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Table 4 Growth and yield data from the winter wheat experiment on clay loam, 1973

	Date	DD	ST	DT	P	SE(±)
Plants/m^2	21.11.72	282	218	122	33	10.2
Plants/m^2	5. 4.73	298	302	287	219	10.0
Yield d.m. (g/m^2)	23. 3.73	65.4	69.5	51.4	27.2	5.02
Yield d.m. (g/m^2)	31. 5.73	687	676	640	660	34.5
%lodging	21. 6.73	57	67	76	58	8.2
Yield of grain (tonnes/ha, 85% d.m.)	16. 8.73	3.90	4.09	3.50	4.28	0.164 P=0.05

Prior to the experiment the land contained three main weeds: couch, *Agropyron repens*, wild oat, *Avena fatua*, and blackgrass, *Alopecurus myosuroides*. Specific herbicide applications were made in 1971-73 to control them. A high degree of success was achieved with the first two—the wild oat population in 1973 was less than 1 panicle/m^2—but the blackgrass has been slower to respond to herbicide treatment (tri-allate granules). However the population of blackgrass is much reduced and is not now expected to affect the experiment.

Spring barley

In this experiment, as in the other barley experiments, the primary tillage treatments followed burning in the autumn. During the mild dry winter of 1972-73 there was an appreciable emergence of seedling blackgrass and volunteer barley which was controlled by the application of paraquat during a frost in January. When the soil moisture was measured during March the 0-12 cm surface layer on the non-cultivated plots was significantly moister than the equivalent layer on the ploughed plots: this difference was not apparent in the 12-24 cm layer. Nevertheless cultivation and sowing were readily achieved. As in the other experiments the soil of the non-cultivated plots, after sowing, resisted the penetrometer more than that of the ploughed plots and again there were no differences in the soil bulk density.

The germination and establishment of the barley proceeded in much the same manner as in the adjoining wheat experiment the previous autumn. The emergence of barley on the direct-drilled and lightly cultivated plots was more rapid than that on the deep-cultivated or ploughed plots. The latter, however, caught up by 25 April to give equal populations. To some extent the original difference may have been due to a slightly greater sowing depth on the deeply cultivated plots, but it is probably also attributable to the higher moisture content of the non-cultivated soil. Earlier emergence on the reduced cultivation plots appeared to lead to the presence of more seminal roots per plant on 4 April and more tillers per plant on 1 May, but these differences were not reflected in differences in dry weight of crop/m^2 on 7 June (Table 5). Nor were they associated with other differences in root growth.

In this experiment, rainstorms also caused extensive lodging, again in a pattern associated with the old ridge and furrow system. Although not statistically different there was some suggestion that lodging was slightly worse on the deeply cultivated plots. The lodging damage resulted in mediocre yields and there were no significant differences, although there was some suggestion of a trend to higher yield with increasing depth of primary cultivation (Table 5).

Table 5 Growth and yield data from the spring barley experiment on clay loam, 1973

	Date	DD	ST	DT	P	SE(±)
Plants/^{2}	8.4.73	205	119	116	87	16.8
Plants/m^2	25.4.73	420	429	419	423	7.2
Seminal roots/plant	4.4.73	5.1	4.3	3.2	3.4	0.38
Tillers/plant	1.5.73	1.7	1.5	1.2	1.2	0.10
Shoot dry wt (g/m^2)	7.6.73	515	531	555	544	12.6
Yield of grain (tonnes/ha, 85% d.m.)	15.8.73	4.34	4.36	4.60	4.86	0.124 P=0.05

The earthworm populations on this experiment followed the same trend as in the other experiments: the population on the direct-drilled plots was about 50% higher than on the ploughed plots. There was only one difference in weeds. After the herbicide application (tri-allate granules) the population of blackgrass was least on the direct-drilled and ploughed plots and greatest on the shallow and deep-cultivated plots, a trend which is consistent with experience elsewhere.

CONCLUSION

Only the most interesting results of the experiments in 1973 have been presented here. In interpreting these results it is necessary to bear in mind that consistency in the long-term is more important than a single year's experience. Since the series is planned to continue for at least another four years, results of completed experiments will be published as the analyses of all the data become available. In the meantime the interim results provide a continuing support for direct-drilling and shallow tine cultivation as viable alternatives to plough cultivation.

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Weed control in the fens

A co-operative project with ADAS

M. J. MAY and J. HOLROYD

The acreage of organic fenland soils is small compared with the total arable area in the UK but their potential productivity, and hence their economic value, is great. The high humus content, water holding capacity and fertility of these soils provide an excellent medium for growing both crops and weeds. Consequently, the normal weed populations are much higher than those of most mineral soils. In fen soils one or two weed species tend to be dominant, unlike mineral soils which have a large number of co-dominant species. These weed populations may arise in a series of flushes, the number and size of which depend on the prevailing weather. As a result, single applications of foliar herbicides are often inadequate. However, the use of soil-applied herbicides also poses problems, for the adsorptive capacity of the soil may reduce their effectiveness. This loss in activity varies from compound to compound and may also be influenced by the amount and type of soil organic matter and the weather.

THE WRO FENLAND TEAM

The ARC Weed Research Organization has been looking at these problems since 1965, mostly at the MAFF Arthur Rickwood Experimental Husbandry Farm. Initially teams operated from WRO but, in 1968, a permanent WRO Fenland Team was formed which is based on the EHF during the spring and summer. The EHF provides the Team with office and laboratory accommodation, land for experiments and help with crop husbandry. Each year, in addition to the Team's basic programme, a number of additional experiments are carried out in direct collaboration with the EHF staff. In the winter months the Team returns to WRO where there are more comprehensive facilities for glasshouse and laboratory work.

The Team's research programme includes field evaluation of herbicides, first for activity on the weeds and second, activity having been established, for their toxicity to a wide range of crops commonly grown on the fens. Herbicides which show useful selectivity are tested further for reliability under a variety of conditions. In other experiments some of the factors which influence herbicide activity in the fens are examined in greater detail. So far over 90 new herbicides have been tested.

SOIL-APPLIED HERBICIDES

Some herbicides are almost completely inactivated by adsorption onto the organic matter of fen soils; others retain activity but at such a low level that to achieve weed control very high rates have to be used, which are not always economically feasible. A number of herbicides are inactive unless incorporated into the top few inches of the soil. This may increase their effectiveness but may again involve unacceptable costs unless the incorporating cultivation is part of seed-bed preparation. Some soil-acting herbicides can be made highly effective through the foliage by the addition of oils and surfactants. This allows treatment to be delayed until many weeds have emerged and reduces the time over which residual activity is required from the herbicide. There is a risk, however, that increases in foliar activity may be accompanied by a reduction in selectivity between the crop and weeds.

RESEARCH ON LENACIL

Mobility in the soil

Early work by the Team showed that lenacil left on the surface of the organic fen soils of East Anglia could remain virtually inactive until incorporated mechanically. A small plot experiment, using turnips as an indicator crop, showed that applications of lenacil as high as 4.5 kg a.i./ha were immobile when left on the soil surface. There was little or no downward movement during the 11 weeks following application. At the end of this period, when the lenacil was incorporated its activity was almost as great as the same amount incorporated immediately after application.

Depth of incorporation

The optimum depth of incorporation of lenacil was investigated in two small plot experiments, one in 1969 and one in 1971. In these, the herbicide at 0.6, 1.1, 2.2 and 4.5 kg a.i./ha was incorporated to depths of 1.5, 2.5, 5.0 and 7.5 cm. The optimum depth of incorporation was between 5.0 and 7.5 cm, when 2.2 kg a.i./ha gave excellent weed control. Linuron, which was also included in these experiments, was most active as a surface application and the activity decreased as the depth of incorporation increased.

Incorporation equipment

Different methods of incorporating lenacil into a sugar beet seed-bed have been investigated in a number of experiments (some in direct collaboration with staff of the EHF). These experiments showed that lenacil was more active when incorporated by rotary cultivation than by single passes of tined implements such as spring tine cultivators fitted with crumbler bars, the 'Roterra' or reciprocating harrows. Since rotary cultivation is a relatively slow method of cultivation and also leaves the fine textured fenland soils susceptible to 'soil blows' (wind erosion) a special machine was designed and built in the hope of overcoming these problems. It was christened the 'rotabar'. In this the normal blades from a Howard 'Rotacadet' were replaced by 6 horizontal T-Section bars of the same length as the rotor. Although with the 'rotabar' it was possible to control the depth of incorporation more precisely it had no other advantages over the normal rotary cultivator and the project was shelved. The machine will, however, prove useful as a research tool.

Sub-surface application

The effectiveness of lenacil placed as a layer in the soil was also investigated. In small plot experiments the top soil was removed to depths of 1.5, 2.5, 5.0 and 7.5 cm, the exposed surface sprayed with 0.6, 1.1, 2.2 and 4.5 kg a.i./ha of lenacil and the top soil replaced. The optimum depth of the layer was 1.5 to 2.5 cm. Lenacil at 0.6 kg a.i./ha gave good control at 1.5 cm but as the depth of the layer increased so did the amount of lenacil necessary for effective weed control.

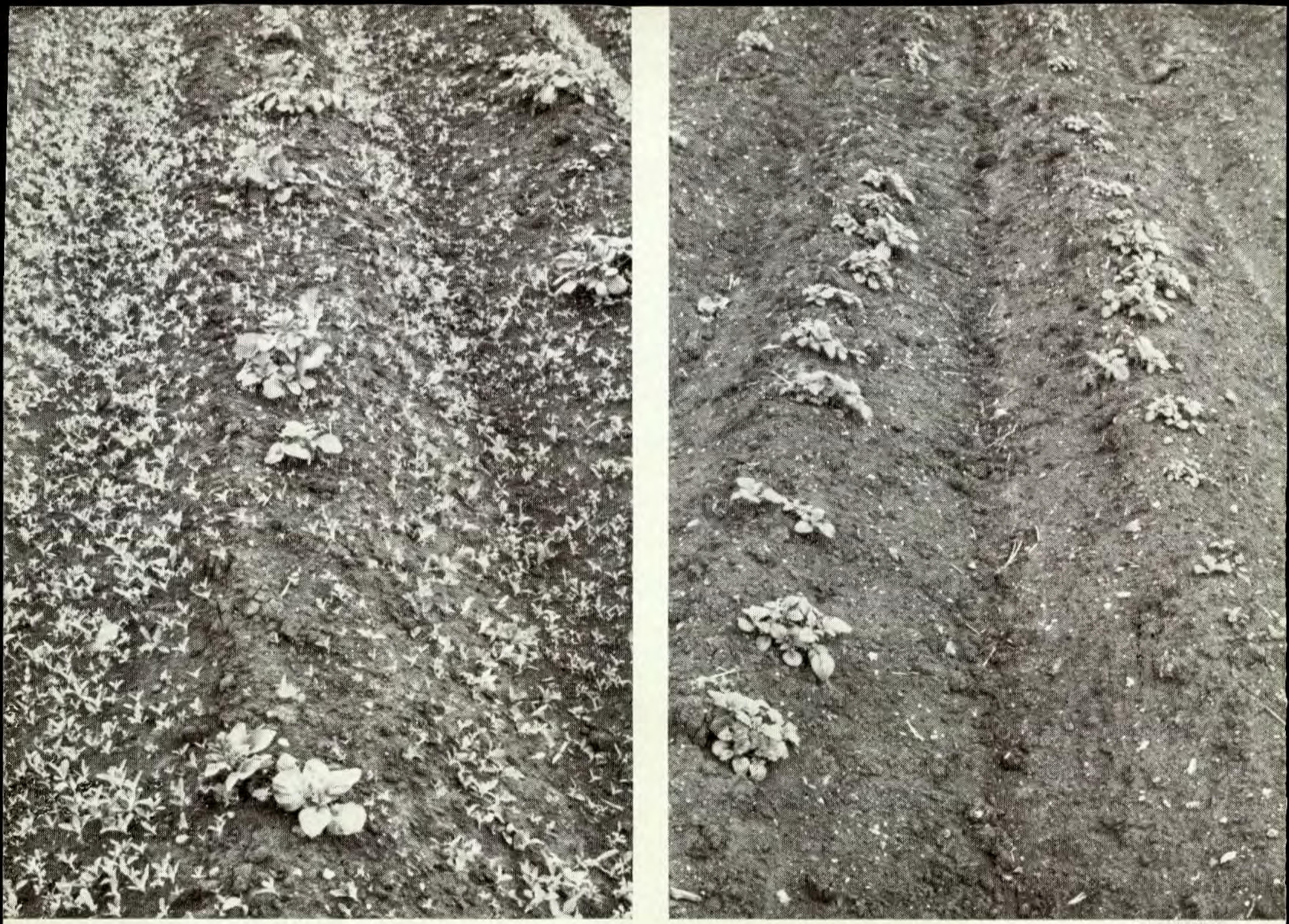
The only machine which can apply layers of herbicide in the soil on a field scale is the NIAE sub-surface A-blades (Holly, 1969). This was tried at the EHF, but was mechanically unsatisfactory in organic soils at these shallow depths because of the inadequate strength of the surface soil.

Additives

The addition of 2.5% Sunoco 11E oil to lenacil applied as a foliar spray enhanced activity in one experiment. However, subsequent experiments with this and other additives were not successful.

RESEARCH ON METRIBUZIN

In 1971 it was found that metribuzin applied to the surface of fen soils was highly active. Incorporating the herbicide to a depth of 5 cm with



Controlling weeds in fen soils. These photographs of adjacent plots on a WRO trial of potato herbicides show, on the left, a typical 'flush' of weed seedlings in the untreated plot and, on the right, the weed control achieved by an application of metribuzin at crop emergence.

a rotary cultivator almost doubled its activity. This herbicide also proved moderately active when applied to the foliage of both crops and weeds. Potatoes were one of the more tolerant crops and in 1972 metribuzin was tested for weed control in the variety King Edward. Staff of the EHF collaborated in this experiment which was situated on a commercial farm. The results suggested that the optimum time of application was at or about crop emergence. An early application immediately after planting did not provide sufficient residual activity and weed competition reduced yields. Late applications, when the crop was approximately 30 cm high, controlled weeds well but selectivity was inadequate and yields were reduced.

In 1973 metribuzin was approved for use on most main crop potato varieties but Maris Piper was a notable exception. This variety is particularly important in the fens of East Anglia as it is resistant to *Heterodera rostochiensis*, the common species of potato cyst eelworm in this area. Early trials by the manufacturers had raised doubts about this variety's tolerance of metribuzin when grown on mineral soils In 1973 the EHF and WRO carried out two collaborative experiments using metribuzin on Maris Piper grown on organic soils.

The variety King Edward had, in 1972, tolerated 1.5 kg a.i./ha applied immediately pre-emergence or at 20-30% crop emergence, but slight crop damage was experienced at this rate and these times of application with Maris Piper in 1973. Despite this, the optimum time to apply metribuzin to Maris Piper, as with King Edward, proved to be at or about crop emergence. This WRO work was taken into account when the manufacturers produced their 1974 recommendations which say that most maincrop potato varieties (including King Edward) can be treated from pre-emergence until the most advanced shoots are 15 cm (6 in.) in length but that Maris Piper (and Pentland Ivory) should only be treated pre-emergence.

PERSISTENCE OF HERBICIDES

In the past, the persistence of herbicides in organic soils has not received much attention. It is known that the majority of herbicides are adsorbed by the soil but whether this affects their subsequent breakdown is not fully understood. Obviously, if the rate of breakdown of a herbicide is reduced there is a greater risk of damage to following sensitive crops.

The Fenland Team, in collaboration with the WRO Chemistry Group, is studying the persistence in the field of two compounds, metribuzin (a triazinone) and linuron (a urea) applied to an organic soil with no cultivation. The method employed is to sample the field plots over a period of a year, analyse the samples for chemical residues and finally bioassay the samples to determine the amount of chemical still available to plants.

One experiment on metribuzin, started in April 1972, has now been completed. In this the chemical half-life of metribuzin in organic soil was approximately six months. The bioassay showed that the majority of the chemical was available to plants.

MINERALISATION OF FEN SOILS

With the natural wastage of the peat due to oxidation, the depth of organic material is steadily decreasing and, in many parts of the fens, mineral soil outcrops can be seen. These outcrops can cause problems when using soil-acting herbicides. The amount of herbicide required for effective weed control on the organic part of the field may be too high for the mineral outcrop and lead to crop damage. If on the other hand the herbicide is applied at a rate suitable for mineral soils, weed control is unlikely to be adequate on the rest of the field.

At the EHF, and on some commercial farms in the area, an attempt is being made by farmers to reduce the loss of organic matter by mixing the mineral sub-soil with the upper layers of the soil. This usually creates a more homogeneous soil, decreases the organic matter content of the upper layers and, for at least the first year after mixing, reduces the weed population. If there is an acid—'drummy'—layer between the organic top-soil and mineral sub-soil there will be a fall in the pH.

The limited amount of work carried out by the Team suggests that the organic part of 'mixed' soils still has an overriding influence on the activity of soil-applied herbicides. Changes in pH also affect the activity of some soil-applied herbicides in current use.

CONCLUSION

This work has produced a considerable body of knowledge on which to base future investigations, but the main problems have still to be completely solved. The cost of using many residual herbicides in the fens is high and ways of decreasing this cost and increasing the range of useful herbicides available must continue to be studied. There are deficiencies in the choice of herbicides available for all the crops. There is, for example, a requirement for a residual herbicide for application post-emergence to sugar beet, an effective residual herbicide for lettuce and, for carrot, an effective herbicide to control *Poa annua* and *Matricaria* spp. In addition, the application of existing herbicides could be more effectively timed if the periodicity of weed flushes could be reliably preducted and the depth at which germination occurs accurately established.

In the past perennial weeds were not a great problem in the fens but *Agropyron repens* and *Polygonum amphibium* are now becoming more evident especially in the 'skirt' areas. This may partly be due to a reduction in the use of hand labour and also because the cropping systems on these areas have changed to include more cereals. In future more of the Team's work will have to be devoted to perennial weed problems. At present, surveys are being conducted to determine the comparative importance of current weed problems in the fens, and findings from these will be taken into account. However, the Team consists of only one scientific officer and an assistant so the amount of work it can tackle is limited.

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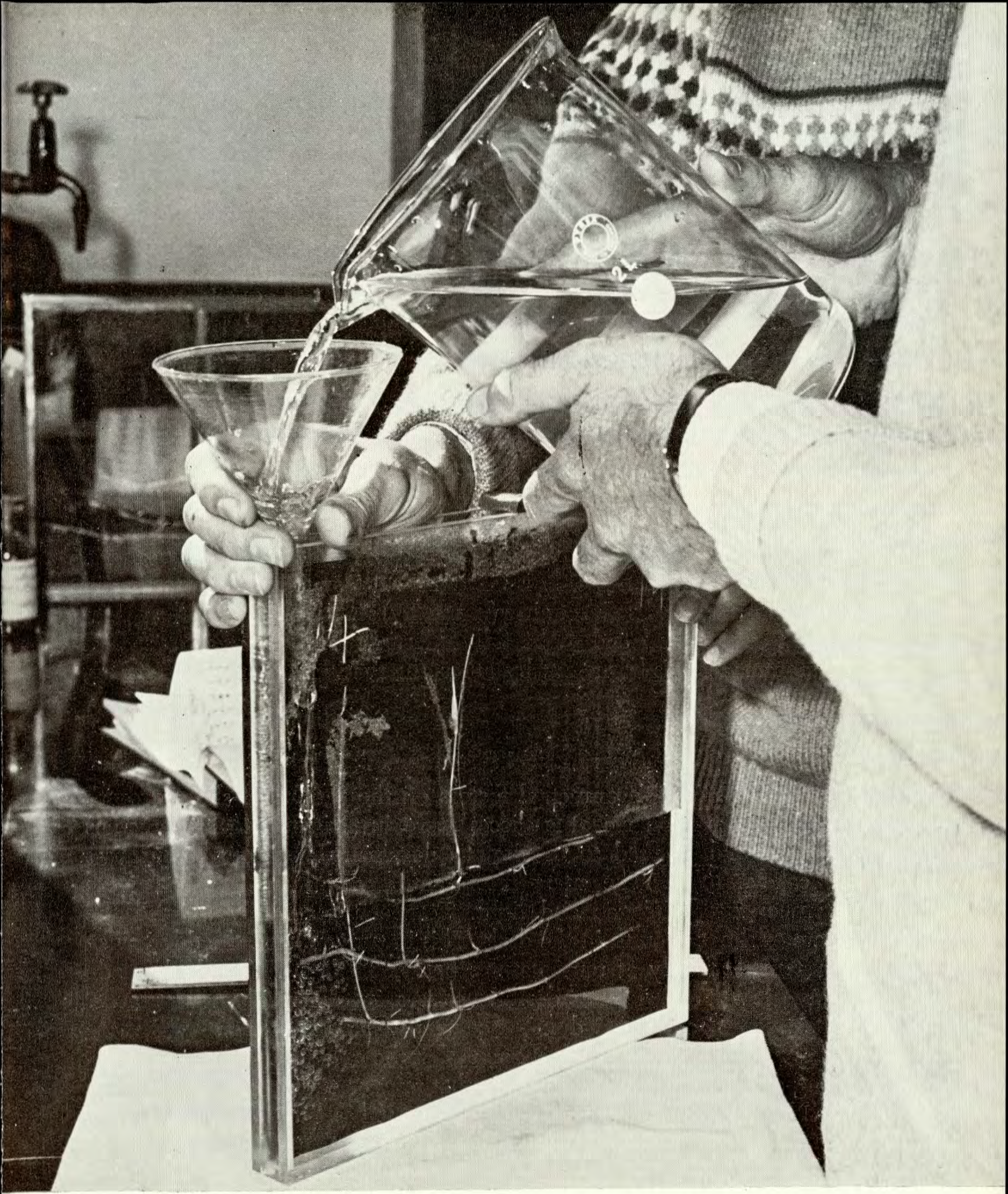
Dormancy and dominance in couch rhizomes

R. J. CHANCELLOR and R. R. B. LEAKEY

Couch grass (*Agropyron repens*) is probably the most important perennial grass weed of arable land in temperate regions. In Britain, the importance of couch in agriculture is evident from a recent survey, which reported that 32% of all cereal crops were infested with it (Anon, 1968). A characteristic feature of this plant is the presence of long horizontal underground stems (rhizomes) that spread extensively. These rhizomes have a series of buds along their length, one at each node. In undisturbed soil, the rhizomes occur mostly in the top 10 cm (Palmer, 1962). It has been calculated that one hectare of infested soil could contain about 4¼ thousand kilometres of rhizome and that, at an average of ten buds per 25 cm of rhizome, there could be over 160 million buds per hectare (Buchholtz, 1962).

APICAL DOMINANCE DORMANCY

In undisturbed conditions, the buds are normally dormant, the dormancy probably being controlled by growth regulators produced by the rhizome apex. This dormancy is strong and 95% of the buds make no growth whatever during the life of the plant (Johnson & Buchholtz, 1962). Under natural conditions this form of dormancy conserves the plant's resources. In arable land, however, the situation is very different. Cultivations cut up the rhizomes into fragments of various lengths and, because most have lost the main rhizome apex, dominance is lost. The effect of fragmentation on dominance has been investigated at WRO. It was found that, in 7- and 15-node pieces the majority of the hitherto dormant buds started into growth, but that most of them quite quickly stopped growing again because a new dominance system was established among the shoots. After about three weeks only one, the dominant shoot, continued growing. It was noticed that, initially, the longest of the young shoots on these rhizome fragments occurred at the most apical node but that, later on, the shoots further back became faster growing and, ultimately, dominated. Thus the dominant shoot occurred most frequently at the second or third node. In general, the



Using the small perspex growth chambers illustrated here, the growth of buds and shoots on couch rhizomes can be studied without disturbing them.

other shoots then stopped growing in sequence, starting with those that were farthest away from the shoot that became the dominant (Chancellor, 1974).

The nature of apical dominance

In plants generally, apical dominance is thought to be due to a chemical (auxin), which is produced by the growing apex and passed backwards from it causing bud inhibition. To see if the same system also operates in couch rhizomes, apex-substitution experiments were carried out in which auxin was applied to the cut apical end of a rhizome to see if buds could thereby be kept dormant.

A mixture of 1-naphthyl acetic acid (NAA) and 6-benzylamino-purine (BAP) was found to be the most effective apex substitute, but artificial dominance was only completely maintained when NAA or the mixture was applied simultaneously to both ends of the fragment. This suggests that not only is the dominance system similar to that in other plants, but also it requires (unusually) some factor from the parent plant at the basal end to be fully effective. The existence of such a parental factor is borne out by other observations and results (Leakey, 1974).

The effects of environmental factors on apical dominance

The effects of environmental factors on the pattern of shoot growth from multi-node rhizome pieces were investigated to see whether these could be used to manipulate dominance for control purposes (Leakey, 1974). The most important environmental factors were temperature, nitrogen and light. Temperature mainly affected the rate of shoot growth in the dark. This in turn affected the dominance system, but only at temperatures below 8°C when few buds made any growth and absolute dominance was not achieved amongst them. Between 8° and 28°C dominance was unaffected, but at 33°C there was no dominance, which suggests that the growth regulator controlling dominance was denatured at that temperature.

Nitrogen too is an important factor. It has been found to release buds from apical dominance in intact rhizomes attached to the parent plant (McIntyre, 1965), but not to prevent dominance establishment in multinode rhizome pieces (Chancellor, 1974). The addition of nitrogen at different stages during the development of dominance in multi-node fragments was found to alter the sequence of bud growth and thus the position of the dominant shoot (Leakey, 1974). This illustrates the influence of nutrients on dominance.

Light had the greatest effect on dominance of any of the environmental factors tested. Natural daylight and artificial light containing wave-lengths of 600-720 nm completely prevented the development of a new dominance system in lengths of detached rhizome without an apex. Once shoots began to photosynthesise, they became independent of the rhizome, competition for stored nutrients ceased, growth became uniform and more new plants were formed from shoots.

LATE SPRING DORMANCY

In addition to the dormancy imposed by the dominant apex a further form of dormancy has been described from Wisconsin in America, which has been called Late Spring Dormancy (Johnson & Buchholtz, 1962). It was found that, during the summer, if rhizomes were cut into one-node pieces, so that there was no interference between buds, many of them still would not grow. Growth, however, could be stimulated by adding nitrogen. This suggested that it was simply a nutritional deficiency. The situation has been re-examined in detail over the last three years at WRO. Rhizomes were collected monthly from field-planted swards and one-node pieces were grown on nitrogen-free, damp, filter paper in growth chambers in the dark. The lengths of the shoots arising from the buds varied greatly with the time of year, the shoots being longest on average in March and April and shortest in June and July. Indeed, some of the buds in June and July made no growth at all and so exhibited Late Spring Dormancy. This occurred mainly in old rhizomes and less frequently than in America. However, its occurrence in this country demonstrates that it is an inherent characteristic of the species rather than just a consequence of farming conditions in Wisconsin.

The nature of late spring dormancy

Besides measuring the lengths of the shoots from one-node pieces, the rhizomes were analysed for stored nutrients, i.e. sugar, starch and nitrogen. It was found that, when grown in a nitrogen free medium, the dry weight of the shoots was correlated with the nitrogen content of the old rhizomes from which they had grown. Other experiments have confirmed that nitrogen alone determines the regenerative capacity of old rhizomes (Leakey, 1974). It appears that late spring dormancy is brought about by the rapid and extensive mobilization of nitrogen reserves for the production of new rhizomes in spring. This temporarily depletes the nutrient reserves of the old rhizomes and so causes their 'dormancy'.

MANIPULATION OF DOMINANCE FOR WEED CONTROL

From the practical point of view, manipulation of dominance in rhizomes could be of prime importance in controlling not only couch, but a variety of other creeping weeds, both temperate and tropical. By encouraging all the buds to grow and continue growing, the dormancy of buds, upon which the plant relies for its continuing resurgence after repeated cultivations, would become inoperative and the plant would then no longer be an effective weed.

Although environmental factors have a considerable effect on the dominance systems, it is difficult to turn them to advantage. The use of growth regulators on the other hand seems more promising. A range of 28 growth-regulatory chemicals has so far been screened at WRO for their activity on dominance in rhizomes (Caseley, 1970; Chancellor, 1970; Chancellor & Leakey, 1972). The most effective of these has been 2-chloro-ethylphosphonic acid (CEPA), which released buds from dominance. However, it only worked if the rhizome fragments were attached to their parent plant. Furthermore, there was the disadvantage that the buds developed into rhizomes, rather than leafy shoots. This resulted in an increased number of dormant buds; the reverse of what is required. Ten other chemicals delayed the onset of dominance. One of these was methyl-2-chloro-9-hydroxyfluorene-9-carboxylate (chlorflurecol-methyl), which also occasionally broke dominance within the lateral shoots, so that secondary shoots grew out at their base.

These examples illustrate the possibility of regulating dominance by chemical treatment and indicate that the manipulation of dominance to aid weed control might be feasible provided a suitable regulator could be found.

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The control of bindweed in fruit crops

J. G. DAVISON

Two species of perennial bindweed are found in fruit crops. The most common and the most difficult to control is *Convolvulus arvensis*, the field bindweed, cornbine, bearbine or simply bindweed that is found throughout Britain in arable land, gardens and waste places. *Calystegia sepium*, the bellbine or large bindweed, is less important, easier to control, and is not discussed here.

Bindweed has become increasingly important in fruit crops as successive herbicides have been introduced to control most other weeds and cultivation as a method of weed control has been abandoned. Previously, competition from other weeds and frequent disturbance of its roots kept it in check. The latter, together with crop competition, still prevents bindweed becoming a major problem in arable land. It is, however, a nuisance in fruit crops because it climbs over bushes and trees and, apart from any direct effect on growth or yield, it has serious indirect effects. The time taken for pruning and picking is increased and fruit that is not easily seen often remains unpicked. Quality is also affected; for instance, apples that are shaded do not develop their full colour and are consequently down-graded.

BIOLOGICAL FEATURES

When considering the biological features which contribute to the success of bindweed it is interesting to compare them with those of that other serious perennial weed, couchgrass. Thus, while most couchgrass rhizomes occur in the top 15 cm of the soil, bindweed is notorious for the depths to which its roots penetrate. They have been found 23 feet (7 m) down (Salisbury 1961). We have not made observations to that depth at Begbroke but, in the top 30 cm of soil, we have found up to 5 tonnes of roots per hectare and a further 1.8 tonnes/ha in the 30-60 cm layer. We do not know how much there is below 60 cm. Another difference between couchgrass and bindweed is in their regenerative capacity in the field. Most small fragments of couchgrass rhizome develop into independent plants. This is not so with bindweed roots. Although almost any piece of root produces buds that develop into shoots the majority perish because they never

Bindweed climbs over fruit bushes, interferes with picking and pruning and affects the yield and quality of fruit. It has thrived as other weeds have been controlled with herbicides.

produce new roots. The regrowth that occurs after cultivations comes from undisturbed root systems.

Under favourable conditions, a bindweed plant can spread 3 m in a year. This is achieved by successive roots growing horizontally for 50 to 150 cm before turning down. Approximately 70 per cent of these spreading roots occur in the top 15 cm and none are found deeper than 30 cm (Davison 1970). Because of the shallow depth at which the new roots occur, and their poor survival when fragmented, cultivation is an effective means of preventing spread.

In the more competitive fruit crops such as blackcurrant, bindweed spreads slowly even in the absence of cultivation. This was demonstrated in an experiment at Begbroke, where bindweed planted into rows of blackcurrants only thrived at the ends of the crop rows.

Bindweed produces viable seed and seedlings are sometimes seen in fruit crops, but there is no evidence that they are a source of new infestations.

CHEMICAL CONTROL

The choice of a suitable herbicide is largely determined by its safety to the crop, but the grower also needs to know how effective the different herbicides are against bindweed. Work at WRO has helped to clarify the relative merits of the growth-regulator herbicides such as 2,4-D and MCPA and the soil-acting benzonitriles, chlorthiamid and dichlobenil.

Growth regulators

Most of the growth-regulator herbicides that are used to control broadleaved weeds in cereals and grassland also control the top-growth of field bindweed in the year of treatment. Recent WRO experiments showed that 2,4-D-amine, MCPA-salt and 2,4,5-T-amine, applied at 2.5 kg/ha, were all equally effective and also gave about 90 per cent control in the year after treatment. June was the best month for treatment although there was only slightly more regrowth from May applications. Recovery from July applications was variable.

When the amount of 2,4-D or MCPA was reduced to 1.25 kg/ha there was hardly any reduction in regrowth in the year after treatment, even though this amount killed the shoots in the year of treatment.

Other WRO experiments have also shown the benefit of increasing the amount applied beyond that required just to kill the shoots in the year of treatment. Increasing the amount of 2,4-D, MCPA, MCPB, dichloprop and mecoprop from 2 to 8 kg/ha, and of dicamba from 0.25 to 2.0 kg/ha, all improved the degree of control in the year after treatment. Of these six herbicides, 2,4-D, MCPA and MCPB were the most effective at the rates of application normally recommended.

The improved control we have achieved with high rates of application of growth-regulator herbicides contradicts the widely held belief that high rates result in rapid leaf kill which prevents adequate translocation of herbicide to the roots. In an experiment started in 1973 we have applied 2,4-D at rates up to 27 kg/ha. We await the results on shoot growth in 1974 with interest, but we already know that increasing the rate from 1 to 3 kg/ha has increased the amount of root killed from 30 to 50 per cent. Increasing it further, from 3 to 27 kg/ha has not killed any more roots but neither has it killed any less, again confirming that relatively high doses of growth-regulator herbicides do not reduce the degree of control.

Soil-applied herbicides

Of the many soil-acting herbicides used by fruit growers only chlorthiamid and dichlobenil are effective against bindweed. In WRO experiments on a variety of soils both have given consistently good results when applied at 10 kg/ha.

The manufacturers recommend application in February or March before the bindweed emerges. However, it is often more convenient for growers to apply these herbicides after the bindweed has emerged. This enables treatment to be confined to affected areas, an advantage with expensive herbicides like these. In both wet and dry years we have had good results at WRO with applications as late as mid-May. Doubling the rate of application, whether in March or in May, extends the period of control by one month. Of the two factors, date and rate of application, the latter has most effect on the control of bindweed.

THE SAFETY OF EFFECTIVE TREATMENTS

Fruit growers want to control weeds for a variety of reasons, but ultimately their objective is increased productivity. Ideally, therefore, a herbicide treatment should have no adverse effect on the crop, even when applied in the absence of the problem weed. But in practice it is enough that the effect of removing the weed outweighs any adverse effect of the treatment on the crop and there are occasions when a short-term adverse effect on the crop is acceptable if it leads to long-term benefit.

Growth-regulator herbicides

The translocated growth-regulator herbicides that are so effective in controlling bindweed can damage fruit crops either by foliage or root uptake. Foliage uptake can arise either by drift or by accident when making a directed application. Drift, whether it arises within the crop or from neighbouring fields, can be overcome by choosing the correct time and method of application. It is more difficult to avoid accidental contact with the crop when applying a 'directed' treatment and, after the treatment is applied, the grower has very little control over the factors influencing root uptake. The relative importance of these hazards has been investigated at WRO.

The work of Clay and Ivens (1968) showed that accidental application to several varieties of apples and pears was unlikely to have serious consequences. They applied several herbicides to individual shoots of each variety at the rate needed for weed control. Although the treated shoots were severely damaged or killed there was no damage to other shoots except in pears and in the apple variety Bramley Seedling. In both Conference and Williams' Bon Chretien pears, 2,4-D and 2,4-DB caused dormancy and abnormal leaves in untreated shoots. The other herbicides, MCPA, MCPB and mecoprop, only affected the treated shoots. In Bramley Seedling apple, 2,4-D, MCPA and 2,4,5-T all induced dormancy in untreated shoots. The symptoms were most severe with 2,4-D which was the only herbicide to produce abnormal leaves.

Later work by Davison and Clay (1970) showed that amounts of 2,4-D-amine, MCPA-salt and 2,4,5-T-amine greatly in excess of those needed for weed control had no adverse effect on the growth and yield of young apple trees when applied to the base of the trunk or to the surrounding soil. Extensive commercial usage has confirmed the safety of these treatments. However, in both experiments and commercial usage, there has been damage to pears from treatments that are safe in apples. The damage occurs as dieback of shoots, dormancy of buds, the production of abnormal leaves and flowers and, in severe cases, a reduction in yield. Sometimes the symptoms do not appear until the summer after treatment and they may persist for more than one year. The damage is caused either by entry of the herbicide through the base of the trunk or through the roots. The conditions leading to damage are not fully understood although variety, herbicide and soil type seem to be the most important factors (Davison 1973). For instance, 2,4-D is much more damaging than either MCPA or 2,4,5-T. Timing of application and soil moisture are less important.

Because of the difficulty of avoiding blackcurrant and gooseberry bushes with 'directed' sprays, the use of growth regulator herbicides is at present confined to MCPB which can be applied as an overall spray when growth has stopped. Bindweed control would be improved if MCPB could be applied earlier but growers sometimes delay spraying until September. Our experiments showed that delaying spraying even as late as August severely reduced bindweed control in the following year. This has led us to try earlier applications. We have had promising results with overall applications of MCPB to gooseberries immediately after harvest, despite severe leaf damage in the year of treatment.

At WRO, sprays of MCPB deliberately applied to the soil around blackcurrants from April onwards, at rates in excess of those needed for weed control, have not caused any damage. Even when the lower branches were sprayed, the damage was confined to those branches. These results are encouraging and if confirmed in further experiments should be of great practical value in enabling growers to apply directed sprays to the bindweed between bushes before the crop is harvested.

Soil-applied herbicides

Chlorthiamid and dichlobenil are liable to produce marginal leaf chlorosis of fruit crops. However, in our experiments with blackcurrants and gooseberries, even when chlorosis has occurred, there has been an adequate safety margin at the rates of application needed for adequate bindweed control.

PRACTICAL CONSIDERATIONS

Organizations like the WRO can play an important role in providing the basic information on weed susceptibility and crop tolerance which will enable growers to exploit the available herbicides more fully. When there is insufficient information on which to base a recommendation or when it is known that a treatment is likely to damage the crop, 'spot treatments' offer a greater margin of safety. Why risk an entire crop if only ten per cent is affected with a particular weed?

The ultimate objective is to reduce bindweed to a level at which it does not interfere with the crop, but often it is expedient to concentrate on short-term control. For instance, a single application of MCPB or 2,4-D is more effective in reducing the amount of bindweed roots than a single application of chlorthiamid. However, when faced with the problems of bindweed interfering with the harvesting of blackcurrants or gooseberries, it is better to apply chlorthiamid or dichlobenil because they are effective in the year of treatment.

In top-fruit, unless there is some other good reason for using chlorthiamid or dichlobenil, it is better to use a growth-regulator herbicide. Apart from having a greater effect on the bindweed roots, it ensures control at the most critical period for these crops—namely late summer and autumn. If soil-acting treatments are used they tend to break down too soon to prevent the bindweed becoming a problem, but too late to apply a growth-regulator herbicide.

Treatments that are effective against bindweed may not control other weeds which may then become a problem. The grower must find a compromise that gives satisfactory overall weed control. It is fortunate that the shoots of bindweed can easily be killed with most of the growth-regulator herbicides used in fruit. In orchards, for instance, it is better to use mecoprop than 2,4-D if *Galium aparine* (cleavers) is present. If *Cirsium arvense* (creeping thistle) is present, 2,4-D should be applied before it becomes too tall to spray overall beneath the trees, even though this may be earlier than the best time for controlling bindweed.

CONCLUSION

Field bindweed can be controlled with the herbicides already available, though complete elimination is very difficult to achieve. Increasing the current recommended rates of application of growth-regulator herbicide offers the greatest promise for improved long-term control. The information on crop response to herbicides demonstrates an adequate margin of safety in most fruit crops with the herbicides needed to control bindweed.

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LIST OF RESEARCH PROJECTS
1972-73

WEED SCIENCE DEPARTMENT

Head of Department: K. Holly

HERBICIDE EVALUATION SECTION (Joint Heads: K. Holly, J. Holroyd)

1. Biological activity, selectivity and soil persistence of new herbicides: K. Holly, W. G. Richardson.
2. New herbicide treatments for the control of annual grass weeds of arable land: J. Holroyd, M. E. Thornton.
3. New herbicide treatments for the control of perennial grass weeds of arable land: J. Holroyd, A. M. Blair.
4. New herbicide treatments for the control of weed grasses in grassland and sown forage grasses: J. Holroyd, A. M. Blair.
5. New herbicide treatments for the control of bracken: J. Holroyd, M. E. Thornton.
6. Effect of high organic matter soils on use of herbicides: J. Holroyd, M. J. May.
7. Herbicides, alone and with additives, for the control of woody species: D. J. Turner, M. Loader.
8. Improved techniques for the application of herbicides: K. Holly, W. A. Taylor (Joint project with National Institute of Agricultural Engineering).
9. Environmental factors and the activity of herbicides: J. C. Caseley.
10. Improved equipment and techniques for monitoring the environment; set up controlled environment systems: J. C. Caseley, R. C. Simmons.
11. Environmental factors and the activity of growth regulators: J. C. Caseley.

CHEMISTRY SECTION (Head: R. J. Hance)

1. Analyses of herbicides in soil, water and plant material: C. E. McKone, T. H. Byast.
2. Improved analytical methods for herbicides and their decomposition products: R. J. Hance, T. H. Byast.
3. Effect of herbicides on soil and crop quality: R. J. Hance, T. H. Byast.
4. Criteria by which the ability of a soil to decompose herbicides may be predicted: R. J. Hance, T. H. Byast.
5. Herbicide sorption by soil: R. J. Hance.
6. Behaviour of volatile herbicides: R. J. Hance, C. E. McKone.

MICROBIOLOGY SECTION (Head: E. Grossbard)

1. Effect of herbicides and breakdown products upon microbial activity of soil: E. Grossbard, J. A. P. Marsh.
2. Effect of herbicides and breakdown products upon microbial populations and species composition in the soil: E. Grossbard, G. I. Wingfield.
3. Improved techniques to measure microbial activity in the soil and the influence of herbicides thereon: E. Grossbard, G. I. Wingfield.
4. Effect of herbicides on the decay of plant material: E. Grossbard, G. I. Wingfield.

BOTANY SECTION (Head: R. J. Chancellor)

1. Periodicity of germination of weed seeds. Chemicals for breaking seed dormany: R. J. Chancellor, N. C. B. Peters.
2. Shoot development from rhizomes of couch grass. Effect of growth regulators on dormancy of rhizome buds: R. J. Chancellor.
3. Regeneration of plants from fragments of root systems: R. J. Chancellor.

4. Interaction of factors affecting competition between crops and weeds: R. J. Chancellor, N. C. B. Peters.
5. Surveys of the occurrence, species composition, and density of arable weed populations: R. J. Chancellor.

WEED CONTROL DEPARTMENT

Head of Department: J. G. Elliott

AGRONOMY SECTION (Head: J. G. Elliott)

1. Growth and control of couch (*Agropyron repens*) and *Agrostis gigantea* in cereal cropping systems: G. W. Cussans, P. Smith.
2. Effect of changes in tillage systems on the growth and control of weeds in cereals: G. W. Cussans, P. Smith.
3. Agronomic aspects of the wild oat (*Avena* spp.) problem: B. J. Wilson, G. W. Cussans.
4. Production of cereals by reduced cultivation: J. G. Elliott, F. Pollard (Joint project with ARC Letcombe Laboratory and ADAS).
5. Survey and analysis information about weeds and weed control in agriculture: A. Phillipson.
6. Selective control of mono- and dicotyledonous weeds in pasture: R. J. Haggar, A. K. Oswald.
7. Herbicides for the destruction of swards prior to surface re-seeding: A. K. Oswald.
8. Systems of reduced cultivation for the successful establishment of grass and fodder crops: J. G. Elliott, R. J. Haggar, N. Squires.
9. Competition between cultivated grasses and weed grasses: R. J. Haggar.
10. Tolerance of cereals to herbicides: J. G. Elliott, D. R. Tottman.
11. Control of potato ground keepers: G. W. Cussans, P. J. Lutman.

HORTICULTURE SECTION (Head: J. G. Davison)

1. Effect of important weeds on fruit production: J. G. Davison.
2. New methods of controlling important weeds in fruit crops: J. G. Davison.
3. Persistence of herbicides in the soil: D. V. Clay, J. G. Davison.
4. Inherent tolerance of fruit crops to herbicides: D. V. Clay.
5. Field resistance of crops to herbicides: J. G. Davison, D. V. Clay.

AQUATIC WEED SECTION (Head: T. O. Robson)

1. Methods for the control of emergent weeds: T. O. Robson, P. R. F. Barrett.
2. Chemical methods of controlling submerged and floating vascular plants and algae: T. O. Robson.
3. Potential of grass carp for the control of aquatic weeds: T. O. Robson, P. R. F. Barrett.

LONG TERM PROJECT (Head: J. D. Fryer)

1. Influence of repeated applications of MCPA, tri-allate, simazine and linuron on 'fertility' of soil at Begbroke Hill: J. D. Fryer, J. Ludwig.
2. Persistence in Begbroke Hill soil of paraquat applied repeatedly to vegetation cover or bare soil: J. D. Fryer, J. Ludwig.
3. Persistence in Begbroke Hill soil of picloram applied annually: J. D. Fryer, J. Ludwig.
4. Effect of high rates of application upon the rate of decomposition of simazine and linuron: J. D. Fryer, J. Ludwig.

OVERSEAS SECTION (Head: C. Parker)

1. New herbicide treatments for use in tropical crops for control of *Cyperus rotundus* and *Imperata cylindrica*: C. Parker, M. L. Dean.

2. Growth and development of *Cyperus rotundus* with particular reference to regulation of tuber bud dormancy: M. L. Dean, C. Parker.
3. Studies on the biology and control of parasitic weeds (*Striga* spp., *Orobanche* spp.): C. Parker.
4. Biology and control of *Imperata cylindrica* and *Eupatorium odoratum* in Nigeria: G. Ivens.
5. Biology and control of weeds of East Africa, with emphasis on *Cyperus* spp.: P. J. Terry.

JOINT RESEARCH PROJECTS OF THE ARC LETCOMBE LABORATORY AND THE WEED RESEARCH ORGANIZATION

To facilitate liaison on joint projects between the two institutes, other institutes and ADAS, responsibility for planning each project is vested in a Co-ordinating Committee while a Project Group is responsible for the execution of research.

JOINT CEREALS TILLAGE PROJECT

Co-ordinating Committee

Chairman:	R. Scott Russell	(Letcombe)
Secretary:	J. G. Elliott	(WRO)
Members:	R. A. Cannell	(Letcombe)
	F. B. Ellis	(Letcombe)
	J. D. Fryer	(WRO)
	J. Holroyd	(WRO)

Project Group

Leaders:	J. G. Elliott (convenor)	(WRO)
	R. A. Cannell	(Letcombe)
Members:	F. B. Ellis	(Letcombe)
	F. Pollard	(WRO)

JOINT HERBICIDE PROJECT

Co-ordinating Committee

Chairman:	J. D. Fryer	(WRO)
Secretary:	E. R. Mercer	(Letcombe)
Members:	R. J. Hance	(WRO)
	K. Holly	(WRO)
	R. Scott Russell	(Letcombe)
	M. G. T. Shone	(Letcombe)

Project Group

Leaders:	K. Holly (convenor)	(WRO)
	E. R. Mercer	(Letcombe)
Members:	J. Caseley	(WRO)
	R. J. Hance	(WRO)
	J. Holroyd	(WRO)
	M. G. T. Shone	(Letcombe)

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42. Selected references to the effect of paraquat and diquat on tuber rot in potatoes, 1965-1970 (8 references), price UK and overseas surface mail £0.30, overseas airmail £0.37.
43. Selected references to the biology and control of wild oats (*Avena fatua* and *Avena ludoviciana*), 1940-1959, (298 references), price UK and overseas surface mail £5.25, overseas airmail £6.60.
44. Selected references to the biology and control of wild oats (*Avena fatua* and *Avena ludoviciana*), 1960-1972, (742 references), price UK and overseas surface mail £3.75, overseas airmail £4.64.
45. Selected references to the biology and control of *Digitaria scalarum*, 1952-1972, (65 references), price UK and overseas surface mail £0.60, overseas airmail £0.80.
46. Selected references to the selection and breeding of cereal and other crop varieties for increased tolerance of herbicides, 1953-1972, (30 references), price UK and overseas surface mail £0.35, overseas airmail £0.57.
47. Selected references to the biology and control of *Juncus effusus* and *Juncus inflexus*, 1957-1971, (40 references), price UK and overseas surface mail £0.35, overseas airmail £0.50.
48. Selected references to the biology and control of *Senecio jacobaea*, 1962-1972, (63 references), price UK and overseas surface mail £0.45, overseas airmail £0.70.
49. Selected references to the biology and control of *Orobanche* spp., 1970-1972: a supplement to Annotated Bibliography No. 23, 1964-1970; (81 references), price UK and overseas surface mail £0.60, overseas airmail £0.80.
50. Selected references to the biology and control of *Striga hermontheca* and other *Striga* species: a supplement to Annotated Bibliography No. 17, 1966-1973, (53 references), price UK and overseas surface mail £0.40, overseas airmail £0.60.
51. Selected references to the biology and control of *Cuscuta* spp., 1967-1972, (75 references), price UK and overseas surface mail £0.45, overseas airmail £0.70.
52. Selected references to chemical weed control in tea, 1966-1972, (60 references), price UK and overseas surface mail £0.35, overseas airmail £0.60.
53. Selected references to the biology and control of *Sorghum halepense*, 1968-1972, (51 references), price UK and overseas surface mail £0.40, overseas airmail £0.60.
54. Selected references to the biology and control of Scotch broom *Sarothamnus* (=*Cytisus*) *scoparius*, 1954-1971, (53 references), price UK and overseas surface mail £0.35, overseas airmail £0.60.
55. Selected references to national statistics on the production and consumption of herbicides and the economics of weed control, 1963-1973, (89 references), price UK and overseas surface mail £0.50, overseas airmail £0.70.
56. Selected references to the uptake, metabolism and tolerance of atrazine by maize, 1960-1972, (51 references), price UK and overseas surface mail £0.35, overseas airmail £0.55.
57. Selected references to the establishment of cereals, grass and fodder crops by minimum cultivation, 1966-1972, (113 references), price UK and overseas surface mail £0.60, overseas airmail £0.80.
58. Selected references to the effects of some common triazine herbicides on microbial activities and populations, 1951-1972, (192 references), price UK and overseas surface mail £1.25, overseas airmail £1.50.
59. Selected references to the effects of some common phenoxyacetic acid herbicides on microbial activities and populations, 1940-1972, (187 references), price UK and overseas surface mail £1.25, overseas airmail £1.50.

*Obtainable, together with complete list, from WRO Information Department.

60. Selected references to the effects of some common carbamate herbicides on microbial activities and populations, 1948-1972, (61 references), price UK and overseas surface mail £0.55, overseas airmail £0.75.
61. Selected references to the effects of some common substituted urea herbicides on microbial activities and populations, 1952-1972, (107 references). price UK and overseas surface mail £0.80, overseas airmail £1.00.
62. Selected references to the effects of some common benzonitrile herbicides on microbial activities and populations, 1964-1971, (10 references), price UK and overseas surface mail £0.30, overseas airmail £0.40.
63. Selected references to the effects of some common quaternary ammonium herbicides on microbial activities and populations, 1965-1972, (32 references), price UK and overseas surface mail £0.35, overseas airmail £0.55.
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65. A review of the literature on the distribution, characteristics and control of *Sorghum halepense* (L.) *Pers.* in temperate crops, 1961-1970, price UK and overseas surface mail 0.55, overseas airmail £0.80.

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R. J. Dale	Farm Manager	Begbroke Hill Farm	22.5.72
A. G. Strickland	HSO	Annual Crops	5.6.72
D. Coupland	SO	Herbicide	1.9.72
Mrs. H. R. Broad	HSO (P/T)	Information	4.9.72
P. J. W. Lutman	HSO	Annual Crops	21.11.72
P. Ayres *(on internal promotion)*	SO	Annual Crops	1.2.73
J. A. Bailey *(on internal promotion)*	SO	Perennial Crops	1.3.73
Miss N. Kiley	HSO	Information	1.10.73
Mrs. B. Ellis	SO	Information	3.9.73
Miss G. F. Kempson-Jones	SSO	Chemistry	8.10.73

RESIGNATIONS

F. Barnes	Farm Manager	Begbroke Hill Farm	28.4.72
Miss E. M. Watson	SO	Information	31.1.73
L. Kasasian	PSO	Tropical Weeds	20.4.73
J. W. Ludwig	SSO	Long Term Project	20.4.73
M. Latham	SO	Information	18.5.73

STAFF VISITS OVERSEAS

Overseas visits have been undertaken by members of staff in the period covered by this report as follows:—

January 1972	J. D. Fryer	Philippines & Indonesia on behalf of US National Academy of Sciences.
	L. Kasasian	Malta to assess experiments laid down in previous autumn on behalf of ODA.
February 1972	C. Parker	USA to attend Weed Science Society of America, Monsanto Chemical Co. and Purdue University on behalf of ODA and sponsored in part by Monsanto.
	L. Kasasian	Netherlands to co-ordinate WRO/IBS assistance to BIOTROP weed science training course on behalf of ODA.
	R. J. Hance	Philippines to visit International Rice Research Institute on behalf of US National Academy of Sciences.
March—July 1972	L. Kasasian	Indonesia and British Solomon Islands Protectorate to advise and carry out field trials and to assist with BIOTROP course on behalf of ODA.
May 1972	C. Parker	Nigeria, Kenya, Uganda, Tanzania and Ethiopia to advise on weed control problems and to see current work on behalf of ODA.
	R. J. Hance	Netherlands to visit IBS Wageningen.
	T. O. Robson	India, Thailand and Indonesia to lecture to BIOTROP weed science course on behalf of ODA.

une 1972	J. D. Fryer	Bulgaria for the EWRC summer meeting sponsored in part by the British Crop Protection Council.
	R. J. Haggar J. E. Y. Hardcastle J. Holroyd and R. J. Hance	Germany to visit Bayer, Leverkusen, sponsored by Bayer.
	G. W. Cussans and J. G. Elliott	Netherlands and Germany to discuss weed and tillage research.
July 1972	M. E. Thornton	Czechoslovakia to attend international conference on the mechanisation of field experiments.
August	E. Grossbard	Sweden to attend IBP symposium on modern methods in the study of microbial ecology.
November 1972	J. C. Caseley	Ceylon, Indonesia to advise on research programme for BIOTROP in weed control.
December 1972	J. Holroyd	Canada to Nth Central Weed Cont. Conf. and USA, sponsored by Croptex Ltd.
December 1972	R. J. Hance	France to attend EWRC programme committee on behalf of EWRC.
January 1973	J. D. Fryer	USA on behalf of the US National Academy of Sciences.
February 1973	C. Parker	Saudia Arabia and Sultanate of Oman to advise on behalf of ODA.
February 1973	J. D. Fryer	Netherlands for an executive committee of EWRC.
March 1973	J. D. Fryer	USA on behalf of the US National Academy of Sciences.
April 1973	J. D. Fryer	Belgium to attend meeting on soil physics, soil-plant relations and reduced tillage organised by Biology Division of EEC.
	L. Kasasian P. J. Kemp C. Parker	Malta to attend EWRC parasitic weeds. symposium sponsored by ODA and EWRC.
May 1973	J. D. Fryer	Belgium to attend international symposium on crop protection.
	R. J. Hance	Belgium to attend the same symposium on behalf of EWRC.
June & July 1973	J. D. Fryer	USA on behalf of the US National Academy of Sciences.
July 1973	P. J. W. Lutman	Netherlands to discuss experiments on volunteer potatoes on behalf of Potato Marketing Board.
September 1973	J. D. Fryer	Poland to attend EWRC summer meeting and international symposium on herbicide/soil/plant interactions sponsored in part by British Crop Protection Council.
	E. Grossbard	Poland to attend international symposium on herbicide/soil/plant interactions sponsored in part by Polish Academy of Science.
	R. J. Chancellor	France to attend international symposium on weed biology and ecology.
	T. O. Robson	France to attend symposium on behalf of European & Mediterranean Plant Protection Organisation.

November 1973	J. D. Fryer	USA on behalf of US National Academy of Sciences.
December 1973	J. D. Fryer R. J. Hance	France to attend EWRC symposium on herbicides and the soil, Mr. Fryer's attendance sponsored in part by British Crop Protection Council.
	T. O. Robson	India to attend UNESCO/International Hydrological Decade seminar on noxious aquatic plants on behalf of UNESCO.
For 2 years until October 1973	G. W. Ivens	Nigeria conducting a weed control project on behalf of ODA.
Since December 1971	P. J. Terry	Tanzania conducting a three year herbicide research project on behalf of ODA.

STAFF COMMITTEE SERVICE

Members of WRO have served on the following committees:

ADAS/WRO Liaison Group

ARC Ad hoc Consultative Committee on Incorporation of Granules into Soil
- Fruit Weed Control Group
- Saxcil Cabinet Users Group
- Working Party on Direct Drilling and Reduced Cultivation

British Crop Protection Council (BCPC)
- Annual Review of Herbicide Usage
- Conference Organizing Committee
- Containers Disposal Sub Committee
- Herbicides in British Fruit Growing Symposium
- Pesticides Application Committee
- Programme Committee (Weeds)
- Programme Policy Committee
- Recommendations Committee (Weeds)
- ULV Symposium Organising Committee
- Working Party on influence of EEC

British Grassland Society
- Executive Committee
- Programme Committee
- Publications Committee

British Standards Institution Technical Committee PCC/1

CAIN Tapes Project Advisory Committee

COLUMA Groupe d'etudes Sur les residues d'herbicides daus le sol

European Weed Research Council (EWRC)
- Education Committee
- Finance Committee
- Aquatic Weeds Research Group
- Annual Grass Weeds Research Group
- Parasitic Weeds Research Group
- Scientific Committee for Symposium 'Herbicides-Soil'

International Association of Mechanisation of Field Experiments
- Herbicide Application Equipment Committee

IUPAC 3rd International Congress of Pesticide Chemistry

Ministry of Agriculture, Fisheries and Food
- Agricultural Chemical Approval Scheme Science Advisory Committee
- National Advisory Campaign on Wild Oat
  - Steering Committee
  - Executive Group
- Pesticides Analysis Advisory Committee
  - GLC Panel
  - Compatability Panel
  - Formulation Panel

National Institute of Agricultural Engineering Consultative Group on Tillage Experiments

National Institute of Agricultural Botany Herbage Trials Advisory Committee
- Working Party on Persistence
- Working Group on Herbage Seed (Weed Control)

Oxford Farming Conference Committee

Overseas Development Administration (ODA) PANS Policy Committee

Rothamsted Statistics Department Remote Access Users Committee

Society of Chemical Industry
- Physicochemical and Biophysical Panel Committee

University of Reading Plant Sciences Joint Committee

Weed Research: Editorial Board

RESEARCH WORKERS VISITING WRO

Research workers and trainees to whom it has been a pleasure to offer the facilities of WRO during 1972-73 have included J. D. Banting from Regina Research Station, Saskatchewan, Canada (on a year's sabbatic leave), P. Catizone from the Institute of Agronomy, University of Bologna, Italy (for 6 months), Richardo Labrada from Central Laboratory for Plant Protection, Havana, Cuba (FAO Scholarship for 3 months), J. W. Ostrowski from the Institute for Organic Industrial Chemistry, Warsaw, Poland (FAO Scholarship for 9 months), R. K. Pandey from the Central Grassland and Fodder Crops Research Institute, Jhansi, India (Colombo Plan for 6 months), Umporn Suwunnamek from the Department of Plant Science, Kasetsart University, Bangkok, Thailand (Colombo Plan for 12 months and now continuing with PhD work at Brunel University), D. G. Swan from the Department of Agronomy and Soils, Washington State University, Pullman, USA (on a year's sabbatic leave), and P. G. Todorov from the Institute of Botany, Sofia, Bulgaria (FAO Fellowship for 3 weeks).

Higher degree students of various Universities conducting experimental work at WRO under joint supervision have included Miss L. M. Boize (physical characteristics of sprays in relation to selective phytotoxicity; Leeds University, CAPS award in conjunction with BP Ltd), R. R. B. Leakey (dormancy and dominance of buds and shoots of *Agropyron repens*; Reading University), and G. J. Wells (ecology of *Poa annua* in perennial ryegrass; Reading University).

In addition, ten 'sandwich' students have conducted short term research projects in various sections in fulfillment of the industrial training portion of their degree course.

GLOSSARY OF CHEMICALS MENTIONED IN THIS REPORT

An asterisk (*) signifies a common name approved by the British Standards Institution.

AC 84777	1,2-dimethyl-3,5-diphenylpyrazolium methyl sulphate
aminotriazole*	3-amino-1,2,4-triazole
asulam*	methyl(4-aminobenzenesulphonyl)carbamate
atrazine*	2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine
barban*	4-chlorobut-2-ynyl *N*-(3-chlorophenyl) carbamate
carbetamide*	D-*N*-ethyl-2-(phenylcarbamoyloxy)propionamide
chlorthiamid*	2,6-dichlorothiobenzamide
2,4-D*	2,4-dichlorophenoxyacetic acid
dalapon*	2,2-dichloropropionic acid
dichlobenil*	2,6-dichlorobenzonitrile
dichlorprop*	(±)2-(2,4-dichlorophenoxy)propionic acid
glyphosate*	*N*-(phosphonomethyl)glycine
linuron*	*N*'(3,4-dichlorphenyl)-N-methoxy-*N*-methylurea
MCPA*	4-chloro-2-methylphenoxyacetic acid
mecoprop*	(±)2-(4-chloro-2-methylphenoxy)propionic acid
methabenzthiazuron*	*N*-(benzothiazol-2-yl)-*NN*'-dimethylurea
paraquat*	1,1'-dimethyl-4,4'-bipyridylium
picloram*	4-amino-3,5,6-trichloropicolinic acid
pyrazone*	5-amino-4-chloro-2-phenylpryidazin-3(2H)-one
2,4,5-T*	2,4,5-trichlorophenoxyacetic acid
TCA*	trichloroacetic acid
terbacil	5-chloro-6-methyl-3-*tert*-butyluracil
tertutryne*	4-ethylamino-2-methylthio-6-*tert*-butylamino-1,3,5-triazine
tri-allate*	*S*-2,3,3-trichloroallyl *NN*-di-isopropyl(thiocarbamate)

PRINCIPLES GOVERNING ACCEPTANCE OF NEW HERBICIDES FOR EVALUATION BY THE WEED RESEARCH ORGANIZATION

The Weed Research Organization welcomes offers of new herbicides and growth regulators under development by the agricultural chemical industry for possible inclusion in its own research programmes. WRO is not, however, under any obligation to accept chemicals from other organizations or commercial firms for evaluation purposes.

Chemicals will only be accepted if the following conditions are agreed to (information to be provided, if necessary, in confidence):

(a) Composition of chemical and details of concentration and type of formulation must be stated.

(b) The suppliers must agree to provide the information, as far as it is available, asked for in a standard questionnaire covering physical and chemical properties, toxicology and phytotoxic properties.

(c) The suppliers must have carried out adequate preliminary tests that indicate the chemical has herbicidal or growth regulatory properties.

(d) There must be a reasonable prospect of the herbicide being developed commercially if promising uses are found.

(e) The suppliers must agree to comply with the terms of the British Pesticides Safety Precautions Scheme and to keep WRO fully informed of their action, where relevant.

(f) The suppliers must be agreeable to a two-way interchange of information between themselves and WRO during the period of development of the herbicide and to giving prior information concerning the nature of their future development programme.

Acceptance of a herbicide by WRO does not imply any obligation on the part of the Organization to carry out work on the herbicide or to report the results of any work that may be carried out.

WRO retains the right to publish the results of its work on publicly disclosed compounds without consulting the suppliers. In the case of herbicides disclosed confidentially, some indication of the period for which confidential status is requested must be given. Material cannot be withheld from publication indefinitely, though WRO will always try to be co-operative in relation to specific patent situations.

Any information given by WRO to the suppliers must not be reproduced in published documents without specific permission and in no circumstances must it be used in advertising.

INSTITUTES FOR AGRICULTURAL RESEARCH IN GREAT BRITAIN

The research programmes of all the following research Institutes, supported from public funds, are co-ordinated by the Agricultural Research Council. Most of them publish reports annually and details can be obtained from the Secretaries of the Institutes concerned.

ARC Institutes

Animal Breeding Research Organization	West Mains Road, Edinburgh, EH9 3JQ
Food Research Institute	Colney Lane, Norwich, NOR 70F
Institute of Animal Physiology	Babraham, Cambridge, CB2 4AT
Institute for Research on Animal Diseases	Compton, Newbury, Berks.
Letcombe Laboratory	Letcombe Regis, Wantage, Berks, OX12 9JT
Meat Research Institute	Langford, Bristol, BS18 7DY
Poultry Research Centre	King's Buildings, West Mains Road, Edinburgh, EH9 3JS
Weed Research Organization	Begbroke Hill, Sandy Lane, Yarnton, Oxford, OX5 1PF

State-aided Institutes in England and Wales

Animal Virus Research Institute	Pirbright, Woking, Surrey
East Malling Research Station	East Malling, Maidstone, Kent, ME19 6BJ
Glasshouse Crops Research Institute	Worthing Road, Rustington, Little-hampton, Sussex
Grassland Research Institute	Hurley, Maidenhead, Berks, SL6 5LR
Houghton Poultry Research Station	Houghton, Huntingdon, PE17 2DA
John Innes Institute	Colney Lane, Norwich, NOR 70F
Long Ashton Research Station	Long Ashton, Bristol, BS18 9AF
National Institute of Agricultural Engineering	Wrest Park, Silsoe, Bedford, MK45 4HS
National Institute for Research in Dairying	Shinfield, Reading, RG2 9AT
National Vegetable Research Station	Wellesbourne, Warwick
Plant Breeding Institute	Maris Lane, Trumpington, Cambridge, CB2 2LQ
Rothamsted Experimental Station	Harpenden, Herts, AL5 2JQ
Welsh Plant Breeding Station	Plas Gogerddan, Aberystwyth, Cardiganshire, SY23 3EB
Wye College, Department of Hop Research	Ashford, Kent, TN25 5AH

State-aided Institutes in Scotland

Animal Diseases Research Association	Moredun Institute, 408 Gilmerton Road, Edinburgh, EH17 7JH
Hannah Research Institute	Ayr, Scotland, KA6 5HL
Hill Farming Research Organization	Bush Estate, Penicuik, Midlothian EH26 0PH
Macaulay Institute for Soil Research	Craigiebuckler, Aberdeen, AB9 2QJ
National Institute of Agricultural Engineering (Scottish Station)	Bush Estate, Penicuik, Midlothian EH26 0PH
Rowett Research Institute	Bucksburn, Aberdeen, AB2 9SB
Scottish Horticultural Research Institute	Invergowrie, Dundee, DD2 5DA
Scottish Plant Breeding Station	Pentlandfield, Roslin, Midlothian EH25 9RF

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