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with the degradation and, in one experiment, subsequent mineralization of the nitrogen was observed.

Addition of fertilizer did not affect nitrogen immobilization or mineralization responses to paraquat, but appeared to induce a cyclic production of $^{14}CO_2$ from the maize. This suggests sequential increases and decreases in the maize degradation.

Effects of herbicides on legumes in grass swards

Collaboration with the Grass and Fodder Crops Group (*WRO 9th Report*) on the effects of herbicides on sward composition has continued. The results of some 800 analyses each year, continue to indicate that the percentage nitrogen content of the total crop is increased by application of carbetamide and particularly propyzamide, every second or third year. This is primarily associated with grass. However, the increase in dry matter yield of clover results in a considerable increase in total nitrogen yield of the sward.

Deoxygenation of water following weed kill by herbicides

Investigations of water deoxygenation after weed treatment with terbutryne (*WRO 9th Report*) have continued. A laboratory simulation of the process using fermenters showed that increased water movement by stirring reduces the severity of deoxygenation. Effects of factors such as herbicide concentration and the species and biomass of the target weed were less predictable. It is unlikely that water deoxygenation can be predicted from a few simple measurements made in laboratory systems.

Phosphate removal from water by microorganisms colonizing straw

Observations by a drainage contractor that hay introduced into feeder streams of small lakes had reduced algal growth, prompted the Microbiology and Aquatic Weeds Groups to set up a detailed study of the process. Toxin production from the hay is a possible mechanism of limiting algal growth but nutrient immobilization by the hay microflora is a much more likely reason. As phosphorus is essential for algae, phosphorus immobilization is the most likely mechanism. In laboratory experiments phosphorus removal rates of up to 3 μg P g^{-1} dry wt. straw h^{-1} have been found. Laboratory studies, and a collaborative study with the Welsh Water Authority at Gludy Lake, Brecon, S Wales, have both shown that straw

encourages the proliferation of microorganisms and of invertebrates and fish, establishing a food chain which can immobilize phosphorus for substantial periods of time.

AQUATIC WEEDS AND UNCROPPED LAND GROUP

Research projects on aquatic weeds

A detailed report of the work on aquatic weeds is given in the topical article on p. 70 of this report.

Management of vegetation in rural amenity areas

The Countryside Commission-sponsored project on the feasibility of using chemicals in rural amenity areas, reported in the *WRO 9th Report*, was extended to the end of March 1983. Field trials on herbicides and growth retardants for sward management, and on chemicals for scrub control were completed.

The study showed that low doses of herbicides applied in autumn have potential for manipulating sward composition, though further work is required. Grass growth retardants, particularly mefluidide, will be useful to amenity land managers. Several techniques of chemical scrub control were successfully demonstrated. Slot-seeder introduction of wild-flowers was possible. Several of the techniques described may be useful for vegetation management in other situations, such as field margins and other areas on the farm.

Field and field margin floras

Following on from the Countryside Commission project, attention has turned to uncropped land on the farm, notably field margins. Studies which are now in progress include monitoring field and field margin floras on areas receiving different levels of pesticide input, studies of weed spread from hedgerows (both at Boxworth EHF) and a project on the susceptibilities of common hedgerow plants to chemicals.

WRO involvement with the MAFF Boxworth Project began with weed surveys and the provision of advice, made by the Annual Crops Group, and has been extended to include the field edge flora. The headlands and field margins have been surveyed and classified, and selected areas are being studied in more detail. The different pesticide regimes began in September 1983 and will continue to harvest in 1988.

The Perry Foundation are sponsoring a three-year project at WRO to work on the relative susceptibility of common hedgerow plants to

chemicals. The work began in November 1983; plants are being raised from seed for treatment with commonly used cereal herbicides. Chemicals which may have potential for managing field margins when applied directly will be examined at a later stage.

ENVIRONMENTAL STUDIES GROUP

During the autumn of '83 there was widespread damage to cereals following use of herbicides which had caused few problems in previous seasons. This apparent loss of selectivity has been widely attributed to the unusual pattern of weather during the late summer and autumn and strikingly illustrates the complexity of weather/plant/herbicide interactions. Furthermore it highlights the need for a continuing and strengthened research programme on this topic.

The Group have continued to refine the environment/herbicide performance profile concept and several more herbicides are under investigation (see below), and work on soil moisture is the subject of a topical article (p. 55). In the light of previous experience, attention has concentrated on weather conditions at the time of spraying and the short-term (48 h) and long-term (4–8 weeks) periods thereafter.

The profile studies enable the importance of individual factors to be ranked. The physiological and biochemical work seeks to explain the underlying reasons for changes in herbicide performance resulting from imposition of contrasting environmental factors. Furthermore the time course of progress of the chemical from the leaf surface to its site of action may be pinpointed allowing the duration of an environmental regime for satisfactory performance to be quantified. This is essential if the increasing accuracy of short-term weather forecasts are to be fully exploited. Consequently emphasis has been placed on quantifying the environment, the herbicide (including degradation products) and the plant response. In the case of photosynthetic inhibitor herbicides such as isoproturon, arrival at the site of action is now followed using infra-red gas analyser (IRGA) and fluorescence measurements which indicate phytotoxicity in advance of the development of visual symptoms. Auxanometers are to be used to follow effects of weather and herbicides on cell division and cell extension. Systems utilising IRGA, fluorescence measurements and auxanometers have been developed by the Group and all these devices are linked to dedicated minicomputers for ease of use and data handling.

A new fully automatic meteorological station has been installed which is linked by land line to the controlled environment laboratory where current meteorological conditions are displayed on a VDU and 24 h records of hourly means printed, while archive material is kept on floppy disks.

Glyphosate

The 'night spraying' concept proposed in the *WRO 9th Report* has received favourable comments in the farming press and farmer experience indicates that there are no major technical difficulties. Where 'day' and 'night' comparisons have been made in the same field they were equally effective.

When glyphosate was applied to couch-grass (*Elymus repens*) at the start or middle of a 12 h 'day' or 'night' period, there was equal reduction of node variability following fragmentation of the rhizomes after 12 h. In the case of plants treated at the start of the night period, washing the herbicide from the foliage after 6 h slightly reduced performance, while cutting off the foliage at this time led to a complete loss of phytotoxic action. These results indicate that glyphosate enters the foliage in the dark, but light is required for effective transport to the nodes.

Under warm, humid conditions as little as 2 h is sufficient for a lethal dose of glyphosate to penetrate the foliage of couch-grass, but under less favourable conditions this period may be extended to 8 h or more. We have made preliminary studies on the 'sticker' approach to reducing glyphosate vulnerability to rain. This employs water soluble synthetic or natural polymers which are tank mixed with the spray solution. In some circumstances, such as rain 2 h after spraying, these materials significantly improved glyphosate performance over that of unamended 'Roundup'. However, they are ineffective until the polymer matrix skin has formed at the air/spray deposit interface and some of these materials reduce glyphosate performance in the absence of rain.

Application in between the leaf sheath and the other stem tissues is at least five times more effective as application to the adaxial surface of the lamina, and was used as a method to study the influence of light, temperature and humidity on the translocation of glyphosate in couch. Increased light levels and temperature enhanced basipetal translocation, but increased humidity had no significant effect.

Once glyphosate has accumulated in the rhizome, high compared to low temperature leads to reduced phytotoxicity. Metabolism studies revealed that there was no build-up of any of the known intermediate metabolites of glyphosate at the high temperature (26/16°C), but there was more degradation of glyphosate to $^{14}CO_2$.

Fluazifop-butyl

During the 48 h following application of fluazifop-butyl to the foliage of greenhouse grown couch-grass plants, warm, humid conditions enhanced activity. This was assessed by fragmenting the rhizome and determining node viability. These results generally concur with ^{14}C fluazifop-butyl studies which show that entry into the leaf was greater at 90% RH than at 50% RH and uptake increased in the order 26°C > 16°V > 8°. There was no effect of light intensity (100 Wm^{-2} compared to 12 Wm^{-2}) over 48 h.

Low soil moisture depressed herbicide performance as did heavy rainfall (10 mm in 1 h) within one hour of spraying fluazifop-butyl. However, 2 mm h^{-1} did not affect fluazifop perfomance even when applied within 5–10 minutes of herbicide treatment.

A temperature regime of 10/6° compared to 26/10°C during the four weeks after spraying enhanced herbicide performance. Between 0.3 and 0.9 μg/node was required to kill single nodes grown on sterile agar.

Sethoxydim

The short term post-spraying profile for this herbicide is very similar to that of fluazifop-butyl. The long term study suggested that after two weeks plants in the 26/16°C regimes were controlled better than those at 10/6°C, but after four weeks there was no difference in performance between the two regimes. The response of single nodes grown on sterile agar indicates that between 0.3 and 0.9 μg/node is required for complete control.

Chlorsulfuron

In a pot experiment it was found, using *Sinapis alba* as a bioassay, that chlorsulfuron residues in soil were much lower in pots that contained wheat plants and that high temperature compared to low temperature favoured reduction of the chlorsulfuron residue with and without wheat.

AC 222293

This post-emergence herbicide is under development by American Cyanamid for control of wild-oat (*Avena* spp.) and black-grass (*Alopecurus myosuroides*) in cereals.

Foliage activity is predominant in wild-oat (*A. fatua*), while entry via the soil is more important in black-grass and following soil drench treatments performance fell as organic matter increased. AC 222293 is an ester which is metabolised in the plant to the phytotoxic parent acid. ^{14}C AC 222293

studies show that the ^{14}C-label is omni-mobile, but only a small quantity moves out of the treated leaf and reaches the apical meristem where the ^{14}C parent acid inhibits cell division and arrests growth. Biochemical studies show that DNA, RNA protein and cellulose synthesis are inhibited in declining order of severity. Mitosis in the apical meristem is arrested at interphase within 24 h of treatment and this correlates well with the inhibition of DNA synthesis.

Control of wild-oat was best with a 16/10°C temperature regime and declined at 26/16°C due to increased metabolism of the parent acid to non-phytotoxic derivatives over 7 days. In contrast black-grass was most susceptible to foliage treatments at 26/16°C but the reason for this is not clear. Despite enhanced uptake of the ^{14}C AC 222293 during the first day following treatment at high temperature, the amount of ^{14}C—parent acid in the meristem did not rise significantly above that found at other temperatures. Unlike many other foliage-applied herbicides, AC 222293 activity against wild oats was relatively unaffected by post-spraying humidities in the range 50 – 95% RH at 16/10°C (day/night), but black-grass was more susceptible to foliage treatments at high humidity.

One and 5.0 mm rain in 0.5 h applied 30 minutes after an overall herbicide treatment decreased activity against wild-oat but enhanced control of black-grass. Light intensity after spraying had little effect on performance.

In both pre- and post-emergence treatments, awned canary-grass (*Phalaris paradoxa*) was susceptible and common canary-grass (*P. minor*) moderately resistant to AC 222293. ^{14}C labelled AC 222293 studies showed that more than double the amount of herbicide penetrated the foliage and arrived at the apical meristem of awned canary-grass and degradation of the parent acid occurred more slowly in this species. When parent acid was deposited in the leaf sheath, awned canary-grass was four times more susceptible than common canary-grass.

In awned canary-grass, increasing the temperature from 11/6 to 26/16°C increased herbicide penetration into the foliage and subsequent phytotoxicity. Humidity had little effect on activity. Low light intensity and low soil water content both reduced activity.

Ioxynil

Raising the temperature after spraying increased the activity of the ioxynil ester applied to chickweed (*Stellaria media*). Humidity had little effect on the ester, but the salt was most phytotoxic at high relative humidity. The

phytotoxicity of the ioxynil ester was increased when the post-spraying light intensities were either low or high. Collaborative studies with the Biometrics Group revealed that the interaction of ioxynil and mecoprop applied to chickweed is synergistic at certain growth stages.

Isoproturon

Following both pre- and post-emergence application, common canary-grass was more susceptible than awned canary-grass and in both species more phytoxicity resulted from soil compared with foliar treatments. Soil activity was most effective at low compared to high temperatures, but the opposite was found for foliage treatments.

WEED BIOLOGY GROUP

Brome grasses

Research has been continuing into the biology of various weedy brome grasses including barren brome (*Bromus sterilis*), soft brome (*B. mollis*) and meadow brome (*B. commutatus*) and into the newly introduced crop species, rescue brome (*B. willdenowii*), a grass with high yielding potential, to see whether and how it differs from the weedy species.

Stimulation of germination of most weed seeds by light is dependent upon a proportion of the photoreceptor being converted into its active form, Pfr. Studies with barren brome (*B. sterilis*) seeds have shown their response to be unique; germination being inhibited by Pfr. Further studies have shown that low temperatures and reduced water availability can enhance this inhibitive effect greatly. The response of basal seeds to light did not differ from seeds elsewhere in the spikelets. Conversely, soft brome (*B. mollis*) was unresponsive to changes in either light quality or quantity.

Investigation of the effects of straw-burning and cultivation regime upon the population dynamics of barren brome (*B. sterilis*) indicate that substantial control of this weed can be obtained by these means. An initial population of 12,635 seeds m^{-2} declined by 85% between July and late August in uncultivated stubble without straw burning. Only 44% of seeds produced seedlings, the remaining 41% suffered post-germination mortality. A further 10% produced seedlings by late December and another 5% emerged between February and April after which no viable seed remained. Seedlings produced in spring lack vernalisation and so do not

flower that year. Straw burning destroyed 97% of ungerminated seed and reduced the number of seedlings by 94%. Ploughing to a depth of 20 cm eradicated the weed.

A series of experiments comparing the crop grass, *B. willdenowii*, with the weed, *B. commutatus*, showed surprisingly that while the weed had little dormancy and germinated almost completely under most conditions, the crop grass was slow in germinating, especially at low temperatures. In addition, many of its seeds remained dormant in the dark. This suggests that buried seeds could persist at least from one year to the next so that it could infest succeeding crops.

Natural factors affecting wild-oat emergence

Studies on the action of light have shown that germination of various stocks of wild-oat (*Avena fatua*) seed stored dry or imbibed can be enhanced greatly by light via the photoreceptor phytochrome. In addition there is a strong positive correlation between light quality and nitrate concentration, a factor of considerable importance in dormancy loss of seeds in the soil.

Flushes of wild-oat emergence in the autumn have been found to occur in mild spells following immediately after periods when soil temperatures approach 0°C. British strains of this weed vary in their level of seed dormancy.

Rough meadow-grass

Two recent surveys, which are the subject of an article on p. 27, showed unexpectedly that rough meadow-grass (*Poa trivialis*) was one of the four most frequent grass weeds of winter cereals. A study was therefore made of its biological adaptation to the habitats it occupies. Seeds were collected from two contrasting habitats, long-term arable and grassland. Although similar in their germination requirements they exhibited subtle differences in behaviour. Seeds of the arable populations were more dormant than those of the grassland populations. Storage of seed at 4°C resulted in rapid loss of innate dormancy whereas storage at 23°C induced dormancy. However, dormancy of dry stored seed appears to be regulated by an endogenous rhythm which appears to be under genetic control. Obviously this will have broader implications for storage of herbage seed crops.

Seeds from the two habitats also showed different responses to light quality and depth of burial. The results suggest that their seed germination behaviour may be adapted to the type of habitat in which the seed was matured.

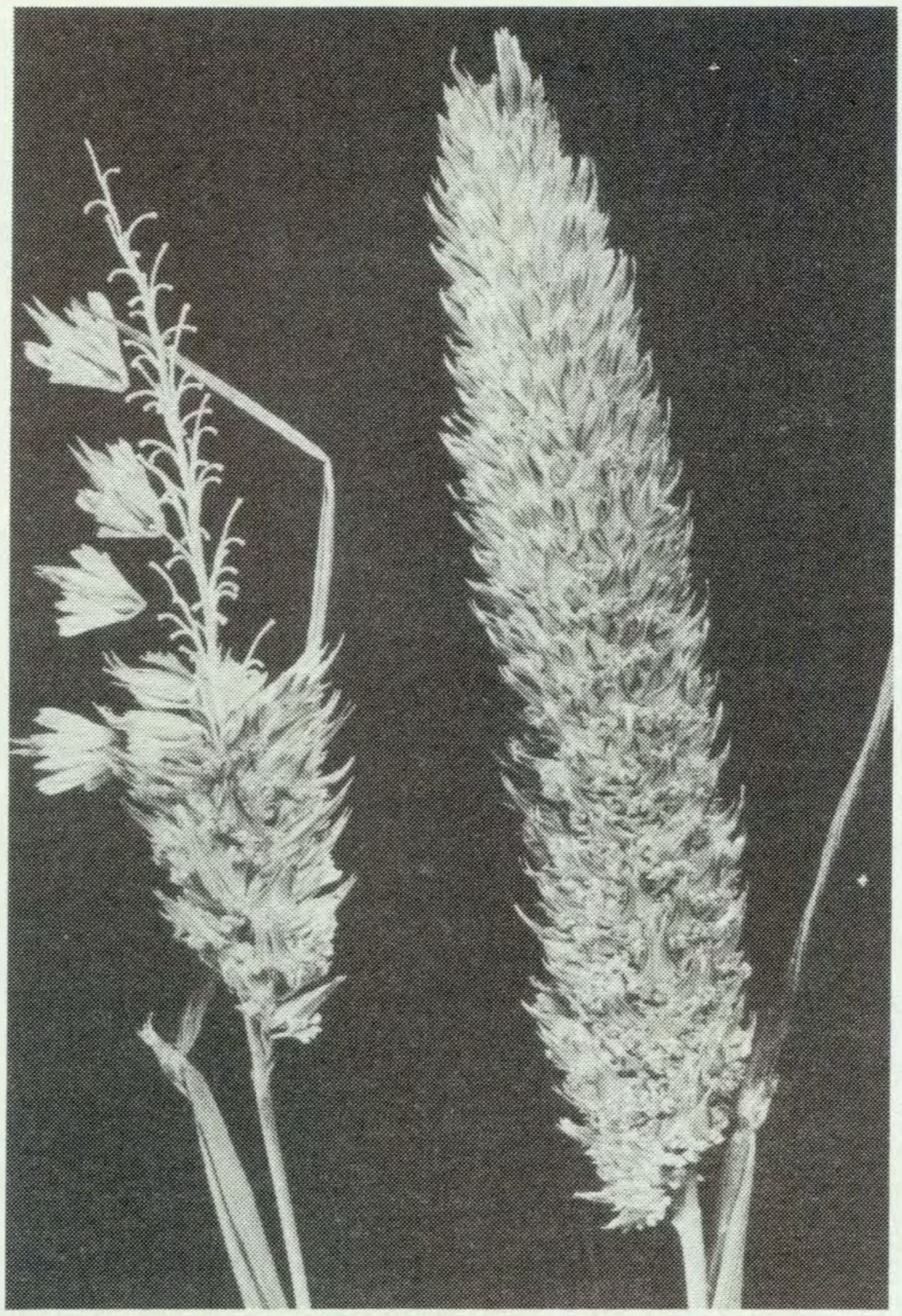


Fig. 1.

Awned canary-grass

The biology of this newly-introduced grass weed (*Phalaris parodoxa*) has been studied, for it could become a serious problem. The flower head (Fig. 1) resembles that of meadow foxtail (*Alopecurus pratensis*). It was found that the seeds are subject to a variety of dormancy mechanisms, which suggests that they could persist in the soil, so seeding should be prevented wherever it occurs.

Cleavers

Another important weed shown up by recent weed surveys is cleavers (*Galium aparine*). Research on this species has indicated that buried seeds

lose dormancy during autumn and reacquire it in late spring. Dormancy is broken by high soil temperatures in summer but germination does not occur until it decreases again in autumn. If summer temperatures are not high enough to break dormancy then chilling in the autumn provides an alternative; periodicity of emergence is thereby determined.

Competitive effects of cleavers and other weeds have been studied in cereals. In an experiment with spring barley grown in large boxes of soil it was found at weed populations of 35 m^{-2} that cleavers reduced yield by 19% and chickweed by 11%. The relationship between weed density and crop yield loss took the form of a rectangular hyperbola. The results suggest that chickweed competed only at an early stage, for although fertile tillers were reduced in number the 1000 grain weight was not, even at 617 chickweed plants m^{-2}, whereas cleavers reduced both. Investigations are now concentrated on comparing the competitive ability of important broad-leaved weeds with grass weeds.

DEVELOPMENTAL BOTANY GROUP

The shedding mechanism of wild-oat seed

Physiological and ultrastructural studies of the shedding of wild-oat (*Avena fatua*) seeds have shown that a hormonally controlled and active cell from cell separation occurs at the base of the lemma and palea, at the junction with the pedicel. The process is speeded by abscisic acid and retarded by auxin. The mechanism involved is unlike that in dicotyledons where ethylene is the hormonal agent that evokes the cell separation response. Studies have revealed a progressive diminution of ethylene production from glumes, lemma, palea and caryopses from the start of fruit desiccation with low levels of production prior to abscission. The evolution of an alternative abscission enhancing mechanism for seeds that dehydrate correlates with rises in abscisic acid in tissues under water deficit and the vulnerability of the ethylene biosynthesis pathway in water stress conditions.

Hormonal control of enzyme production in aleurones of the wild-oat

Gibberellin induction of specific hydrolases and the mechanism of secretion of these enzymes by aleurone layers and isolated aleurone protoplasts of wild-oat are being investigated at the biochemical and ultrastructural level. Gibberellin controlled isoenzymes have been identified and the

involvement of the endomembrane system in the intracellular translocation and overt secretion of these has been demonstrated. X-ray microprobe analysis has revealed that the bulk of the wild-oat seeds' mineral and phosphorous reserves are located in the aleurone layer and are re-distributed during germination to the developing seedling.

DNA synthesis in early germination

Studies of the biochemical events in the first few hours of imbibition of dormant and non-dormant seeds have demonstrated the early synthesis (within minutes) of DNA. Both nuclear DNA repair and a continuous DNA synthesis operate but only non-dormant embryos achieve full semi-conservative replication leading to cell division and germination. The activity and function of enzymes concerned in DNA replication and repair are being followed in dormant and non-dormant embryos of the wild-oat.

Mechanisms controlling hormone and assimilate movement

Plant tissues containing statocytes (gravity sensing cells) have been shown to play an important role in the regulation of hormone (auxin) movement in the flowering stalks of grasses. Most recent studies indicate that these cells may also perform a function in the movement of assimilates between plant parts. The ability of grasses to modify assimilate movement in different environmental conditions could relate to the formation and operation of this statocyte tissue.

TROPICAL WEEDS GROUP/OVERSEAS ACTIVITIES

The activities of the Tropical Weeds Group were severely curtailed when the Overseas Development Administration (ODA) ceased funding the main overseas liaison project in April 1982. As a result the evaluation of herbicides on tropical species was discontinued and the information and advisory service previously offered to visitors and correspondents had to be reduced to a minimum.

A proposal for a resumption of these activities in a collaborative project with counterparts in France has been submitted to Directorate General XII of the EEC and is being considered. Meanwhile ODA have continued to fund a *Striga* research project at WRO and an *Imperata* project in Indonesia, which has involved the home-based officer. There have also been a number of activities sponsored by other organizations on a consultancy basis.

The Striga Project

This ODA-financed project supports the work of the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) towards development of sorghum and millet varieties with resistance to the parasitic *Striga* species. Progress has been made in the understanding of resistance mechanisms in sorghum and in the selection of resistant material from semi-wild 'shibra' millet. A student from Ethiopia has been trained in the techniques involved in work on *Striga*, and the Group Leader has contributed to courses and symposia on the problem, including a workshop in Senegal to prepare guidelines for future research and international collaboration.

Overseas projects and consultancies

The Group Leader joined a Bookers Agriculture International consultancy team for 5 weeks in Indonesia to prepare a 10-year Crop Protection development plan for the Government of Indonesia, under finance from the Asian Development Bank.

The home-based officer visited Vanuatu for ODA to advise on weed control, in particular to assess the importance of *Mikania* in forest plantations.

This was followed in March 1982 by an 18-month secondment to BIOTROP, Bogor, Indonesia to lead an ODA-sponsored research project on the biology and control of *Imperata cylindrica*. Glasshouse trials showed that growth inhibition of upland rice by *Imperata* residues could be largely overcome by nitrogen fertilizer. Field trials demonstrated that satisfactory control of *Imperata* can be obtained by applying glyphosate with CDA equipment and, at substantially reduced doses, with rope-wick weed wipers. Assistance was given in weed science training courses at BIOTROP.

The Canadian Government supported the home-based officer on a short consultancy in December 1983 to visit their weed specialist in Kenya. FAO then sponsored participation in a two-week weed control training course held in Zambia.

ELECTRON MICROSCOPY

Both transmission and scanning microscopy is available at WRO. A full conventional TEM Service is provided and collaborative work with a number of groups at WRO as well as with the Letcombe Laboratory is

continuing. Conventional scanning electron microscopy is carried out by WRO staff on a self help basis; selected staff from various Groups at the Institute have been trained in basic preparation techniques and the use of the microscope.

In recent months the acquisition of 2 important accessories have greatly expanded the versatility of the SEM facility. A Hexland Cryo system enables specimens to be quickly frozen and examined fully hydrated, at sub zero temperatures. In this way artifacts associated with chemical fixation, solvent extraction and drying are avoided. Fig. 1 illustrates a specimen prepared in this way. It shows the surface of a wild oat leaf being colonized

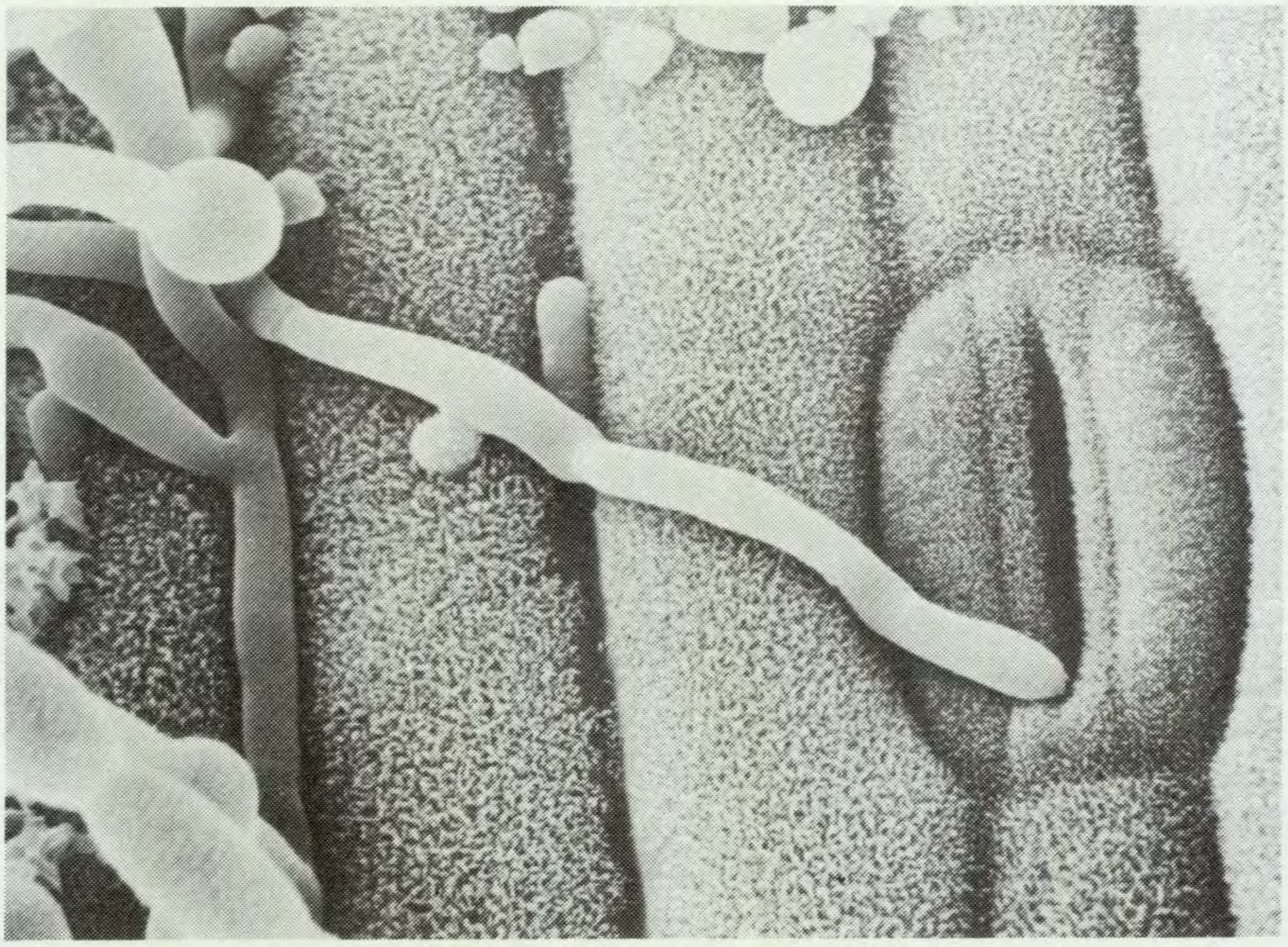


Fig. 1.

with the fungus, *Erysiphe graminis*. The technique has preserved not only the waxy bloom on the leaf surface but also the sculpturing on the fungal walls. The clear preservation of the epicutical wax reveals stretch lines on the cuticle of the stomatal guard and accessory cells during stomatal pore regulation.

The second addition to the SEM is a Link energy dispersive X-ray microanalysis system which enables elements to be detected, estimated, and localized at sub cellular levels. This has already yielded much data on, for example, the redistribution of elements in the wild oat seed during germination.

These advanced techniques are made available to other ARS Institutes, particularly those in the Thames Valley. Institutes which have used them include PBI, EMRS, NVRS, NIRD and LL. They are also used by researchers from Oxford University and the High Voltage Electron Microscope Service in the University is used by WRO.

BIOMETRICS

The AFRC Letcombe Laboratory/WRO Joint Biometrics Group has continued to provide a statistical and computing service to staff of WRO. Two members of the Group were based full-time at WRO and three others visit as necessary. Advice and assistance were provided with the design and analysis of experiments and computing and other problems arising from this work.

A major part of the effort of the Group at WRO has been devoted to streamlining the processing of data, especially from field experiments. Portable Epson HX-20 data-loggers are extensively used and programmes have been developed to facilitate the handling of the data on Apple microcomputers and transfer to main-frames for subsequent statistical analysis.

Dedicated microcomputers are extensively used in other parts of the Institute, for example by the Microbiology Group in conjunction with fermentors and autoanalysers. Others are linked to an image analyser and to an electronic balance. Members of the Group participate in the development of such facilities when necessary.

In September 1983 WRO was linked up to the new AFRC VAX 11/780 computing system via 2 VDUs and an LA 100 printer and a number of staff attended courses at the Computer Centre. Data storage and retrieval systems are being investigated and close liaison with the Information Section is maintained with a view to their also being able to make use of this system.

Statistical work included increasing emphasis on the analysis of series of

experiments as a whole and some investigation of methods for dealing with the results of experiments on mixtures of herbicides.

Programmes written to handle WRO meteorological data using a combined PIP and APPLE II system have been extended and improved, and others developed to overcome problems in using a serial printer at WRO and to decode and store data recorded on cassette tape from an echo sounder used in aquatic experiments.

LIAISON AND INFORMATION

ADAS

The effective interaction between the ADAS liaison unit and WRO staff was demonstrated again during the reporting period. A number of highly successful meetings were held between WRO, ADAS and representatives of the agrochemical industry to exchange views on weed control in cereals.

Widespread interest was shown in the WRO/ADAS joint exhibit at Wheat '83 and Drill 250 on the effect of cultivation and straw disposal on grass weed biology and control. ADAS presented data on the level of black-grass (*Alopecurus myosuroides*) control achieved by various commercial products, while WRO highlighted work on the effect of cultivation on the biology of grass weeds and the influence of soil adsorption on herbicide performance.

Our ADAS colleagues are well placed to assess the potential danger of new occurrences of the less widespread weed species. Recently they drew the WRO's attention to the risks posed by cranesbills (*Geranium molle* and *G. dissectum*) and awned canary-grass (*Phalaris paradoxa*). The cranesbills, later germinators encouraged by early drilling of winter cereals, have already been subjected to a herbicide screen conducted by the Herbicide Group for control in oilseed rape and cereals. In the case of *Phalaris*, several effective herbicide treatments have been identified in ADAS trials. WRO's Weed Biology Group has revealed that this species has innate dormancy and therefore may prove a significant threat to winter cereals.

Amongst the steady stream of enquiries from ADAS colleagues, farmers, growers, consultants and herbicide distributors and manufacturers, an increasing proportion of those from the horticultural sector were concerned with herbicide resistance shown by weed species.

Contacts with the agrochemical industry, agricultural merchants and consultants

Annual Chemical Industry Days organized in conjunction with the British Agrochemicals Association were held in 1982 and 1983 providing useful contact between the staff of chemical companies and WRO. A total of almost 200 technical specialists attended.

WRO staff participated in the Reviews of Pesticide Usage sponsored by the British Crop Protection Council and held in London on 27 October 1982 and at WRO on 26 October 1983.

During the reporting period WRO also staged two Merchants' days in February of each year in conjunction with the United Kingdom Agricultural Supply Trades' Association. A total of 196 merchants' staff attended the days in 1982 and 1983. Consultants' Days held in co-operation with the Association of Independent Crop Consultants were also continued and proved to be very successful, with attendances of 32 and 52 in the two years under review.

Public relations events

Displays of WRO research on various topics were prepared by the Information Section for exhibition in 1982 for the Beechams Food Group Focus on Oilseed Rape meeting and the BCPC (Weeds) Conference at Brighton. In 1983 displays were prepared for the RASE Wheat '83 event, the Royal Show, the RASE Autumn Cultivations and the ADAS Jethro Tull Celebration Drill 20 at Wallingford, the International Congress of Plant Protection and the AAB/SSI/EWRS Conference on the Influence of Environmental Factors on Herbicide Performance and on Crop and Weed Biology.

In addition to visitors to the Merchants', Chemical Industry and Consultants' Days, a total of 1600 visitors were recorded at WRO during the period of this report.

Conferences

During the reporting period WRO members were called upon to participate in organising and planning the programmes of several conferences and symposia. These included BCPC Weeds, International Congress on Plant Protection, BCPC Symposium on Soils and Crop Protection Chemicals, EWRS Symposia on Aquatic Weeds, Herbivorous Fish and on Weed Problems in the Mediterranean area, AAB Conferences on Broad-leaved Weeds and their Control in Cereals and Crop Sensitivity to Herbicides, and

the AAB/EWRS/SCI Conference on Influence of Environmental Factors on Herbicide Performance and Crop and Weed Biology.

Information Group

WRO continued to provide specialist library, current awareness and information retrieval services to its own staff and to other research scientists in the UK. Almost 2,000 enquiries were answered during 1982 and 1983. Many of these were online retrospective literature searches. Lists of recent WRO publications are circulated half-yearly to weed scientists and institutions and requests were received for 397 technical reports, 2,460 reprints and 1,900 copies of the WRO 9th report. Some 130 copies of the library Current Awareness publication are distributed each week, including 39 on subscription.

As part of CAB's programme of consolidation for their journal production, responsibility for the production of *Weed Abstracts* and *Plant Growth Regulator Abstracts* was transferred from WRO to the Commonwealth Bureau of Pastures and Field Crops at Hurley.

Publications

Books produced by WRO staff included *Some Common Crop Weeds of West Africa and Their Control* by P J Terry, published by the United States Agency for International Development, and *Striga Identification and Control Handbook* by C Parker as co-author, published by the International Crops Research Institute for the Semi-Arid Tropics. J G Elliott and B J Wilson edited the British Crop Protection Council publication *The Influence of Weather on the Efficiency and Safety of Pesticide Application—the Drift of Herbicides*.

The 7th Edition of the Weed Control Handbook: Principles edited by H A Roberts was published in 1982. Six members of WRO staff acted as chapter managers and eleven others contributed as joint authors of chapters.

WRO authors wrote chapters for a number of other books including *Recent Advances in Weed Research*, edited by W W Fletcher, *Plant Pathologists' Pocketbook*, 2nd Edition, edited by A Johnson and C Booth, *Advances in Research and Technology of Seeds*, edited by J R Thomson, *Plant Growth Substances*, edited by P F Wareing, *The Physiology and Biochemistry of Seed Development: Dormancy and Germination*, edited by A A Khan and *Embryonic Development Part B: Cellular Aspects* edited by K V Thiman.

Several members of staff served either as chairmen or as members of the editorial boards of a number of scientific journals including *Weed Research*, *Pesticide Science*, *Aquatic Botany* and *Annals of Applied Biology*. WRO also continued to be associated with *Tropical Pest Management* published by the Tropical Development and Research Institute and the *Pesticide Manual* produced by the British Crop Protection Council.

EDUCATION AND TRAINING

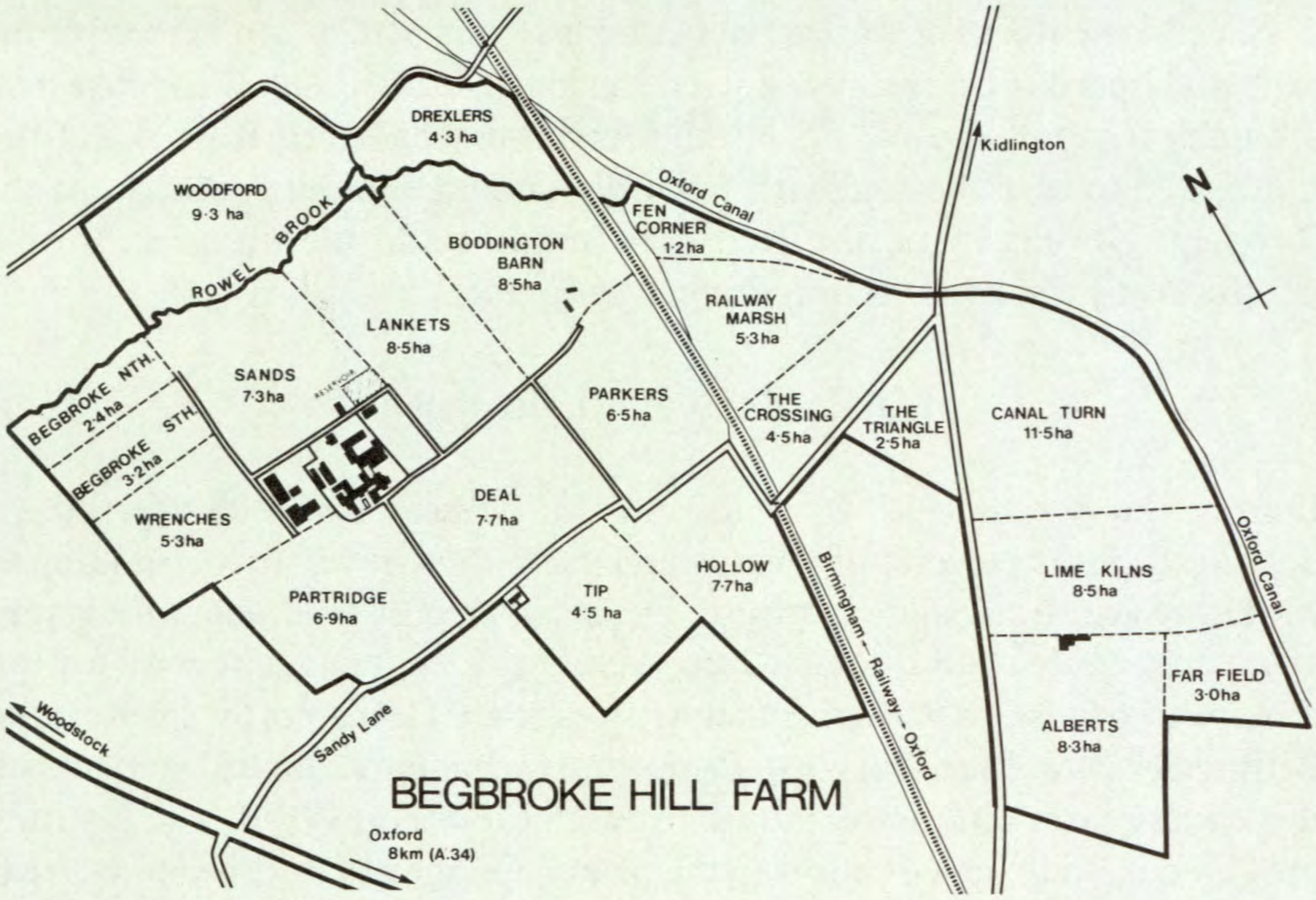
During the period 1982–83 WRO provided research facilities for higher degree students, several of whom came from the University of Reading of which we are an associate Institute. Details of all post-graduate students are given on p. 143. In addition facilities were provided for a number of visiting research workers. WRO continues to provide staff lecturers for the Reading University MSc course in Crop Protection technology. Several students on this course carry out their 3-month research projects at WRO. The Institute provided a 2-day introduction on the principles of weed science for overseas students participating in the Silwood Park Pest Management Course. Staff have also lectured for the MSc course in Bioaeronautics at Cranfield Institute of Technology. Individual members of staff have also given courses of lectures on weed related subjects at Leeds University and Chelsea College.

During the reporting period, staff have attended day release and block research courses at the Oxford College of Further Education (CFE), Oxford Polytechnic and the Berkshire College of Agriculture. The WRO Training Officer sits on the Science and Mathematics Advisory Committee of the CFE and the HTec Applied Biology Course Committee of the Polytechnic. A number of pupils from local schools have received work experience in various research groups at WRO.

THE FARM

The WRO farm has 90 ha of arable land and 40 ha of grassland on which to conduct the field research programme.

The arable area is a light sandy loam overlying gravel, capable of growing efficiently a wide variety of crops. It is managed on a 9-year rotation which includes 2 years of experiments and ensures a 5-year break between successive experimental programmes. Some 8 ha are specifically managed



to provide sites for long term experiments. The grassland is a low lying alluvial soil with a high water table which resists drought in summer. This area contains a variety of sward types under different managements to suit a wide range of grassland research.

Since the last report Woodford field has been acquired, and a comprehensive drainage scheme has been laid out in Drexlers, which is beginning to show a return. The reclamation of the recently acquired 4.5 ha Corporation site as a grazing area is progressing satisfactorily.

A new five-bay dutch barn has greatly improved facilities for the 140 beef cattle during winter. Grain storage has been much improved with the acquisition of a new grain cleaner and the increasing of storage capacity.

Commercial sales from the farm for the year ending 31.3.84 exceeded £125,000, (fat cattle £75,400; cereals £26,000; potatoes £24,000), making a useful contribution to the WRO budget.

ADMINISTRATION AND SUPPORT SERVICES

Probably the most significant change to occur during the two years covered by this report of the Administration and Support Department was the retirement of our first Institute Secretary, Mr Brian Wright MBE in

January 1983. While the slow process of finding a replacement went on, Mr Geoff Young, the Assistant Secretary, held the reins most ably during the interregnum until October 1983 when Mr Larry Poole MBE, joined this institute. In most other respects however, this was a period of consolidation with little to report in either major progress or change. The acute pressures of reducing budgets prevented any move to reinstate the new laboratory block project, the chances of further land acquisition also became unlikely and improvements to the general support services were limited to refinements on a small scale. The main material achievement was the final completion and setting to work of the new central heating system which in its first year achieved savings of some £7,000 on the previous winter's fuel bill and also proved considerably less labour-intensive to run.

People in Support

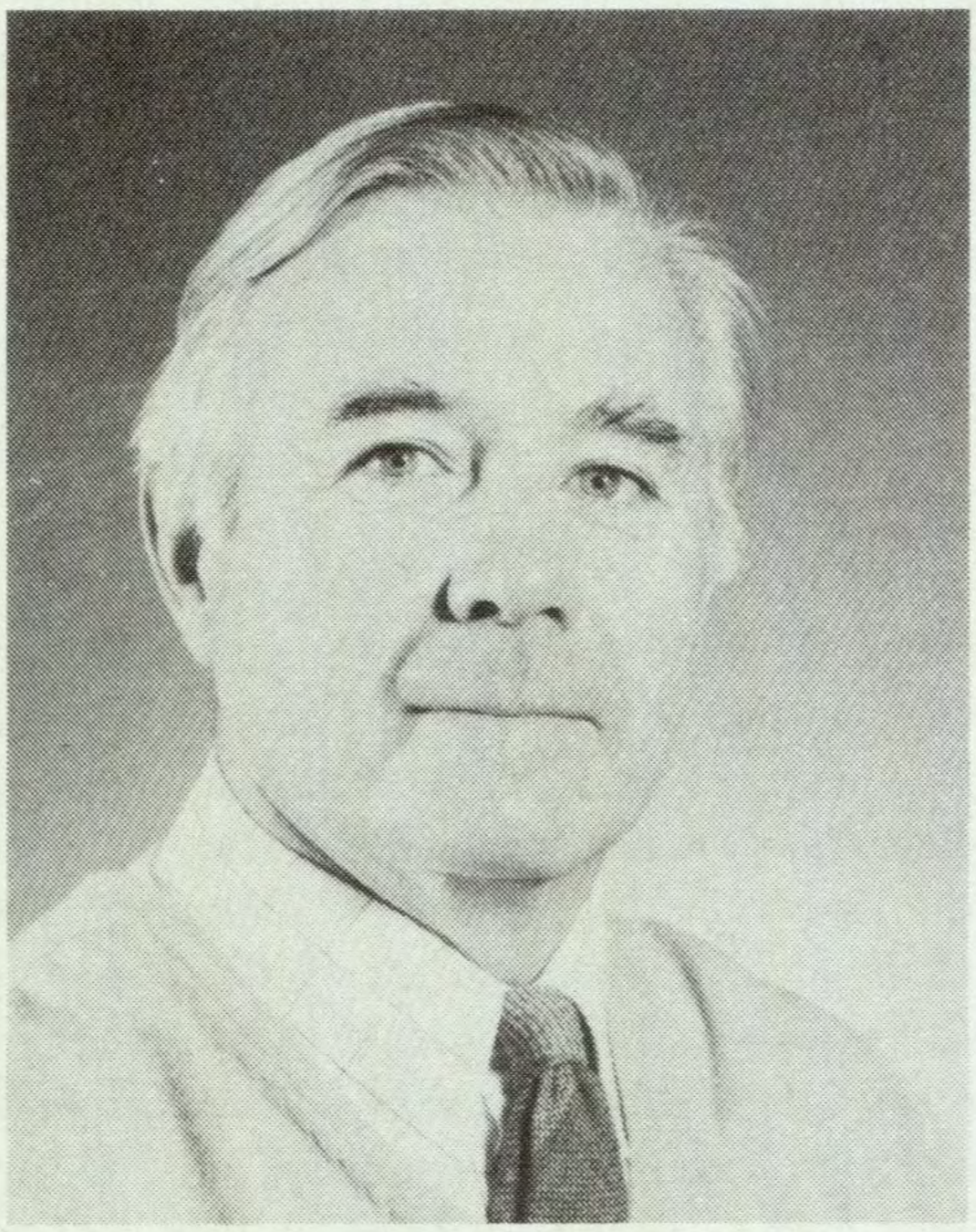
There is always a danger in the technical environment in which we work in the Agricultural and Food Research Service that the role of people takes second place to the science. In the frequently humdrum and routine aspects of administration and scientific support there are rarely exciting breakthroughs to raise morale, create a promotion or enhance an international reputation. Administration in particular can be a long, slow, boring slog and it is to the credit of the small, hardworking team housed in the Forge Block that they have achieved a very high level of efficient support for the work of WRO. Together with the long-standing engineering, stores and cleaning staff, they have remained dedicated to the requirements of a scientific programme and have shown enduring patience in coping with the foibles of scientists, who seen to have a peculiar knack of finding the simplest rules too complicated to observe! It is particularly sad, therefore, that the Council's decision in December 1983 on the future of WRO will hit these loyal people hardest of all. For clerks, secretaries, craftsmen, etc. there is no mobility outlet to guarantee them consideration of a job elsewhere with the AFRS and the 60 odd redundancies which will be created as a result of the decision to close WRO will be very largely found from amongst their ranks. That they have continued to give willingly of their best in the period since the announcement does them great credit and we salute them for their loyalty.

OBITUARY

James Gavin Elliott, known to his many friends and colleagues as Jimmy, died suddenly whilst on holiday in Cornwall on 28th August 1983.

He was educated at Charterhouse and after war service, during which he was commissioned in the Royal Corps of Signals and served in Burma, he read agriculture at Oxford and obtained an MA honours degree in 1950.

After acting as under-manager at the Oxford University Field Station he joined the ARC Unit of Experimental Agronomy in the University Department of Agriculture in 1951 under Professor G E Blackman. In the Unit he played a leading role in field investigations to determine the performance of new methods of weed control, especially selective herbicides.



When the ARC decided to establish the Weed Research Organization, Jimmy led the search for a suitable farm and became farm director at Begbroke Hill when the institute was established in 1960. In recent years he served as Head of the Weed Control Department at WRO and deputised for the Director on many occasions.

Throughout his research career he was characterised by a lively and enquiring mind and a dedicated, sometimes passionate, advocacy of new ideas. His life was dominated by two principles: that scientific investigations should be rooted in practical agricultural needs; and that the results should be taken to practical farming audiences in addition to more formal scientific publications.

His personal research led to very important advancements in agricultural technology, amongst which were fluid drilling, development of non-ploughing techniques for cereals and grassland improvement, a systems approach to the control of grass weeds in cereals, introduction of low ground pressure vehicles for arable agriculture; the chemical manipulation of the botanical composition of grass swards. This research and the work of the department he inspired contributed greatly to the high reputation which WRO enjoys amongst the agricultural community in Britain and weed scientists world wide.

In addition to his research he played a vigorous and effective role in agricultural affairs in Britain, serving as Secretary to the Oxford Farming Conference since 1981, as a Council Member of the Royal Agricultural Society of England since 1981, Chairman of the Oxfordshire Agricultural Trust of which he had been a committee member since 1978. He was actively involved in the British Crop Protection Council and its predecessor the British Weed Control Council. In addition to his numerous contributions to scientific conferences he was a popular and gifted speaker at farming clubs and societies and devoted much of his spare time to communicating the results of WRO research. He also enjoyed lecturing to students and was an honorary member of staff of Reading University.

He is survived by a widow, two sons, and a daughter.

LIST OF RESEARCH PROJECTS 1982/83
WEED CONTROL DEPARTMENT

Head of Department: J G Elliott

ANNUAL CROPS GROUP (*Leader:* G W Cussans)

1. Biology and agroecology of annual cereal weeds: B J Wilson, S R Moss, F Pollard (jointly with Weed Biology Group)
2. Response of cereal crops to weed competition: B J Wilson, S R Moss, F Pollard (jointly with Weed Biology Group)
3. Herbicide treatments for weed control in cereals: G W Cussans, S R Moss, P Ayres, M E Thornton, Dr P J W Lutman, F Pollard
4. Tolerance of cereals to herbicides: G W Cussans, D R Tottman
5. Long term systems and cost effectiveness of cereal weed control: G W Cussans, B J Wilson, S R Moss, Dr R D Cousens
6. The development of more effective weed control systems for soil with high organic matter: Dr P J W Lutman, M J May
7. The effect of weed competition and herbicides on the growth of oil-seed rape: Dr P J W Lutman, M E Thornton
8. The study of the biology of volunteer crops as weeds and the development of control measures: G W Cussans, Dr P J W Lutman, M J May
9. Chemical and cultural techniques in management of field margins (jointly with Aquatics Group): Dr E J P Marshall

GRASS AND FODDER CROPS GROUP (*Leader:* Dr R J Haggar)

1. Weed ingress in young leys: Dr R J Haggar
2. Controlling weeds in young leys: Dr R J Haggar
3. Weeds of permanent swards: A K Oswald
4. Controlling weeds in permanent swards: A K Oswald
5. Manipulating grass/clover contents: Dr R J Haggar
6. Renovating permanent pastures: Dr R J Haggar (jointly with Weed Biology Group)
7. Weed control in grass seed crops: A K Oswald
8. Chemical aids for seed production: A K Oswald

PERENNIAL CROPS GROUP (*Leader:* Dr J G Davison)

1. Agroecology of perennial weeds of fruit: Dr J G Davison, J A Bailey
2. Control of perennial weeds of fruit: Dr J G Davison, J A Bailey
3. Agroecology of annual weeds of fruit: Dr J G Davison, J A Bailey
4. Control of annual weeds of fruit: Dr J G Davison, D V Clay, J A Bailey
5. Predicting the field tolerance of fruit to soil-applied herbicides: D V Clay
6. Tolerance of fruit to post-emergence herbicides: D V Clay
7. Establishment of fruit and other woody plants in horticulture and amenity areas: Dr J G Davison, J A Bailey

WEED SCIENCE DEPARTMENT

Head of Department: Dr K Holly

HERBICIDE GROUP (*Leader:* Dr R J Hance)

1. Assessment of potential herbicides and growth regulators: W G Richardson
2. Influence of formulation components on herbicide activity: Dr D J Turner
3. Phytotoxicity from herbicides in vapour and droplet phases in relation to drift damage: Dr R J Hance, Dr V Breeze
4. Influence of repeated applications of MCPA, tri-allate, simazine and linuron on soil fertility: P D Smith
5. Studies of interactions of herbicides with one another or other xenobiotics: Dr H F Taylor, M P C Loader
6. Factors affecting the performance of soil-applied herbicides: Dr R J Hance, E G Cotterill, P D Smith
7. Evaluation of herbicides for forestry: Dr D J Turner
8. Persistence in soil of paraquat: T H Byast, P D Smith
9. Improvement of methods for the application of herbicides: W A Taylor, P D Smith

ENVIRONMENTAL STUDIES GROUP (*Leader:* Dr J C Caseley)

1. Improving herbicide performance by understanding the importance of weather factors: Dr J C Caseley, A M Blair, Dr D Coupland, Dr C R Merritt, R C Simmons
2. Overcoming adverse climatic effects by understanding the mechanism of herbicide/plant/environment interactions: Dr J C Caseley, A M Blair, Dr D Coupland, Dr R C Merritt

MICROBIOLOGY GROUP (*Leader:* M P Greaves)

1. Microbial aspects of pesticide persistence and efficacy: G I Wingfield, M P Greaves
2. Integration of biological and chemical methods of weed control: M P Greaves
3. Effects of pesticides on microbial contributions to soil fertility: M P Greaves, J A P Marsh
4. Interactions between crop root region microflora and herbicides as a factor in yield variability: M P Greaves, G I Wingfield
5. Control of filamentous algae (jointly with Aquatic Weed Group)
6. Development of microbial biomass on straw residues: M P Greaves, G I Wingfield (jointly with Letcombe Laboratory).

WEED BIOLOGY GROUP (*Leader:* R J Chancellor)

1. Influence of light on weed seed germination: Dr J R Hilton
2. The manipulation of vegetative regeneration of weeds: R J Chancellor
3. Seed cycles of grassland weeds: E D Williams
4. Weed surveys in cereals: R J Chancellor, Dr R J Froud-Williams
5. Biology and agroecology of annual cereal weeds: R J Chancellor, Dr R J Froud-Williams (jointly with Annual Crops Group)
6. Response of cereal crops to weed competition: Dr N C B Peters (jointly with Annual Crops Group)
7. Renovating permanent pastures: E D Williams (jointly with Grass and Fodder Crops Group)

EXTRA-DEPARTMENTAL RESEARCH GROUPS

DEVELOPMENTAL BOTANY GROUP (*Leader:* Dr D J Osborne)

1. Biochemical and ultrastructural studies in abscission: Dr D J Osborne, Dr J A Sargent
2. Biochemical and ultrastructural studies in dormancy: Dr D J Osborne, Dr R J Hooley, Dr J A Sargent
3. Biochemical and ultrastructural studies in desiccation tolerance of germinating seeds: Dr D J Osborne, Dr J A Sargent, Dr M Wright
4. Biochemical and ultrastructural studies in bud development: Dr D J Osborne
5. Biochemical and ultrastructural studies in the function of the grass node meristem: Dr D J Osborne, Dr J A Sargent, Dr M Wright

AQUATIC WEED AND UNCROPPED LAND GROUP (*Leader:* T O Robson)

1. Herbicides and growth regulators for the control of aquatic plants: T O Robson, P R F Barrett, M C Fowler
2. Control of aquatic plants by herbivorous fish: T O Robson, M C Fowler
3. Control of filamentous algae: T O Robson, P R F Barrett (jointly with Microbiology Group)
4. Chemical and cultural techniques in management of field margins: T O Robson, Dr E J P Marshall (jointly with Annual Crops Group)

ODA TROPICAL WEEDS GROUP (*Leader:* C Parker)

1. Resistance of crops to *Striga*: C Parker
2. Advisory work on weed control in developing countries: P J Terry

LIST OF PUBLICATIONS
1982–83

1158* ADLINGTON, R M, APLIN, R I, BALDWIN, J E, RAWLINGS, B J & OSBORNE, D J. On the biosynthesis of ethylene. *Journal of the Chemical Society, Chemical Communications, 1982,* 1086–1087.

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1121 AYRES, P. The influence of drop size and nozzle size on the control of broad-leaved weeds using an hydroxybenzonitrile/mecroprop mixture. *Aspects of Applied Biology,* **1**, Broad-leaved weeds and their control in cereals, 1982, 261–267.

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1150 BARRETT, P R F & LOGAN, P. The localised control of submerged aquatic weeds in lakes with diquat-alginate. *Proceedings EWRS 6th International Symposium on Aquatic Weeds,* 1982, 193–199.

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1240 BLAIR, A M, RICHARDSON, W G, WEST, T M. The influence of climatic factors on metoxuron activity on *Bromus sterilis. Weed Research,* 1983, **23**, 259–265.

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1181 CASELEY, J C. Effect of spring wheat and temperature on chlorsulfuron persistence in soil. *Proceedings British Crop Protection Conference—Weeds,* 1982, 137–140.

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* The numbers appearing in the left hand margin of this list are the WRO serial numbers for each item. For reprints please quote the number(s) required and remit a reproduction and postage charge at the rate of £2.00 per reprint. Technical Reports are available (cash with order) at the prices quoted in the list. Technical Leaflets are available free. All publication orders should be addressed to the Secretary, AFRC Weed Research Organization, Begbroke Hill, Yarnton, Oxford, OX5 1PF.

1143 CHANCELLOR, R J. Weed seed investigations. In: *Advances in research and technology of seeds,* Part 7, J R Thomson (Ed) Netherlands; Centre for Agricultural Publishing and Documentation, 1982, 9–29.

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S Cox — H Jordon* — C Green*
M C Leach — A J Woodhams* — L Weller
K E Murdoch — B Langford

PHOTOGRAPHY SECTION

R N Harvey FIIP — J M Charlett* — J S Kilcoyne

ENGINEERING SERVICES

Station Engineer: J F Hooper MIPE

Research Engineering

R Kibble-White BA — J A Drinkwater — R Foddy
N Heath

Buildings and Grounds Maintenance

A W H Gardner — R Wells — R A R Burnham
J W Keidel — C Kerry

Vehicle Maintenance

P A Savin — P Wickson

Electronics and Electrical

C J Stent BA — B Kelly — R Brogden

Clerical Staff

S Dale

Stores:

T H Evans

FARM

Farm Manager: R J Dale Dip Farm Man.

F A Penfold — C G Woodhams — R O Langford

* Part-time

Cleaning Staff
Supervisor: E N Luke*

M Jakeman* J Robinson* M Robinson*

ATTACHED STAFF

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

Agricultural Development and Advisory Service Liaison Officers

J H Orson BSc (Agriculture) A J Greenfield BSc (Horticulture)

Secretarial Staff

D G M Roberts* C Morris*

In January 1984 major changes were made to the above structure. The two Departments of Weed Control and of Weed Science were abolished, and a Deputy Director, Dr K Holly, was nominated instead. Two other senior staff took on part-time roles as Assistant Director (Research Policy), Dr D J Osborne, and Assistant to Director, C Parker. The Microbiology Group and the Aquatic Weeds and Uncropped Land Group were fused under M P Greaves to form the Microbiology and Vegetation Management Group.

CHANGES IN RESEARCH, TECHNICAL AND ADMINISTRATIVE STAFF

NEW APPOINTMENTS

S J Barrett (née Norris) *(on internal promotion)*	SO	Biometrics Group	1.4.83
J E Birnie *(on internal promotion)*	SO	Aquatic and Uncropped Land Group	1.6.83
V G Breeze	HSO	Herbicide Group	1.1.83
R D Cousens	HSO	Annual Crops Group	1.4.83
A W H Gardner *(on internal promotion)*	PTO III	Maintenance Group	1.4.83
S J Higgs *(on internal promotion)*	EO	Administration Group	1.4.83
M J May *(on internal promotion)*	SSO	Annual Crops Group	1.4.83
S R Moss *(on internal promotion)*	SSO	Annual Crops Group	1.4.83
C J Marshall	SSO	Biometrics Group	1.4.83
L D Poole	SEO	Administration Group	1.10.83
J Webb	HSO	Electron Microscopy Service Group	5.4.83

RESIGNATIONS, RETIREMENTS AND APPOINTMENTS

C J Bastian	SO	Annual Crops Group	23.4.82
H R Broad	SSO	Information Group	31.1.83
A J Dick	EO	Adminstration Group	19.7.82
J E Y Hardcastle *(appointed to another ARC post)*	PSO	Information Group	31.5.82
M L Hirst	SO	Environmental Studies Group	
F W Kirkham *(appointed to another ARC post)*	SO	Grass and Forage Group	6.6.83
W L Millen	SIO	Information Group	31.12.82
T O Robson	PSO	Aquatics and Uncropped Land Group	31.12.83
M Turton	HSO	Information Group	31.12.83
B A Wright	SEO	Administration Group	31.12.83

STAFF VISITS OVERSEAS

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

1982

February	G W Cussans	Belgium. To attend Winter Congress. Institut International Recherches Betteraviers, Brussels. Funded by SBREC.
March	J C Caseley	Switzerland. To present papers at the EPPO/WMO Conference, Geneva. Funded by EPPO.
	J G Elliott M E Thornton R J Dale	France. To attend Paris Agricultural Show. Funded by ARC.
	R J Hance	German Federal Republic. To attend Symposium on Bioassays in Weed Science, Hohenheim. Funded by EWRS.
	R J Hance	France. To visit INRA Laboratories at Versailles and Dijon. Funded by ARC.
	P J Terry	Vanuatu. Weed consultancy work. Funded by ODA.
March/ April	Janet R Hilton	The Netherlands. To attend SEB Meeting Leiden. Funded by ARC.
March-December	P J Terry	Indonesia. Consultancy work on *Imperata cylindrica.* Funded by ODA.
May	J C Caseley	USA. To present an invited paper on AC 222293 at the American Cyanamid Company. Princeton. Funded by American Cyanamid.
	J C Caseley	German Federal Republic. To attend the EWRS Environmental/Herbicide Performance Working Group Meeting "Measurement and Control of Soil Water in Pot Experiments". Funded by EWRS.
	G W Cussans R J Hance C Parker	Belgium. To attend the 34th International Symposium on Crop Protection, Ghent. Funded by EWRS/ARC.
	G W Cussans P J W Lutman	German Federal Republic. To visit research facilities and field experiments at Hoechst AG, Frankfurt. Funded by Hoechst.
	J D Fryer	The Netherlands. To visit CABO, Wageningen. Funded by ARC.
June	Daphne J Osborne	Canada. To give invited papers at the Canadian Botanical Society Meeting, Regina. Funded by Canadian Society for Plant Physiology.
	R J Hance	Italy. To attend FAO/IAEA Symposium on Agrochemicals: Fate and Food and the Environment using Isotope Techniques. Funded by IAEA.
July	P J Terry	Philippines. Weed consultancy work. Funded by ODA.
August	W A Taylor	USA. To visit the Agricultural Engineering Department, University of California, Davis. Funded by Lurmark and University of California.
September	J D Fryer	Italy. To attend FAO/IWSS Meeting in Rome, Weed management for the 1980's. Funded by FAO.

	R J Hance	Japan. To attend the 5th IUPAC International Congress of Pesticide Chemistry. Funded by IUPAC/ARC.
	T O Robson P R F Barrett G I Wingfield S Hanley Margaret C Fowler	Yugoslavia. To attend 6th EWRS Symposium on Aquatic Weeds and 2nd EWRS Symposium on Herbivorous Fish. Funded by EWRS.
October	R J Hance	Australia. To attend Soil Residue Workshop, Rutherglen and to carry out a lecture tour. Funded by Victorian Weed Science Society and others.
	P J Terry	Indonesia. To lecture for BIOTROP Training Course on Weed Management in Plantation Crops, Bogor. Funded by ODA.
November	T O Robson	Austria. To act as Chairman of a Working Group to advise on the use of radio-active isotopes for controlled release techniques. Funded by IAEA.
1983		
January	Daphne J Osborne	India. To give an invited paper at Indian Science Congress, Tirupati. Funded by Indian Science of Congress. To receive Gold Medal, University of Calcutta.
	Daphne J Osborne	India. To give an invited paper at 25th Anniversary of Indian Plant Physiological Society, New Delhi. Funded by Indian Science of Congress.
January-February	C Parker	Indonesia. Consultancy work. Funded by Bookers.
January-August	P J Terry	Indonesia. To work on *Imperata* project. Funded by ODA.
February	J D Fryer	USA. To give an invited paper at IWSS/WSSA Meeting "Communication of Weed Science Technology in Developing Countries", St Louis. Funded by ARC/WSSA.
March	M P Greaves	USA. To visit research centres working on biological control of weeds and to give lectures at Washington State University Pullman, Arkansas University and the USDA Southern Weed Science Laboratory. Funded by ARC.
	R J Hance	German Federal Republic. To attend Symposium on Bioassays in Weed Science, Hohenheim. Funded by EWRS.
	C Parker	Upper Volta. Project discussion. Funded by ODA.
May	R J Hance C Parker	Belgium. To attend 35th International Symposium on Crop Protection, Ghent. Funded by EWRS/ARC.
July	J D Fryer	Switzerland. To visit Ciba-Geigy AG. Funded by Ciba-Geigy.
	R J Hance	German Federal Republic. To attend FAO/IAEA Meeting on Bound Pesticide Residues in Soils, Plants and Food, Munich. Funded by IAEA.

	Janet R Hilton	Sweden. To attend Photomorphogenesis Symposium, Frostavallen. Funded by ARC.
August	M P Greaves	USA. To attend and sit on workshop panel at 3rd International Symposium on Microbial Ecology, Michigan State University. Funded by ARC.
	M P Greaves	Philippines. Invited by the University of the Philippines to establish a course on herbicide interactions with the soil and to lecture on microbiological aspects. Funded by British Council.
	C Parker	USA. International *Striga* training course, Raleigh, North Carolina. Funded by Intsormil.
September	K Holly	Peoples' Republic of China. To carry out consultancy assignments. On behalf of and funded by United Nations Industrial Development Organization.
	J D Fryer	Italy. FAO meeting, Rome. Funded by FAO.
	J C Caseley	Japan. Lecture tour of Chemical Companies, Government Laboratories and Universities. Funded by Japanese Chemical Industry and ARC.
	R J Hance	Switzerland. To visit Ciba-Geigy. Funded by Ciba-Geigy.
November	R J Chancellor	Switzerland. To give an invited paper at Colloque de Malherbologie, Geneva. Funded by Conservatoire, Geneva.
	R J Chancellor R D Cousens G W Cussans N C B Peters B J Wilson	The Netherlands. To discuss research projects of common interest in weed biology with Dutch and German associates. Funded by ARC.
	M P Greaves	German Federal Republic. To attend a workshop in Braunschweig on root-soil interactions and to appraise a coordinated research project sponsored by the German Federal Government. Funded by the German Federal Government.
	M P Greaves	Switzerland. To attend a workshop meeting on Biological Control of Weeds and to establish EWRS Working Group on Biological Control. Funded by ARC.
	M P Greaves	Switzerland. To visit Federal Research Institute Wadenswil, discuss research of common interest and organize forthcoming FAO Consultation. Funded by Swiss Federal Authorities.
	R J Hance	German Federal Republic. To visit Biologische Bundesanstalt, Braunschweig. Funded by ICI.
	C Parker	Senegal. To attend International *Striga* Workshop, Dakar. Funded by ICSU.
December	R J Hance	German Federal Republic. To give seminar at Kernforschungsanalage, Julich. Funded by KFA.
	R J Hance	France. To attend EWRS Committee, Paris. Funded by EWRS.
	P R F Barrett	USA. To carry out a short research programme and to give talks on diquat alginate at USDA, Fort Lauderdale, Florida, and the Centre for Aquatic Weeds,

	University of Florida, Gainesville. Funded by ICI.
C Parker	France. To attend 12th COLUMA Conference, Paris. Funded by EWRS.
P J Terry	Kenya. Weed consultancy work. Funded by Canadian Government.
P J Terry	Zambia. To assist in a weed control training course. Funded by FAO.

STAFF COMMITTEE SERVICE

Members of WRO served on the following Committees during 1982-83:

Association of Applied Biology
- Conference Organizing Committees
- Editorial Board; Annals of Applied Biology
- Weeds Group Committee

Agricultural and Food Research Council
- AFRC, ADAS, University Working Group on Cereal Growth Regulators
- Librarians Committee
- Promotion Board C

British Agrochemicals Association
- Environmental Research Committee

British Crop Protection Council
- Board of Management
- Chemicals Application Committee
- Editorial Committee BCPC Handbook on Crop Protection in Cereals
- Editorial Committee BCPC Handbook on Crop Protection in Grass and Clover Swards
- Education and Communications Committee
- Finance and General Purposes Committee
- Programme Committee Symposium on Soils and Crop Protection Chemicals
- Programme Committee Symposium on Weeds, Pests and Diseases of Grassland
- Programme Committee—Weeds
- Programme Policy Committee
- Publications Committee
- Research and Development Committee
- Working Party on Influence of Weather on Pesticide Application Efficiency and Safety

Drayton Experimental Husbandry Farm
- Farm Advisory Committee

European Weed Research Society
- Editorial Board of Weed Research
- Scientific Committee
- Symposium Organizing and Programme Committees
- Working Group on Biological Control of Weeds
- Working Group on Herbicides/Soils
- Working Group on Environmental Effects on Herbicide Performance

Food and Agriculture Organization/IAEA Joint Division
- Consultants Meeting to Recommend Future Pesticides Programme (with International Atomic Energy Agency)

10th International Plant Protection Congress Executive Committee

10th International Plant Protection Congress Programme Committee

Joint Consultative Organization for Research and Development in Agriculture and
- Food Crop Protection Committee

National Institute of Agricultural Engineering
- Spray Studies Group
- Cultivations Study Group

Ministry of Agriculture, Fisheries and Food
- Agricultural Development Advisory Service/WRO Liaison Group
- Boxworth Steering Committee
- Agricultural Chemicals Approval Scheme Scientific Advisory Committee

Organization for Economic Co-operation and Development
- Ad hoc meeting of Experts in Ecotoxicology Testing

Pesticides Safety Precautions Scheme, Environmental Panel

Society of Chemical Industry
- Editorial Board of Pesticide Science
- Pesticides Group Committee
- Physiochemical and Biophysical Panel
- Publications Committee

Sugar Beet Research and Education Committee
- Weed Beet Committee

POST GRADUATE RESEARCH STUDENTS AT WRO 1982–1983

Name	*University and Higher Degree*	*Estimated Period at WRO*	*Topic of Research*
S Adalla	Reading; PhD	1980–82	Factors affecting the performance of soil-applied herbicides in winter cereals
T Codd	London; PhD (CASE award)	1982–85	Studies on the use of chemicals to protect cultivated oat seedlings from damage by herbicides
R Elder	Oxford; DPhil	1981–84	Biochemistry of embryos of dormant and non-dormant wild oats
S D Hankins	Oxford; DPhil	1983–86	The effect of precipitation on herbicides used for broad-leaved weed control
F K Ismael	Reading; PhD	1981–84	Factors affecting the control of *Elymus repens* by glyphosate
S J Midgley	Reading; PhD (CASE award)	1980–84	The effects of surfactants and inorganic additives on the activity of MCPA and glyphosate
E-S S Mohamed	Bath; PhD	1981–83	Herbicides in fenugreek *(Trigonella foenum-graecum)* with particular reference to diosgenin and protein yields
M T McManus	Oxford; DPhil	1980–83	Studies of ethylene responsive target cells in plants
P Newton	Bangor; PhD	1982–85	The dynamics of clover stolons
P D Owen	Reading; PhD	1979–82	The vegetative regeneration and spread of weeds as a factor in the deterioration of swards
A M Sherif	Reading; MSc	1983	Effects of nitrogen and organic matter on *Sorghum bicolor* and *Striga hermonthica*
N T Yaduraju	Reading; PhD	1981–84	Influence of environmental factors on the chemical control of *Avena fatua* and *Phalaris spp*

VISITING RESEARCH WORKERS AND OVERSEAS TRAINEES AT WRO 1982-83

Name and Origin	*Period at WRO*	*Topic of Research*
Beatrice Boutin Lille Polytechnicum	1982 (4 months)	Weed beet project
E N Flach University of Wageningen The Netherlands	1982 (4 months)	Studies on *Phalaris paradoxa*
Dr K Moody International Rice Research Institut, Philippines	1982/3 (12 months)	Studies on *Poa annua*
Dr Britt Pessala Agricultural Research Centre, Vantaa, Finland	1982 (3 months)	Effect of rainfall on herbicide performance
Henrietta van Vrede University of Wageningen The Netherlands	1982 (3 months)	Weed biology studies
Dr B J Wilson Queensland Wheat Research Institute, Toowoomba, Australia	1982 (9 months)	Population dynamics of grass weeds in cereals
J M Garcia INIA, Cordoba, Spain	1983 (2 months)	Cereal weed control
Z Hosokawa Osaka, Japan	1983- (3 years)	Manipulation of clover growth with plant growth regulators
A M Sheriff Institute of Ag Research Nazareth, Ethiopia	1983 (4 months)	Studies on *Striga*
B van Hille Lille Polytechncium France	1983 (4 months)	Weed beet project
Dr G Baldini University of Bolgna, Italy	1983 (6 months)	Studies on *Equisetum*
Dr R H Callighan University of Idaho, Moscow, USA	1983 (6 months)	Vegetative regeneration of weeds
L Faraday MG Kombinat 6500 Baja, Hungary	1983 (4 months)	Weed biology studies
Dr R Field Lincoln College Canterbury, New Zealand	1983/84 (6 months)	Interaction of drought stress and endogenous plant growth regulators on diclofop-methyl activity

FINANCIAL ASSISTANCE FROM OUTSIDE BODIES 1982-83

Source	*£*	*Purpose*
Commonwealth Agricultural Bureaux	36,230	Compilation of *Weed Abstracts*
Countryside Commission	18,182	Research into the use of herbicides in the management of countryside recreation areas
Cyanamid Ltd	20,475	Research into mode of action and response to environmental factors of AC 222293
Forestry Commission	31,000	Research on the uses of herbicides in forestry
ODA	75,350	Research on the parasitic weeds of genus *Striga*
Sugar Beet Research and Education Committee	17,790	Research on weed beet

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 and Food Research Council. Most of them publish reports annually and copies can be obtained from the Secretaries of the Institutes concerned.

AFRC Institutes

Animal Breeding Research Organization	West Mains Road, Edinburgh, EH9 3JQ
Food Research Institute	Colney Lane, Norwich, NR4 7UA
Institute of Animal Physiology	Babraham, Cambridge, CB2 4AT
Institute for Research on Animal Diseases	Compton, Newbury, Berks, RG16 0NN
Letcombe Laboratory	Letcombe Regis, Wantage, Oxon, 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, Yarnton, Oxford, OX5 1PF

State-aided Institutes in England and Wales

Animal Virus Research Institute	Pirbright, Woking, Surrey, GU24 0NF
East Malling Research Station	East Malling, Maidstone, Kent, ME19 6BJ
Glasshouse Crops Research Institute	Worthing Road, Littlehampton, West Sussex, BN17 6LP
Grassland Research Institute	Hurley, Maidenhead, Berks, SL6 5LR
Houghton Poultry Research Station	Houghton, Huntingdon, PE17 2DA
John Innes Institute	Colney Lane, Norwich, NR4 7UH
Long Ashton Research Station	Long Ashton, Bristol, BS18 9AF
National Institute of Agricultural Engineering	Wrest Park, Silsoe, Bedford, MK5 4HA
National Institute for Research in Dairying	Shinfield, Reading, RG2 9AT
National Vegetable Research Station	Wellesbourne, Warwick, CV35 9EF
Plant Breeding Institute	Maris Lane, Trumpington, Cambridge, CB2 2LQ
Rothamsted Experimental Station	Harpenden, Herts, AL5 2JQ
Welsh Plant Breeding Station	Plas Gogerddan, Aberystwyth, Dyfed, SY23 3EB
Wye College, Department of Hop Research	Ashford, Kent, TN25 5AH

State-aided Institutes in Scotland

Hannah Research Institute	Ayr, KA6 5HL
Hill Farming Research Organization	Bush Estate, Penicuik, Midlothian, EH26 0PH
Macaulay Institute for Soil Research	Craigiebuckler, Aberdeen, A89 2QJ
Moredun Institute, Animal Diseases Research Association	408 Gilmerton Road, Edinburgh, EH17 7JH
Rowett Research Institute	Greenburn Road, Bucksburn, Aberdeen, AB2 9SB
Scottish Crop Research Institute	Invergowrie, Dundee, DD2 5DA
Scottish Institute of Agricultural Engineering	Bush Estate, Penicuik, Midlothian, EH26 0PH

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