the slide calculator indicate correct tyre size and inflation pressure, it also provides information ort the optimum amount of ballast required for efficient working.

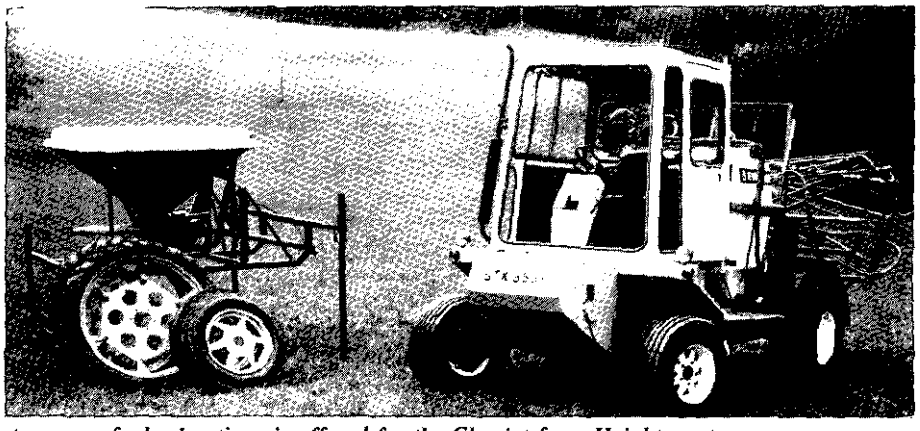
The calculator doesn't only deal with driving wheels — it can be used to select lyre sizes and pressures for trailers and implements. This is particularly important as ADAS lists slurry spreaders, trailers, sprayers and roof harvesters as some of the major culprits in causing soil damage. Unfortunately the calculator does not deal with tyre selection for unequal wheeled four-wheel-drive tractors, which make up an important and growing sector of the farm tractor fleet.

The calculator is available for £2.00 post free from MAFF (Publications), Lion House, Willowburn Esfate. Alnwick, Northumberland NE66 2PF.



Maintaining access by specialist vehicle

Richard Price of Heightcourt Ltd was one of the first to take the low ground pressure vehicle out of its specialist winter-only role and make it into a multi-purpose vehicle for use throughout the growing season. He puts forward the pros and cons of different low ground pressure systems.



A range of wheel options is offered for the Chaviot from Heightcourt.

Modern arable farming methods require repeated applications of fertilisers, chemicals and granules to be made throughout the life cvcle of arable monoculture cereals and oilseed rape. The subseauent réduction in break crons has led to an increase in chemical usage to control both weeds and diseases.

Current practice is to plant fields incompletely, leaving tramlines every 12 metres or so. These provide access to the crop and are a great help in achieving accurate distribution of materials, greatly reducing the possibility of driver error. Before the advent of tramlines, applications were often made in haphazard crisscrossing patterns which led to slight damage over a relatively large proportion of the crop.

The limitations of the tramline system become apparent when they are used for repeated applications through the winter months. Conventional tractors have an all-up weight in excess of three tonnes and can cause massive damage when used in soft ground conditions. In wet winters the necessity for applying chemicals can lead to deep rutting of the soil leading to tremendous soil structural damage. This in turn results in lower crop yields. dam. age to harvesting equipment and a requirement for remedial cultivations following harvest.

The limitations of standard tractor-mounted application equipment used in intensive cropping systems were not widely recognised until 1980 when higher chemical usage coincided with a run of wetter winters. In autumn 1980 the first national low ground pressure demonstration was held at Milton Keynes. Many weird and wonderful creations were on display showing various methods of reducing the ground pressure of chemical-carrying vchicles. The yardstick figure of 5psi (0.345 bar) ground pressure was found to give an acceptable performance on most soil types.

Two different approaches to achieving these levels of ground pressure have become apparent. Either a conventional tractor or utility vehicle can be equipped with oversize tyres to reduce ground pressures or a completely new vehicle may he developed with a low overall weight.

Increasing tyre area has many attractions:

- Use of existing prime mover with proven reliability and versatility.
- U s e of normal spread and spray units.
- Lower initial cost since secondhand units can be used.
- Vehicles may be retained for their original purpose.

The disadvantages are as follows:

- Low ground pressure tyres are expensive and easily damaged.
- Soil structural damage caused bv using vehicles in unsuitable ground conditions has been found to be linked to the overall weight of the vehicle as well as to the actual ground pressure that it exerts on the soil surface. Using wide tyres may result in larger areas of crop being damaged by the passage of the vehicle.
- Linkage mounted sprayers and spreaders are overhung and require counterbalancing to maintain stability.
- Such vehicles are not stable at speeds required for high daily outputs.
- Tractors fitted with wide tyres may be too wide for legal road use.
- Reliability of standard vehicles fitted with oversize tyres may be reduced by overloaded wheel bearings.

Reducing the ground pressure of an existing vehicle has many attractions for the farmer with limited resources, and those situations where only occasional winter applications of agrochemicals are required. Such vehicles will cause unacceptable crop damage if used repeatedly in tramline systems of croppine.

Achieving low ground pressure without the use of wide tyres, by reducing loaded weight to a minimum, has the following advantages:

- Low vehicle weight means narrow tyres which approximate to tramline width.
- Specially-designed lightweight vchicles can have suspension systems which allow higher working speeds.
- Higher power to weight ratio means better field performance.
- Narrow tyres = narrow overall width = easier road transport.

Lighter overall weight means lower energy use.

The disadvantages are:

- Reduced payload means more refilling stops.
- Specialist vehicles produced in low numbers will inevitably be more expensive.

In situations where repeated passes have to be made through a crop, this approach will be greatly superior. However, to ensure maximum output from a lightweight machine a secondary field filling system is required and because of the high purchase cost of specialist vehicles, they will only be attractive to the larger farm or contracting business.

The Chaviot was therefore designed along these principles and includes:

- Diesel power unit.
- Road legal with a high top speed.
- Adjustable track width.
- Useful payload over one tonne.
- Four wheel braking for safety on slopes and at high speeds.
- Low centre of gravity for stability at speed.
- Good ground clearance to cut down crop damage at later growth stages.

High clearance

Despite all the above-listed features, it was felt that the vehicle's potential could be greatly increased if its working season could be made longer. A simple conversion kit consisting of rowcrop wheels and patented, variable height, front axle design allow the vehicle to be raised by 6 inches giving a total of 22 inches clearance. With the addition of a flat undertray and crop dividers the Chaviot can work in crops from planting to harvest with the minimum of crop or soil damage.

Such a vehicle can replace at least one tractor in the farm's fleet. Work rates are between 100 and 200 acres per day and vast annual acreages of 10,000 or more, can be treated by one machine. The effects on the running of a large arable farm are impressive. Day to day management is made easier since there are now many more days when spreading and spraying operations are possible. Because the risk of rutting in fields is reduced. damage to implements used in subsequent operations is also reduced and the annual ritual of subsoiling the tramlines becomes a thing of the past.

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Restoring land to agriculture

A case for the use of imagination, outlined by Neil Bragg of the Field Drainage Experimental Unit, Cambridge.

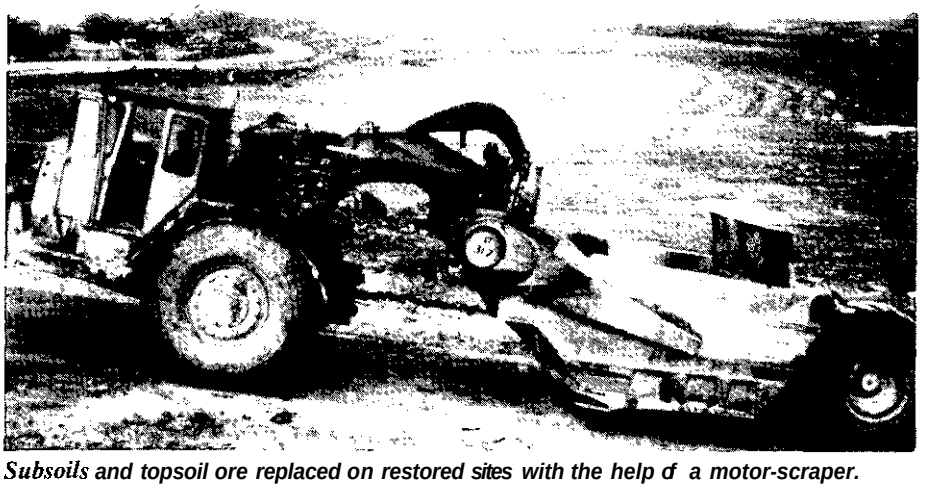
SINCE 1978 the Ministry of Agriculture's Field Drainage Experimental Unit has been employed by the NCB to investigate and solve land drainage problems of reinstated open cast coal sites. It would have been totally wrong if, in that period, we had considered only drainage, and ignored soil stripping, storage, replacement, cultivation, cropping and long-term management.

Problems in restoration of mining sites include the variable type and nature of the soil which overlies the mineral before extraction. When is the best time to handle the soil, how best should it be stored, should any treatment be applied to it in storage, and what changes, chemical, biological and physical will take place in storage?

Further problems are produced by the type and size of machinery available to move the soil. The site contractor wishes to use the most economic plant (often the largest and heaviest), but there is an argument for handling the soil as delicately as possible and not compressing or destroying its inherent structure.

Management of the land immediately after reinstatement, with its long-term future in mind, is receiving most research attention at present. But it must be questioned whether priority should not be given to the first two problem areas.

At present, there appears little possibility of substantially altering the contractual stages of extraction and restoration and the equipment used. Although there can be much debate on whether draglines are better than motorised scraper boxes, in the end one has to start from the point where the land is handed back from the Contractor for agricultural management.



Subsoils and topsoil ore replaced on restored sites with the help of a motor-scraper.

It is here that the current concepts of management practice and treatment of the reinstated land need further examination. First, we need to accept that by having physically moved the soil, it no longer has a direct relationship to adjacent undisturbed ground. That is not to say that it necessarily has lower cropping potential, given correct management.

Better yields may be obtained than those on adjacent land, particularly if the limitations of the undisturbed ground have been corrected in the reinstated soils.

A case in point is where clay subsoils can be replaced using sandier material which may have formed part of the rock overburden (normally inaccessible) before mining.

In the first five years of management or aftercare, the aim at present is to get sites reasonably fit for agriculture as quickly as possible and to take hay or silage cuts or graze to obtain some economic return.

Without careful management, this may be detrimental to the long-term aim, which should be to develop the soil to ifs maximum potential. A management strategy which aims to develop the potential of an inherently limited soil to a far greater level is therdfore of prime importance.

Grass is the crop presently considered the most suitable to improve soil structure, provide ground cover and yield an economic crop. Grass can only help, however, if *it* can root successfully in the soil and if the associated biological agencies are present to incorporate the organic matter and create smaller, more stable soil aggregates.

It must also be questioned whether the most productive agricultural grasses produce such vigorous root systems as less popular grasses. Therefore it may be more desirable in the first five years after reinstatement to grow crops with more adventurous root systems, and disturb the soil biologically.

Plants such as chicory, lucerne, sweet clover, tree lupins and alders have such

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Excessive wheel rutting on a restored site, prior to the installation of underdrainage.

root systems, but some of them are of little or no value as an agricultural crop. Even so, the first years should concentrate on soil development, a process which took at least 10,000 years before mining.

Soil development should be the aim of cultivations and drainage in the first years. Drainage is necessary initially to curtail the risk of erosion and then secondarily to provide a positive connector for secondary treatments of either moling and subsoiling, or hoth.

Normal agricultural design philosophy is inappropriate as sites usually respond as paved area catchments in the first years. Allowance must therefore he made for this in designing schemes. The secondary treatments are aimed at re-routing the water, slowing its movement from the site and curtailing the erosion risk. They also provide fissures for plant root establishment, which in turn leads to a build-up of more organic matter in the soil, increased biological activity and accelerated structural development of the soil.

The plough, like grass, appears often as the well-tried and only option for the reinstated site. There are alternatives, such as the strip-seeder which allows seeding direct into the pioneer sward, thus maintaining some ground cover and reducing further disturbance in an already disturbed profile. Where necessary, chemical control of weeds may be used in grass swards.

There is also the choice of using tines, discs and harrows for reseeding, all of which have the advantage of not turning up raw undeveloped material to the surfam, and hence requiring even greater efforts to be made in establishing the next sward.

The options open to us makeclear that there are basic research aspects which require attention, though and discussion. We must not assume that the state of the art is final. We must be forward-thinking and be prepared to try new concepts and ideas in the restoration of land after open cast workings.

Finally, I wish to add one thought provoking quote from the explorer Sir R. F. Burton (1893); 'Moreover, Desert views are eminently suggestive, they appeal to the future, not the past; they arouse because they are by no means memorial'.

Strip-seeder sowing direct into a pioneer sward on a restored site.

Laying pipes en France

A VISIT to the French national drainage demonstration proved fascinating for Mike Saull. There was a most pleasant atmosphere with no competition between exhibitors to produce the most novel display or the most brightly painted machine. No quibbling over plastic or clay, and, not surprisingly, no toilets! It may be an obvious statement, but the demonstration was typically French, it was casual, carefree and enjoyable, and, judging from the interest of the local farmers present at the small site near Le Touquet in N.E. France, a success, albeit in a different manrier from the British counterpart.

THE different concept and aim of the French event stems from the role and objectives of the sponsoring organisation — the Syndicat National Professional des Entrepreneurs de Travaux de Drainage (SNPETD). The organisation comprises the principal drainage contractors in France, and has the objective of promoting land drainage, and improving knowledge and raising standards of workmanship. Not every contractor can become a member of the "syndicat". Potential members are invited to join, and after a trial period they are only elected as full members if they meet the high standards that are demanded.

This 14th National Drainage Event is the major event in the SNPETD promotional calendar and it is coupled with a conference on the preceding day. The demonstration is smaller than the Farmers Weekly event but concentrates on selling drainage to the farmers of a particular area rather than selling specific products to the drainage contractor.

Operator Training

The CNFPED had a display at the event and is an organisation that the British drainer could pay attention to. It runs a training centre for operators with a staggering 120 four-day courses per year. on machine capabilities, laser use and maintenance of quality work. The funding of this body is through a State tax of 1.1 per cent on the wages a contractor pays to his team. This can only be recovered if the contractor sends his staff on CFNPED courses. Such an arrangement obviously encourages the contractor to educate his staff.

Machinery on Show

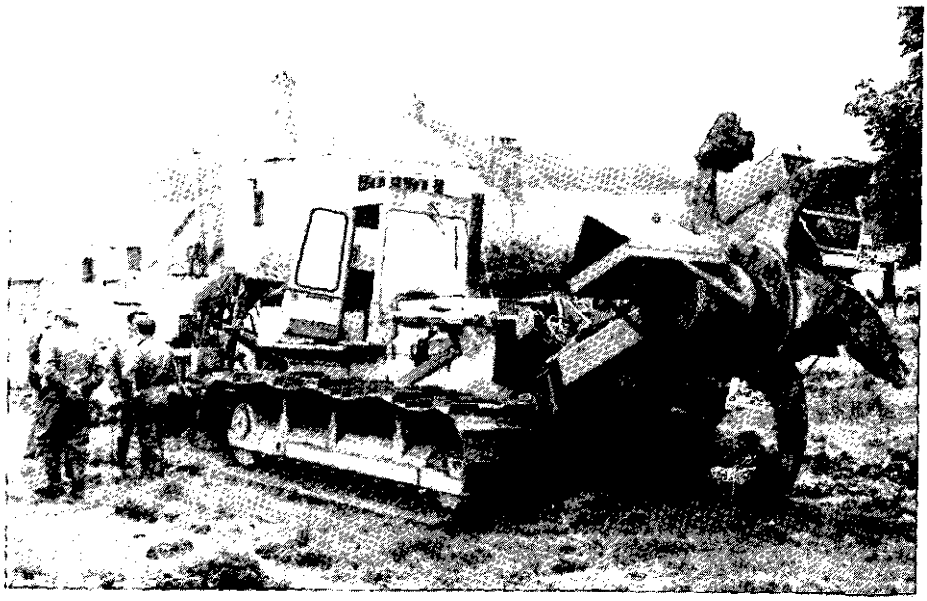
The demonstration is controlled by guides with loud-hailers who take the assembled company around the site explaining the use of various trenchers. backacters and trenchless machines. and more importantly stressirlg overall scheme design and the use of filters, adequate connections and pipe size/ gradient and spacing relationships.

On the silty loam soil of the site, it was interesting to note that all pipes laid were plastic and sheathed by Cocowrap filter. Laterals were at 15-20m spacings with no permeable fill and there were no wheeled excavators on show — hence minimising the risk of compaction.

One particular machine caught my eye On show for the first time in France was Steenbergen Holland-drain's Delta Plough. This caused quite a stir among the drainage professionals and one almost had to fight to jump into a profile pit after the machine had been demonstrated. Mr Steenbergen uses the machine as a deep worker for use where there are no trees and few stones or boulders.

The idea itself looks right and with its 'V' formation it could be likened to "a double sided Paraplow". As long as it does create relatively permanent fissures above the pipe it could be a useful tool. Mr Steenhergen recognises that trials on the machine are needed, but he has spent

Extra traction for the trencher is provided by the Draineuse rotating strake attachment powered by its own diesel engine.



time with Gordon Spoor perfecting the machine and looks to the four machines now operating in Holland to help sell the idea.

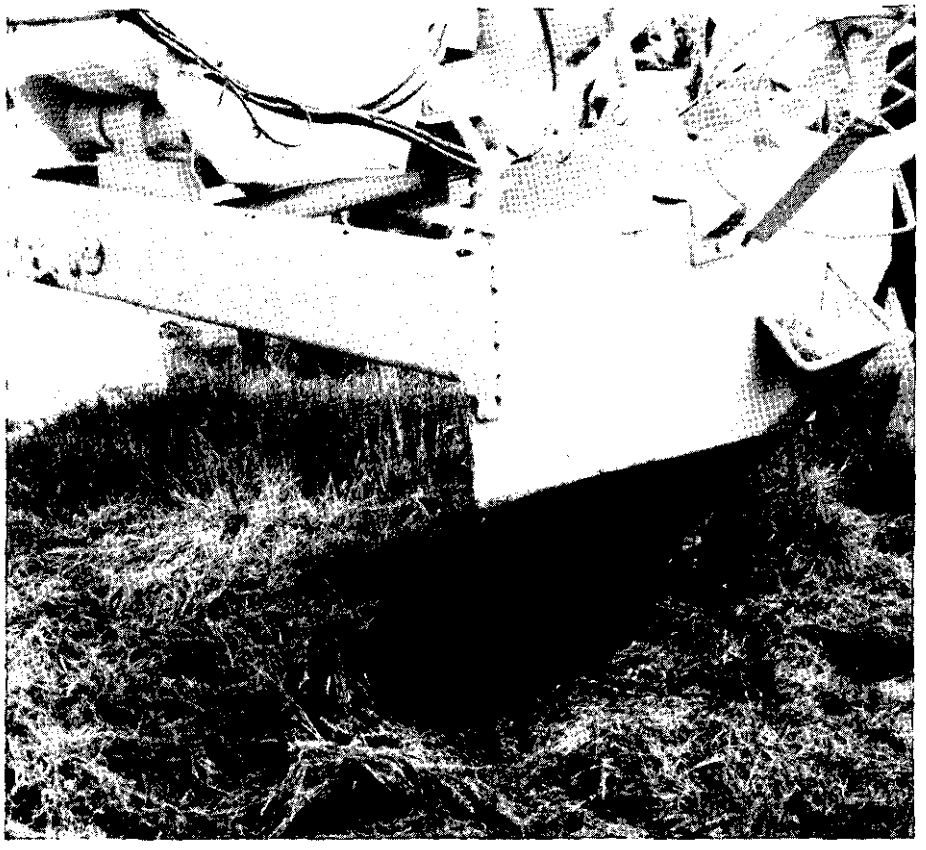
Across the Channel

There were about twenty Britons at the event soaking up the sun and enjoying drainage French style. They included a party of ADAS officers under the leadership of Colin Brown. Colin is a great fan of the French National Demonstration and he applauds the involvement of local agricultural colleges and Chambers of Commerce to promote drainage in anv one area.

He told me that each vear the Syndicat identifies an area of drainage need and sends out personal invitations to farmers, consultants and colleges, as well as to local and national Government representatives to attend the demonstrations. If there is no suitable contractor available in the vicinity, a Syndicat member — perhaps from same considerable distance away — is brought in for a period of twelve months or so. During this time local contractors are trained and encouraged to expand so that they can eventually take over. Colin prepared a report on the 1979 French National Drainage demonstration and if anyone wants more details he can be contacted at the Wolverhampton ADAS office.

Congratulations then to the French — a different approach from the Farmers Weekly event but one that a strong contractors' organisation in this country should encourage. It wouldcertainly help drainage public relations.

Vee-shaped trenchless Delta Plough from Steenbergen is designed to create fissures above the pipe with minimal surface disturbance.



Reclaiming the hills

The aim of hill land reclamation is to provide better quality pasture for livestock. Dr P. Newbould, deputy director of the Hill Farming Research Organisation, outlines some reclamation methods.

HILL SOILS are acid, low in available nutrients, high in organic matter and often have poor physical condition, being either very stoney or excessively wet. If accessible, and given a plan to utilise enhanced production of higher quality herbage with livestock, it is possible. at a cost, to improve most hill soils.

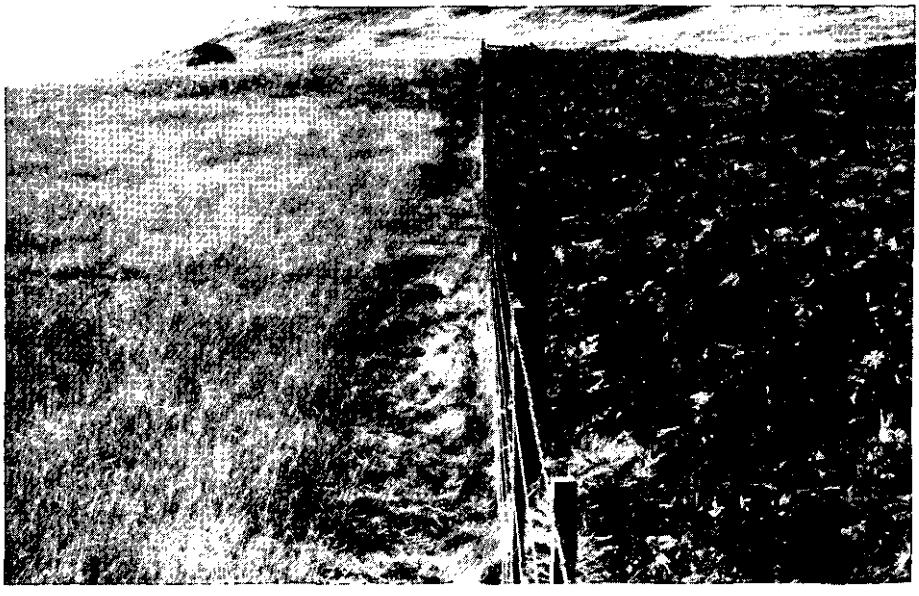
Methods range in cost and speed of response from the erection of a fence and grazing control alone, through the addition of lime and fertiliser and the application of herbicides and the sowing of seeds by oversowing, to cultivation and complete resowing, sometimes in the latter case with drainage too. Irrespective of the method adopted a fence is essential to keep animals in or off the improved pasture so as to optimise its management.

On deep peat soils in wetter regions of the countrv the native vegetation is of such poor quality that increased intensity of grazing alone has little effect on herbage quality. The reclamation procedure recommended for these soils is destruction of the existing vegetation by burning (when this can be conducted safely), or cutting, or heavy grazing by cattle.

The application of 7t/ha magnesium limestone corrects the acidity and ideally this should be applied in autumn prior to a spring sowing date, together with ground rock phosphate giving 30/40kg P/ha. In spring, following the application of NPK fertiliser to give 40kg N, 40kg P and 80kg Klha, a seeds mixture of 3kg white clover (2kg NZ Grasslands Huia and 1kg S100 or S184), 24kg ryegrass (8kg Gremie (VE), 8kg Animo (I), 8kg Melle (VL) and 9kg Timothy (4.5kg Scots (E), 4.5kg Erecta RvP (E) is broadcast per ha, the white clover seed having been innoculated with ***Rhizobium*** just prior to sowing.

On drier sites it is advantageous to change the Timothy component of the grass seeds mixture to Cocksfoot (4.5kg Trifolium (E), 4.5kg Prairial (L) per ha). The letters behind the grass varieties refer to flowering date: VE = very early. E = early, I = intermediate, L = late and VL = very late.

It often helps to tread the seeds into the surface peat by driving a flock of sheep over the paddock. No further cultivation is required since lack of water for germination is rarely a problem in these situations. Provided drier knolls are selected for treatment, drainage is not required, but in some circumstances a few open surface ditches made with a Cuthbertson or similar plough are advantageous to remove excessive surface water. This is particularly important to redirect the flow of water from high unimproved parts of the hill should this impinge on the area to be improved.



Reclamation: Before (right) and after.

On brown earth soils in drier parts of the country most of the methods of reclamation can be applied: the selection of a particular method will depend on the nature of the existing vegetation, the availability of finance and the urgency with which the improved pasture is required.

For complete resowing, cultivation by rotavator is required to break up the surface mat of organic matter and mix it with the underlying mineral soil and with the lime and phosphate which are usually applied prior to treatment, the existing sward having been killed by Gramoxone or Round-up. After application of the compound fertiliser and seeds, it is often advisable to roll the area to firm the seedbed and to conserve moisture.

For hill soil types (podzols and gleys) lying in potential productivity between the poorest (deep peat) and best (brown earth), similar methods can be used, the degree of disturbance by cultivation depending on the moisture status and accessibility of each site.

Irrespective of soil type, careful aftermanagement of the improved pasture is essential. Every attempt should be made to prevent the grass heading and care should be taken to avoid overgrazing in autumn and at too early a stage in spring.

Additional nitrogen fertiliser (40kg/ha) may be required at the start of the first harvest year. Thereafter provided maintenance applications are made of lime (2-3 t/ha ever 4-5 years depending on rainfall), phosphate (40kg P/ha) and potassium (60kg Wha) every 3-4 years, nitrogen fixation by white clover and the return of nutrients recycled through the grazing animal should enable the improved sward to obtain sufficient nitrogen.

Soil samples should be analysed to test for the adequacy of supplies of cobalt and copper for grazing sheep and, if necessary, salts of these metals can he added. However, such additions are not always completely effective and it is better to keep a careful watch on the health of stock, especially lambs, on recently improved pastures and to use proprietary prophylactic measures for the livestock if necessary.

DRAINAGE IN DEPTH

PUT TWO university lecturers together, both experts in their field, and they are almost bound to come up with a pretty comprehensive textbook on their subject.

Land Drainage: planning and design of *agricultural* ***drainage systems,*** by Lambert ***K.*** Smedema and David W. Rycroft, published by Batsford at £19.95, is a modern comprehensive text at university level. The authors have the necessary background to put the theoretical soil physics and chemistry of land drainage into a practical context.

Lambert Smedema is a member of the civil engineering department at Delft University, the Netherlands. He was educated at Wageningen University, the Netherlands, and Cornell University, USA, and worked for 13 years as a professional engineer on irrigation and drainage projects in Europe, Africa, the Middle and Near East and South America with the consulting firm Ilaco/ Euroconsult. He was visiting senior lecturer at the University of Nairobi in 19771 78 and is a frequent consultant for FAO, the Netherland government, and engineering companies on overseas projects.

David Rycroft lecturers on soil physics and land drainage to postgraduate students in irrigation engineering at Southampton University. He was formerly a lecturer at the NCAE, Silsoe, and was a consultant with the firm of Sir M. MacDonald and Partners, working on reclamation and drainage of large irrigation schemes in Iraq and Somalia.

Dr Rycroft began his involvement with land drainage in 1967 when he started a three year study of water movement in peat covered mires in Scotland. He followed this with the post of deputy head of the Ministry of Agriculture's Field Drainage Experimental Unit.

The authors treat land drainage as a field of applied soil physics and applied hydrology. The book cover all the major drainage problems:

- groundwater drainage and water table control.
- surface drainage of sloping and flat lands.
- shallow drainage of heavy land.
- drainage for salinity control in irrigated land.
- drainage and reclamation of polders.
- drainage for seepage control.
- main drainage: design discharges, canal design, outlets.

The book's treatment of the subject is designed to give the reader a good understanding of what goes on physically and chemically in the soil and on the land during the stages of different drainage processes. The aim is to help the reader appreciate the many factors and interrelationships that need to be taken' into account in diagnosing drainage problems and preparing their solution while being aware of the reliability and limitations of the existing theories and formulae.

The theory is backed by extensive practical application, so the book is equally suited to the student and the drainage professional.

ADVERTISERS' INDEX

DIARY

NOVEMBER **1983**

9-10 Autumn National Sugar Beet Demonstration — Setchworth, Newmarket

20-25 **10th** International Congress of Plant Protection, Brighton.

24 **ICI/Midland** Bank Conference — Caythorpe Agric. College, Lincs. Contact G. W. Shepherd, ICI, Tel 0733 313100.

29 Drainage Conference — RASEIADASISAWMA, at the NAC, Stoneleigh. Tel 0203 555100.

DECEMBER

5-9 Royal Smithfield Show — Earls Court, London.

14-16 Yield of Oil Seed Rape Course — University of Warwick, Coventry. Contact Cereals Unit, NAC, 0203 55100 ext 246.

13-15 Irrigation: Principles **&** Practices — Silsoe College, Silsoe, Beds. Contact Pam Cook 0525 60428.

13-15 Aerial photographic interpretation — Silsoe College, Silsoe, Beds. Contact as above.

JANUARY 1984

3-6 Weld Drainage & Soil Management Courses — Silsoe College, Silsoe, Beds. Contact Pam Cook 0525 60428.

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GRAVEL MOLE DRAINAGE WHAT IS IT?

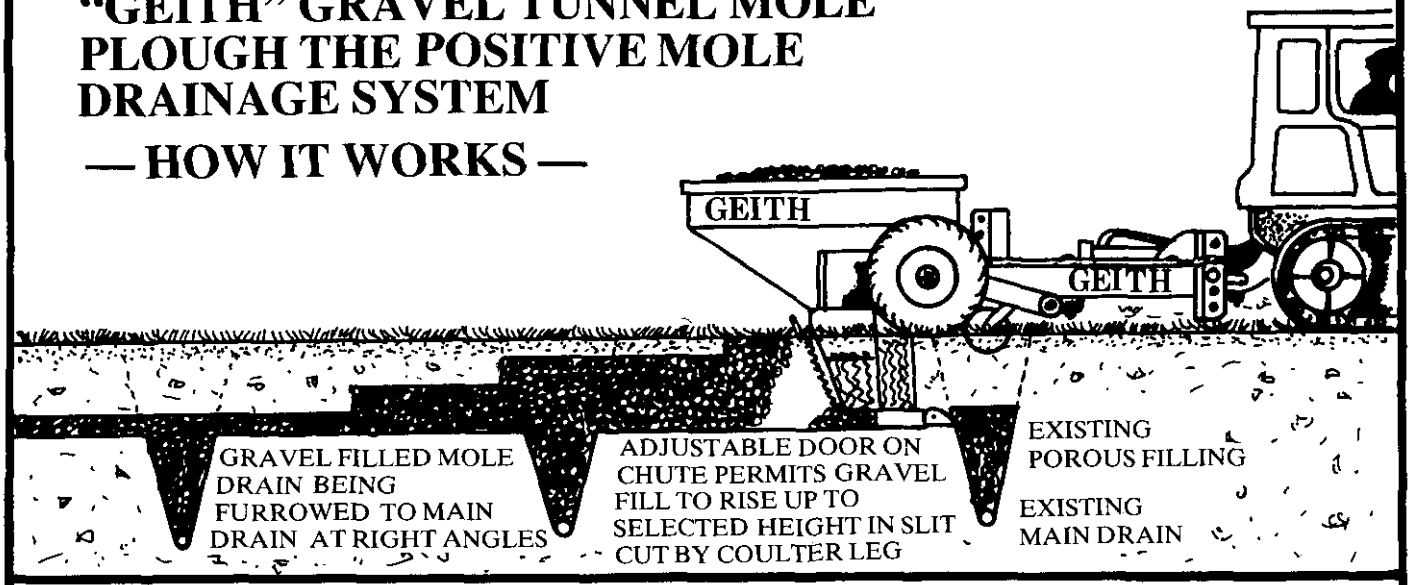
Gravel Mole drainage is essentially mole drainage where the mole wall is supported against collapse and erosion by an insert or permeable gravel through which the drainage water flows. It can also be regarded as a mechanical method of installing French drains close together while at the same time loosening the soil overhead and between the drains.

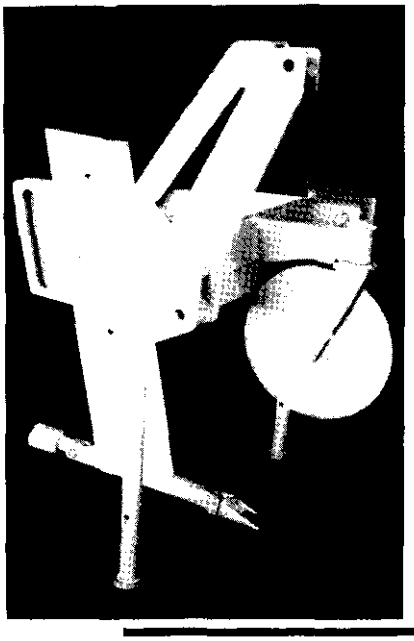
4 MACHINES IN ONE

"GEITH" Gravel Tunnel Mole Plough provides owner with four machines in one (a) as a Gravel Tunnel Machine (b) as a Heavy Duty Mole Drainer (c) as a Heavy Duty Subsoiler (d) as a cable/pipe laying machine.

"GEITH" GRAVEL TUNNEL MOLE PLOUGH THE POSITIVE MOLE DRAINAGE SYSTEM

— HOW IT WORKS —





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Mole/Subsoil Tube-Cable Laying Plough

Can have various attachments added to perform all above jobs

One basic unit

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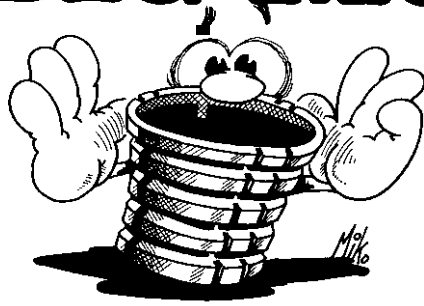
BIG MOUTH



BIG PERFORMER

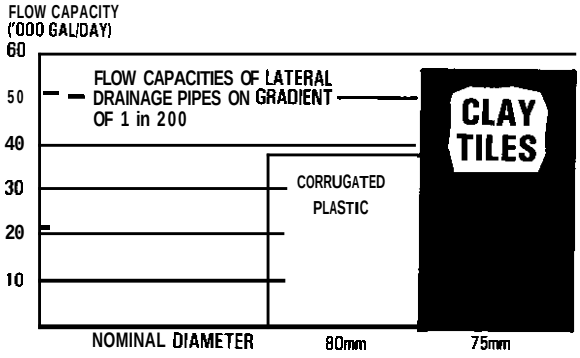
You can fool some of the people all of the time – but don't **try** it on **farmers.**

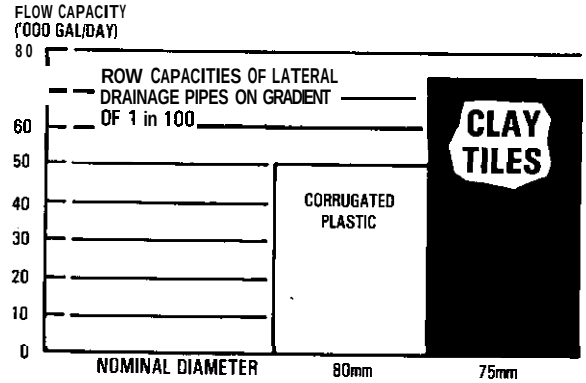
They **know** that 3 inch clay tiles can y twice **as** much water **as 60mm** plastic tubing – so a **claywar** drainage scheme can last twice as long.

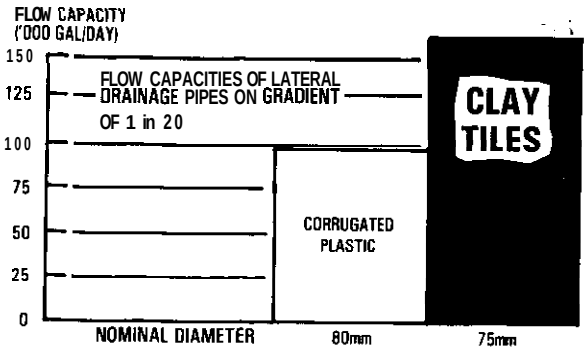
But some salesmen will **try** to tell you that because **80mm** plastic is a **fraction** bigger than 3 inch tiles, it will **carry** more water.

Like so much sales patter, that is quite simply untrue – and there are Ministry figures to prove it.

On a 1 in 200 slope, for example, 3 inch tiles can y 18,500 gallons of water more than **80mm** plastic – each and every day of the year.



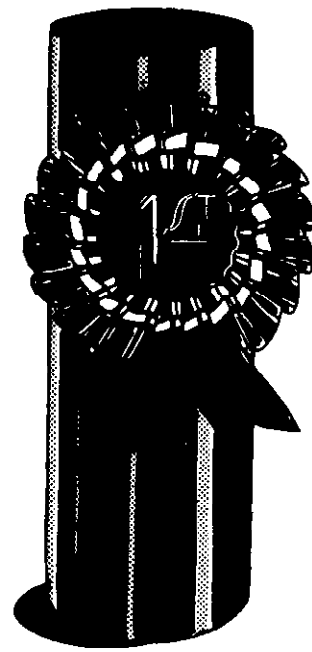




This is because the **corrugations** in the plastic tubing cause what the boffins call "hydraulic roughness": in farming terms, this means the water can't flow as easily.

On steeper gradients **the** comparison is even **more striking, as the charts** show: at 1 in 100 the difference is nearly 25,000 gallons a day, and at 1 in 20 the advantage to is a staggering 60,000 gallons a day.

So when you choose clay tiles, you won't **just** get a **strong, proven, long-lasting, vermin proof,** chemically inert, British product: you'll also get one which shifts more water from your land.



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