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Soil-plant-sheep organochlorine pesticide research

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EXPERIMENTAL SUMMARY

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Soil-plant-sheep organochlorine pesticide research.

1. SOIL O/C DECAY (5812EX)

Background

O/C residues in soil appear to break down at a very slow rate, as evidenced by their presence decades after application to a crop.

Loss of soil O/C appears to be by volatilisation (vapour loss) and by microbiological activity.

Aim

To determine the rate of decay of soil Dieldrin.

Experimental Method

Permanently marked 100.0 m transects in 40 paddocks located throughout the main pesticide areas were sampled at 5.0 or 10.0 m intervals, to 10 cm depth in Feb/Mar 1988, Nov/Dec 1988 and again in Nov/Dec 1989. At each sampling date soil was collected from within centimetres of the previous year's sampling site. A total of 441 samples from the 40 transects were collected for O/C analysis at each sampling date.

The hardsetting nature of loam soils after the summer drought necessitated changing the annual sampling date from Feb/Mar to Nov/Dec.

Results and Discussion

Because at any one sampling date the variation along a transect can be very large it was decided to use the transect means rather than the individual sample values. (see Table 1)

An average 3% decrease was recorded between the Feb and Nov 1988 samplings, with variation ranging from a 30% decrease to a 60% increase. However the 3% decrease was in the expected order of magnitude.

Unfortunately, the values from the third sampling (Nov 1989) were on average 19% higher than the original Feb 1988 values. Furthermore they ranged from a 8% decrease to a massive 108% increase, clearly quite an unacceptable result. The field sampling technique involved the same two operators using the same equipment and method at the 3 collecting dates where samples were obtained within centimetres of the previous year's sampling point. All samples have been transported in a similar fashion, i.e. under cover in cool conditions to the laboratory. Finally the analytical chemical techniques and standards etc. have been checked to be correct.

If the November 1989 values are correct then two possibilities exist.

a) Variation from centimetre to centimetre across a paddock may be sufficiently large to give a 19% increase instead of the expected 1-5% decrease.

b) O/Cs are diffusing up the soil profile into the 0-10 cm zone. However this does not appear consistent with data from the Nov 1988 (second sampling) or with the 1 or 5 cm soil profiles.

It is planned to resample the 40 transects again in November 1990 and then after a five year delay.

The rate of soil Dieldrin decay is important to know so that predictions can be calculated on when a contaminated soil is likely to fall below the M.R.L. Long term land use strategies e.g. cattle grazing vs forestry etc. will benefit from this information.

2. SOIL PROFILE DISTRIBUTION OF O/Cs (5812EX)

Background

O/C insecticides applied as granules or in liquid form (e.g. through irrigation water) are invariably incorporated into the soil by cultivation, e.g. potato digging, post vegetable harvest ploughing, green manuring or in replanting another crop (vegetable, cereal or pasture). During 1988 soil profile trenches were dug to determine the distribution of Dieldrin residues within the soil profile.

Dieldrin was detected within but not beneath the plough zone. This confirms previous reports which state that O/Cs are not water soluble and therefore do not leach in soils.

The depth of contamination averaged approximately 20 cm but ranged from 10 cm to 40 cm.

The distribution of O/Cs within the profile was found to depend on the cultivation history of the paddock. Paddocks which had been cultivated frequently (including those still in a vegetable/pasture rotation) had a quite uniform distribution of O/Cs within the plough zone. In contrast paddocks which had very little cultivation after their O/C application(s) had an O/C distribution which was highest in the surface 10 cm and considerably less in the poorly mixed bottom part of the plough zone.

In approximately one third of the profiles the surface 0-5 cm layer was less contaminated than in the 5-10 cm layer. This suggested that environmental decontamination was occurring at these sites.

If the surface applied O/Cs had remained undisturbed on the plant residue/soil surface the O/Cs probably would have all volatilised away within a few years.

Natural environmental decontamination of soil O/C residues by volatilisation occurs at or close to the soil surface/air interface. Also, as microbiological activity is generally concentrated near the soil surface any microbiological degradation of soil O/C residues would also occur close to the soil surface.

Aim

To determine the distribution of O/Cs at 1 cm intervals down the soil profile.

Experimental method

Twentyone profiles were sampled at 1 cm intervals, eleven to 10 cm depth (see Table 2) and ten to 20 cm depth (see Table 3). Again great care was exercised in preventing soil from any one cm sampling level mixing with any other one cm sampling level.

The profiles were sampled across a range of soil types in the main pesticide areas.

Results and discussion

In most profiles there was a large reduction in surface contamination when compared to the contamination levels at 5 cm depth. The overall surface reduction of O/C contamination averaged 25%.

In 88AL21/1, a classic peat, the depth of surface lowered O/C contamination was extended to 4 cm depth. The open porous nature of the peat at this sampling site may have promoted air exchange and enhanced volatilisation, relative to a duplicate profile on an adjacent paddock, 88A121/3.

In general terms the distribution of O/Cs within the profile can be subdivided into

a) the surface layer of a few centimetres with a reduced level of contamination, lying above the

b) 5-10 cm layer which contains the maximum level of contamination, and

c) below this the concentration of O/Cs decreases to zero.

From the paddock O/C and cultivation histories the amount of surface decontamination does not appear to increase with increasing age of undisturbed (non-cultivated) pastures. This suggests that environmental decontamination of the soil surface by sun, wind and rain is reasonably rapid, i.e. within 3 years. Farmers have been encouraged to preserve this partially decontaminated soil surface by minimizing the frequency and depth of cultivation. A partially decontaminated soil surface will lessen the contamination of pastures (by windblow and mud splash adsorption), and also lessen the contamination of animals by their ingestion of soil and/or pastures.

3. SOIL DECONTAMINATION OF O/Cs (5812EX)

Background

The likelihood of soil O/C residues remaining above the M.R.L. for decades, even centuries, due to their slow decay rate initiated a series of soil decontamination experiments. It was anticipated that any successful, practical and economic means of significantly decreasing soil contamination would greatly reduce current pesticide farm grazing management problems and costs. These benefits would flow through to the export area.

Environmental depletion of soil O/Cs, which are very strongly chemically bonded to the colloidal clay and organic matter fractions, appears to be by volatilisation and microbiological activity (e.g. by mineralisation of organic matter). As a consequence, decontamination experiments should aim to accelerate these pathways. Here, O/C volatilisation can be increased with increased soil temperature (e.g. burning) while microbiological activity can be increased by the supply of moisture in summer (e.g. irrigation). Cultivation can increase volatilisation and microbiological activity by enhanced soil aeration.

In 1988 soil decontamination experiments involving

a) burning dry pastures

b) burning a dry oat crop

c) multiple cultivations with and without multiple irrigations

all failed to significantly lower soil Dieldrin levels. This research continued in 1990.

Aim

To assess practical and economic techniques for decontaminating soil Dieldrin residues.

A) Cultivation

Background

Despite the non-significant result of multiple cultivations on a poorly structured soil it was considered necessary to repeat the multiple cultivation treatment on a wider range of soil types, with good soil structure in permanent pasture paddocks under grazing.

Experimental method

During the 1988/89 summer, one peat and five loam soils were cultivated by rotary hoe cultivation to 20 cm depth twice weekly for three months. Soil samples at 0-10 cm were taken immediately prior to and after the first cultivation and then at fortnightly intervals. Unfortunately, it was only possible to sample the peat soil two days before and not immediately after the first cultivation.

Results and discussion

On all the five loam soils the initial cultivation increased the level of 0-10 cm soil contamination over the 0-10 cm level of soil contamination in the undisturbed soil (see Table 4). The partially decontaminated surface soil was enriched with more concentrated contamination from deeper down in the soil profile. In the five loam soils no significant decrease in soil contamination in the 0-10 level was recorded during the 3 months of multiple cultivations. In the organic peat soil a slight decrease in the 0-10 cm level of contamination was recorded over 3 months (see Table 5). However this small decontamination would not warrant the cost of machinery, time, foregone pasture production, wind and water erosion control or reestablishing permanent pasture. Hidden costs of restoring biological activity, organic matter and nutrient status must also be considered.

B) Topsoil burial

Experimental method

In a pasture paddock regularly rotated into vegetables a single furrow mouldboard plough cultivated a plot 40 m long x 15 wide to an average depth of 15 cm.

The position of the plot in the paddock was determined from the results of a profile trench sampled at 5 cm intervals down to 40 cm. Here O/C contamination was uniformly distributed down to 15 cm, the observed depth of the plough zone.

Ten soil samples (0-10 cm) were collected and bulked from each of 6 marked transects immediately before and after ploughing.

Results and discussion

The site was chosen from profile data that indicated O/C contamination only down to 15 cm.

The mouldboard plough was expected to cultivate down to 25 cm, but unfortunately high pasture residues and low soil moisture limited the cultivation depth to 15 cm. This shallow cultivation minimized the uncontaminated subsoil from mixing with the contaminated topsoil. As a consequence only a 15% reduction was recorded in O/C concentration in the 0-10 cm horizon.

Again this decontamination technique would not warrant the expense. An additional problem on this soil was the nature of the subsoil, a heavy clay. If it had become topsoil, then this would have created additional problems with soil structure and plant productivity. These costs would also have to be measured against the benefits of having non-contaminated topsoil.

C) **Plant uptake**

Soil contaminated at 1.25 ppm to a depth of 25 cm (the contaminated plough zone) will contain a reservoir of 5 kg Dieldrin/ha. An annual plant crop of 10 t/ha with a contamination level of 0.05 ppm will contain a total of 0.5 g Dieldrin. This represents 0.01% of the soil reservoir. It therefore appears unlikely that plant crops can extract sufficient O/Cs to significantly decontaminate soils. Plant contamination appears to be mainly from physical adsorption (windblown dust and rain splashed mud) rather than from root absorption/translocation. Consequently the entire contaminated plough zone will not be subject to soil decontamination by plant uptake.

CONCLUSIONS

All the soil decontamination techniques of burning, cultivating with or without irrigation and topsoil burial have all been quite unsuccessful. Nevertheless, the potential rewards for successful and economic soil decontamination are very high. It must be emphasized that soil decontamination must be complete, because even if the O/C soil residues are reduced to the M.R.L. of 0.1 ppm this can still result in ingested soil and contaminated pastures being sufficiently high to contaminate animal fat.

4. The accumulation and rundown of Ddieldrin in wethers (5841EX)

Background

Soils containing organochlorine (o/c) insecticide residues will contaminate pastures and the ingestion of both contaminated pasture and soil will result in o/c contaminated animals. Contaminated plant and animal products are rejected by both domestic and export markets if the maximum residue level (M.R.L.) of o/cs are exceeded. Farmers can use contaminated land for growing vegetables, fruit, hay or silage, or timber, usually without accumulating high residues. Alternatively farmers can graze dairy or beef cattle or sheep but these choices are more risky and consequently management strategies used must yield products that do not exceed the M.R.L..

Aim

To determine the relationship between the levels of Dieldrin contamination in soil, pasture, sheep body and wool fat.

Experimental method

Eight one hectare sites with a range of levels of Dieldrin contaminated soils were selected in the Albany, Bunbury, Busselton and Manjimup areas. The position of each site within the paddock was determined from the Dieldrin levels of 40 individual soil samples (0-10 cm depth) collected on a 20m square grid pattern prior to grazing.

In July 1988 each plot was stocked with 10 wethers. At the start of winter in 1989 each mob was split into two subgroups of five. One subgroup was retained on the plots whereas the other subgroup was grazed on noncontaminated land at Vasse Research Station at a comparable stocking rate. These sheep were replaced by another 5 wethers from the original population. The replacement wethers had been grazed on noncontaminated land and contained no Dieldrin in their body or wool fats.

The wethers were weighed at the start of each winter, spring, summer and autumn. Following weighing samples of body fat and wool were obtained. Each sample was collected from a new site. The wethers were shorn in September 1988 and 1989.

Pasture availability and the proportion of bare ground at each site were recorded at intervals of four weeks. Samples of both pasture and soil were collected. The botanical composition and growth of the pastures were also recorded at intervals of four weeks but only during the growing season (up to December 1988 and from April to December 1989).

All samples of body fat, wool fat, soil and pasture were analysed for Dieldrin.

Results and discussion

The level of Dieldrin in the pastures depended mainly on the levels of soil contamination. Pasture contamination was also higher on soils with poor structure because of the physical adsorption of soil bound Dieldrin direct onto the pasture from dust and mud splash.

In addition, pasture levels depended on soil type. It appears that pastures grown on organic peat soils do not have the same level of contamination as those grown on loam soils with an equivalent soil contamination when measured at the standard 0 to 10 cm depth.

Pasture Dieldrin levels were highest in newly germinated swards and progressively decreased as the pasture grew into winter. In spring pastures, the high growth rates results in tall, dense, bulky swards which effectively dilute the amount of Dieldrin contamination in pasture. The thin, trampled, dusty, dry pastures of late summer also can contain high levels of Dieldrin.

In general, pastures based on annual species have plant Dieldrin levels that increase in autumn and progressively decrease during winter and particularly in spring. Plant Dieldrin levels will again increase over summer. Levels were higher in sub clover that in grasses or weed species at equivalent levels of soil contamination.

Pastures based on annual species had higher levels of contamination than those also containing perennial species. The organic thatch (stolons, runners, leaves etc) in swards containing perennial species acts as an insulating buffer between the primary source of contamination, the soil and the grazed plant tops.

The seasonal body fat levels generally paralled those of the seasonal pasture levels. At moderate levels of soil contamination (less than 0.5 ppm Dieldrin), the levels of Dieldrin in the body

fat of sheep increased during summer and particularly in autumn, and decreased during winter and spring. At higher levels of potential soil contamination (more than 0.9 ppm Dieldrin), body fat levels increased during summer, autumn and winter and decreased during spring.

During the first 15 months of grazing there was an overall net accumulation of Dieldrin in the body fat of sheep.

Sheep body weights increased slightly in spring but remained relatively constant throughout the study period. Therefore, liveweight, and presumably body composition, would have had minimal influence on the Dieldrin levels detected.

Body fat levels can exceed the MRL of 0.2 ppm Dieldrin on land contaminated at 0.43 ppm. At higher levels of potential soil contamination (1.33 ppm and 0.87 ppm with poor soil structure), the body fat levels of Dieldrin can double and quadruple the MRL.

On loamy soils sheep body fat levels of Dieldrin increased with increasing levels of soil contamination. However, on organic peat soils body fats were not contaminated to the same extent as on loam soils. The body fat from wethers grazed on the poorly structured loam soil contained higher levels of Dieldrin than would be expected from the level of soil contamination.

Once stock were moved onto clean uncontaminated paddocks, the amount of Dieldrin in the body fat fell rapidly, almost halving every three weeks. This rundown was evident in wethers from all sites.

Body fat levels of Dieldrin in all sheep can be reduced to below the 0.2 ppm MRL providing farmers have enough clean land and sufficient time to graze sheep before marketing. Even at moderate levels of soil contamination (less than 0.5 ppm Dieldrin) body fat residues can fall below the MRL during the spring pasture flush.

Wool fat levels of Dieldrin increased progressively on moderately contaminated loams soils (less than 0.5 ppm Dieldrin). Only on soils with high levels of Dieldrin and/or with poor structure did the rate of contamination of wool with Dieldrin rise rapidly. The reason for this rapid increase is not clear but it may be related to soil adsorbed directly on to the fleece.

The "industry standard" limit of 3.0 ppm Dieldrin in wool was not exceeded on any of the eight trial sites, even on soils with a high potential for contamination.

Future work

Apart from the two Albany trials the wethers will be grazed on the other sites until shearing in September 1990. The additional data collected will show differences in soil, pasture, body and wool fat levels between 1989 and 1990, and may give some indication of variations between years. The longer term build up of Dieldrin in body and wool fats will also be established.

TABLE 1

SOIL TRANSECT MEANS(ppm DIELDRIN)

TRANSECT NUMBER	LOCATION	SOIL TYPE	SAMPLING DATES FEB 1988 (ppm)	NOV 1988 (ppm)	NOV 1989 (ppm)	NOV '88 REL TO FEB '88 (%)	NOV '89 REL TO FEB '88 (%)
1	REDMOND	PEAT	0.60	0.53	0.67	88	112
2	"	"	1.04	0.97	1.50	93	144
3	DENMARK	PEAT	0.47	0.44	0.48	94	102
4	"	"	0.93	1.01	0.98	109	105
5	"	"	1.02	1.07	1.18	105	116
6	DENMARK	PEAT	0.13	0.15	0.18	112	136
7	"	"	0.29	0.30	0.31	103	106
8	PEMBERTON	LOAM	2.31	1.87	2.78	81	120
9	"	"	2.04	1.92	1.97	94	96
10	"	"	1.22	1.15	1.18	94	97
11	KIRUP	LOAM	1.35	1.47	1.61	109	120
12	"	"	0.38	0.33	0.35	87	92
13	"	"	1.05	0.84	1.17	81	112
14	DARDANUP	LOAM	0.37	0.48	0.47	129	126
15	"	"	0.53	0.53	0.64	99	119
16	"	"	0.89	0.88	0.94	99	106
17	"	"	0.20	0.20	0.20	98	101
18	CARBUNUP	LOAM	0.16	0.12	0.17	74	102
19	"	"	0.41	0.37	0.45	91	110
20	"	"	0.12	0.11	0.16	85	126
21	"	"	0.56	0.40	0.60	72	106
22	DARDANUP	LOAM	0.47	0.51	0.76	110	162
23	"	"	0.92	0.82	0.91	89	99
24	KIRUP	LOAM	0.83	0.73	0.98	88	118
25	"	"	1.12	0.83	1.24	74	111
26	"	"	0.20	0.14	0.24	71	120
27	DARDANUP	LOAM	0.52	0.53	0.78	102	150
28	"	"	0.73	0.81	1.09	110	149
29	"	SAND	0.39	0.36	0.82	92	208
30	MANJIMUP	LOAM	0.74	0.76	0.99	102	134
31	"	"	1.05	1.17	1.37	111	131
33	"	"	0.30	0.21	0.31	71	103
35	MANJIMUP	LOAM	1.17	1.27	1.36	109	116
36	"	"	4.03	2.81	4.21	70	105
37	"	"	1.22	1.26	1.40	103	115
38	"	"	1.07	0.96	1.16	89	108
39	DONNYBROOK	LOAM	0.39	0.54	0.50	139	130
40	"	"	0.74	1.11	1.00	150	136
41	"	"	0.27	0.43	0.42	160	155
42	JINDONG	LOAM	0.33	0.30	0.32	91	97
		AVERAGE	0.76	0.74	0.90		
		STD.ERR	0.03	0.03	0.04		
% RELATIVE TO FEB '88			100%	97%	119%		

N.B. 441 SAMPLES / SAMPLING DATE

TABLE 2

SOIL PROFILE (0 - 10 cm)

DIELDRIN (ppm)

Sampling Depth (cm)	88AL21/2 - Peat Denmark	88AL21/3 - Peat Denmark	88BY11 - Loam Dardanup	88BY14 - Loam Donnybrook	88BY15 - Loam Goodwood	88BY27 - Loam Donnybrook	88BY28 - Loam Brookhampton	88BU24 - Loam Jindong	88BU25 - Loam Carbunup	88MA47 - Loam Pemberton	88MA48 - Loam Manjimup
0-1	0.18	0.53	1.79	0.82	0.93	0.30	0.27	0.39	0.72	0.76	0.09
1-2	0.14	0.56	1.80	0.96	1.24	0.25	0.30	0.36	0.80	0.86	0.12
2-3	0.20	0.57	1.78	1.09	1.39	0.28	0.33	0.42	0.94	0.92	0.13
3-4	0.45	0.58	1.89	1.30	1.36	0.41	0.37	0.46	0.96	1.12	0.15
4-5	1.12	0.63	2.95	1.46	1.02	0.47	0.38	0.47	0.96	0.83	0.15
5-6	1.53	0.70	2.93	1.37	1.03	0.52	0.36	0.44	0.95	0.83	0.16
6-7	2.29	0.72	2.14	1.47	0.84	0.55	0.36	0.44	0.96	0.89	0.17
7-8	2.34	0.77	1.46	1.49	0.76	0.59	0.35	0.48	0.94	0.99	0.17
8-9	2.03	0.73	1.23	1.49	0.70	0.63	0.38	0.51	0.93	1.06	0.16
9-10	1.68	0.71	1.30	1.60	0.66	0.62	0.41	0.52	0.93	0.74	0.16

TABLE 3

SOIL PROFILE (0 - 20 cm)

DIELDRIN (ppm)

Sampling Depth (cm)	88AL20 - Peat Redmond	88BY9 - Loam Kirup	88BY10 - Loam Dardanup	88BY13/1 - Loam Dardanup	88BY13/2 - Loam Dardanup	88BY28 - Loam Brookhampton	88BU19 - Loam Carbunup	88BU20 - Loam Jindong	88MA45 - Loam Manjimup	88MA46 - Loam Manjimup
0-1	0.43	5.74	1.08	0.63	3.37	0.27	2.09	0.35	0.92	2.06
1-2	0.44	6.74	1.10	0.77	4.13	0.38	2.16	0.40	1.21	2.00
2-3	0.61	6.94	1.07	0.83	4.68	0.42	2.28	0.48	1.35	1.62
3-4	0.88	6.11	1.04	0.84	4.72	0.39	2.49	0.53	1.34	1.81
4-5	0.91	4.58	1.03	0.92	4.77	0.39	2.47	0.56	1.40	1.91
5-6	1.04	2.83	1.10	1.03	4.66	0.38	2.18	0.56	1.47	2.14
6-7	1.04	2.46	1.25	1.16	4.43	0.39	2.18	0.60	1.70	2.26
7-8	1.01	2.19	1.34	1.23	3.84	0.41	2.44	0.53	1.56	2.40
8-9	0.78	2.08	1.49	1.16	2.37	0.41	1.66	0.51	1.51	2.62
9-10	0.69	1.94	1.58	1.11	1.02	0.42	1.93	0.50	1.72	2.40
10-11	0.72	1.82	1.25	0.04	0.02	0.43	1.34	0.52	1.51	2.55
11-12	0.57	1.71	1.08	0.02	0.02	0.40	1.14	0.52	1.44	2.65
12-13	0.53	1.48	0.78	0.00	0.01	0.42	0.96	0.54	1.13	2.89
13-14	0.41	1.15	0.48	0.00	0.01	0.47	0.70	0.57	0.56	2.99
14-15	0.37	0.97	0.25	0.00	0.00	0.45	0.58	0.57	0.56	2.92
15-16	0.24	0.79	-	0.00	0.00	0.47	0.38	0.56	0.65	2.82
16-17	0.05	0.62	-	0.00	0.00	0.47	0.27	0.54	0.52	2.98
17-18	0.00	0.52	-	0.00	0.00	0.48	0.19	0.47	0.45	2.80
18-19	0.00	0.44	-	0.00	0.00	0.52	0.13	0.47	0.52	2.95
19-20	0.00	0.29	-	0.00	0.00	0.50	0.09	0.47	0.46	2.63

TABLE 4

SOIL DECONTAMINATION - CULTIVATION

MEAN SOIL DIELDRIN (ppm)

LOCATION	SOIL TYPE	IMMEDIATELY BEFORE 1st CULTIVATION	IMMEDIATELY AFTER 1st CULTIVATION
DARDANUP	LOAM	0.66	0.71
DARDANUP	LOAM	1.19	1.62
DONNYBROOK	LOAM	0.76	1.04
GOODWOOD	LOAM	2.40	2.72
DARDANUP	SANDY LOAM	0.31	0.39

N.B. (i) Soil samples were collected from 0-10cm depth.
(ii) Rotary Hoe cultivation depth was 20cm at each site.

TABLE 5

SOIL DECONTAMINATION - CULTIVATION

MEAN SOIL DIELDRIN(ppm)

LOCATION	SOIL TYPE	INITIAL	FINAL
DENMARK	PEAT	1.10	0.74
DARDANUP	LOAM	0.71	1.18
DARDANUP	LOAM	1.62	1.73
DONNYBROOK	LOAM	1.04	0.91
GOODWOOD	LOAM	2.72	3.11
DARDANUP	SANDY LOAM	0.39	0.63

N.B. Soil Dieldrin M.R.L. is 0.10 ppm.
Retransformed mean $X = LOG_E(X)$

SURFACE DRAINAGE TRIAL 86V1/5164EX

Efficient surface drainage of paddocks can be achieved by laser levelling. These freely drained pastures should now not be limited by waterlogging or salt accumulation. These pastures should also produce more herbage and carry more stock to pay the $500/ha cost of laser levelling.

Whilst laser levelling is more widely used in irrigated pastures it has also been successfully demonstrated on dryland pastures at Vasse Research Station. This experiment was designed to quantify the response of annual pastures to improve drainage by laser levelling.

The trial plots were laser levelled in 1986 and again in 1987 before being sown to pasture and grazed with sheep.

Results and Discussion

The stocking rate data indicates that the laser levelled treatment can produce good spring pastures and high stocking rates, but fails to yield more early autumn/winter feed relative to the untreated control. Reasons for this include the observations that the laser levelled plots, although better drained, were uniformly waterlogged and uniformly salt affected. In comparison the untreated control plots had high productive mounds and non-productive depressions. The external drainage of the experiment was also limited by low gradient. This has now improved.

The failure of the laser levelled plots to produce good early autumn feed may also be due to poor soil fertility in the "cut" areas where topsoil has been transported to the "fill" areas. This has been very pronounced on some lasered irrigation plots. Topsoil is now stockpiled and respread after laser levelling to prevent nutritional problems.

This experiment will be cropped in 1990 and resown to pasture in 1991. Pasture growth rates will be recorded in 1991/92.

STOCKING RATE (SHEEP/HA) - 86 V1.

TREATMENT	1987			1988			1989		
	CONTROL	RENOVATION	LASER LEVELLING & RESEEDING	CONTROL	RENOVATION	LASER LEVELLING & RESEEDING	CONTROL	RENOVATION	LASER LEVELLING & RESEEDING
AUTUMN APR-JUN	6.8	0	0	3.2	3.2	3.2	10.1	10.0	6.3
WINTER JUL-SEPT	12.6	5.8	3.6	9.6	8.1	8.8	14.7	11.5	10.7
SPRING OCT-NOV	5.4	7.6	7.2	13.0	11.6	15.0	17.5	17.4	23.3
SUMMER DEC-MAR	9.5	9.5	9.5	7.9	9.0	7.5			
AUT-SUMMER MEAN	9.0	5.7	5.6	7.2	7.0	7.2	15.6	14.2	13.9

MOST PRODUCTIVE TREATMENTS - 86 V1.			
	1987	1988	1989
AUTUMN	CONTROL	N.S.D.	CONTROL/RENOV
WINTER	CONTROL	CONTROL	CONTROL
SPRING	RENOV/LASER	LASER	LASER
SUMMER	N.S.D.	RENOVATION	N/A
AUT-SUMMER MEAN	CONTROL	N.S.D.	CONTROL

N.S.D. = NO SIGNIFICANT DIFFERENCES