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THE DEVELOPMENT AND APPROVAL OF HERBICIDES IN THE NORTHERN ENVIRONMENT

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In order to understand approval one must first consider the Pesticides Safety Precautions Scheme. This scheme acts on behalf of the Department of Agriculture for Scotland, and the Ministry of Agriculture Northern Ireland. Its main concern is with toxicology, crop residues, operator safety and environmental effects arising from the use of pesticides. Most of its work is concerned with data that has no regional significance and is in all probability obtained outside the United Kingdom. Crop residues must be obtained from within the United Kingdom but there is no requirement for them to be obtained in particular geographical locations. The safety margin required before clearance is given would be sufficient to cover any variation due to local conditions. Environmental effects are considered in terms of the likely use of a chemical and therefore any wild life or other studies would need to be carried out in the habitat required. In the case of the newer bracken herbicides, for example, such studies could be carried out in any suitable areas of England, Scotland or Wales.

The Agricultural Chemicals Approval Scheme

The purpose of the Scheme is to enable users to select and advisors to recommend, efficient and appropriate crop protection chemicals and to discourage the use of unsatisfactory products. The scheme is operated by the Agricultural Chemicals Approval Organisation on behalf of the Agricultural Departments of the United Kingdom. Approval is granted by the organisation for specific uses under United Kingdom conditions when the organisation is satisfied that the product fulfils the claims made on the label. Although we are here concerned with herbicides the scheme also covers insecticides, fungicides and growth regulators. All herbicides are included in the scheme that are or could be used by the farmer, grower and horticulturist. This includes herbicides for amenity horticulture, forestry, total weed control, aquatic weed control and for home garden use.

Approval of herbicides for use in the North

As stated above approval applies to the whole of the United Kingdom and it can only be granted therefore with the foreknowledge that the material in question will be effective when used in any of the agricultural areas covered by the scheme. Allowance for regional differences is catered for by the scheme and is stated in the introductory document : A.C.A.S. 2 - "Scheme and Procedure" (1) as follows - 'On those occasions when the approved information about a product is not valid for all parts of the United Kingdom, the differences will be shown on the approved label'.

How and where the approved information mentioned above is obtained is a difficult question to answer and depends on the nature of the herbicide and the use for which it is intended. To aid manufacturers the scheme produced a guide in 1962 (6) on the type and extent of data required for approval. This document was not intended as a set of rules but in it the following principles were laid down:

(a) The number of sites at which a chemical is tested should be such as to give an overall picture of the effect over as wide a range of climatic, soil and varietal conditions as are relevant to the crop and pest spectrum concerned.

(b) The distribution of trial sites should be such that more than one of the main areas of crops on which it is intended to use the chemical are included.

(c) Save in exceptional circumstances, results from a minimum of two seasons trials are required for consideration by the Approval Organisation. Failure of pests and diseases to appear in any one season may mean that trials must be continued for longer than the minimum period.

With the experience of recent years the scheme would amend the second principle such that trials of some kind must be carried out in all the main areas in which the crop concerned is grown.

The remainder of the document deals with details of trials lay-out and procedure. This is also described in more detail in the Weed Control Handbook, Vol.1, 5th edition, (3). Both publications give details on how to plan trials and execute them scientifically. Neither gives a guide on the role of statistics in trials procedure but this is well summarised by Kassasian (5). What is not covered in these publications is how to approach the problems of minor crops and regional variations when planning a trials programme. There is a need for a publication in the field of weed control covering not only trials procedure and analysis but also methods of evaluation in all crops, the nature and extent of trials required to cover each crop and the interpretation of results.

Effects on label recommendations.

Differences arising from use of compounds in the Northern environment can be said to affect labels in three ways. The first is that the conditions for use of the product are closely defined on the label and no reference is made to their geographical occurrence. One of the best examples of this is in fact the use of asulam for the control of docks (Rumex spp.) in pasture. The conditions required for this material to be effective are very exact and well defined on the label. Part of the recommendation states that the material should be applied in the late summer when there is at least 6 weeks growing conditions after application. In parts of the North one might not consider that one had this length of growing season, particularly from applications at the end of the summer. This effectively restricts the use of the compounds not by exclusion but by proper interpretation of the recommendations. Similarly it indicates that if used in areas where this growth period was not available, the effect of the material could not be expected to be as indicated on the label. Other similar recommendations exist with respect to residual herbicides. For example those whose use on soils with more than five per cent organic matter are excluded. There are also other factors such as rainfall following treatment which could effectively be used to indicate that the material is not suitable for certain climatic areas of the country.
The second approach on labels is that the areas themselves are defined in terms of usage - one of the best examples one can think of here was the chlorthiamid recommendation for perennial and annual weed control in raspberries. For many years this recommendation stated on the label that it was to be used only in Scotland. From the same company we have had on the market this year the cereal herbicide containing cyanazine and MCPA, which has been developed for Scotland only. This is to some extent a rather extreme example but does show that there are special needs in the North and that products can be made to suit them.

Lastly there is exclusion - that is a strict exclusion from any area specified simply because the material has not been looked at in those areas. Rather than get into difficulty the manufacturer simply removes this area of use from the label. This perhaps is a worse situation than where they at least indicate that there is no knowledge of these areas. The aim of the scheme is always to try and assist the company to get data in order that areas are not excluded as it is of no value to a grower to have to turn to a product in which he feels he can expect no support at all from the manufacturer.

Factors affecting the evaluation of compounds to be used in the Northern environment.

Differing husbandry techniques may require trials to be carried out in order to examine the efficacy of a compound under the different conditions in the Northern environment. These differing husbandry techniques may be due to regional traditions or interaction with the differing climate. One can cite here raspberries which are grown on a stool system against a continuous row system in England. This difference combined with the vigour of the crop in Scotland makes husbandry and herbicide application completely different. Residual herbicides cannot be applied in the early winter in the northern crops due to the vigour of the canes preventing physical entry in to the crop. They must therefore wait until after the cane has been tied in, which could be as late as April, before being applied. Strawberries are a similar example. In Scotland they are not planted until the spring of the year. This is in distinct contrast to the strawberry growing areas of England where they are planted in late summer and early autumn in order to get an early maiden crop the following year. In the arable context we have an example in swedes and turnips which are grown on ridges. This is in distinct contrast to the crop in the South and has led to special recommendations with products containing propachlor.

Climatic induced differences are difficult to define since they may not necessarily be confined to the North. The effects one is thinking of here would be shorter periods of weed emergence e.g. wild oat (Avena fatua) in cereals. Also in the Northern environment longer day length may give a stronger weed growth later in the summer. Gloyne (4) has stated that evapotranspiration is less in the North and this would tend to allow certain weeds to grow throughout the summer and produce a problem that we would not expect to have in the South of England. This can be illustrated by certain broad-leaved weeds in cereals especially redshank (Polygonum persicaria), pale persicaria (Polygonum lapathifolium), hempnettle (Galeopsis speciosa), which are very common in the North. The difference in climate can be also seen in that the yields of barley tend to be much higher and would average nearer 2 ton per acre in the cereal growing areas of the North as against 26 cwts per acre in the South of England.

Other factors in the North which must be taken into consideration could also be the inter-action of climate and soil type. This is particularly important with residual herbicides. As stated above there tends to be greater soil moisture retention in the North and there is also an association with high organic matter content - this is discussed by Batey (2) elsewhere in this symposium. He states that not only would organic matter content tend to be higher in the North but it may be of an entirely different nature to that in the East and South of England. This is important when one considers that the predominance of herbicide development is carried out in the South and East of England on soils which may not necessarily correlate with those in Scotland. This has been amply demonstrated with some of our more marginal herbicides. In the South and East of England there

is a fairly reliable correlation between organic matter content and sand content. As the sand fraction increases the organic matter in the South and East decreases. One can say that any soil with greater than 80% sand will have less than 1% organic matter content. The effect on residual herbicides is to give excessive leaching under heavy rainfall conditions and also of drought under warm conditions. The same situation may not necessarily apply however to Scotland where on sandy loams and loamy sand soils organic matter contents completely out of line with those in England are obtained. In general one can say that in the South and Eastern England any soil with an organic matter content near and above 5% would inactivate any residual herbicide applied to it. This cannot be said to be so of Scotland where prometryne, aziprotryne, lenacil, linuron and many other common soil acting herbicides are quite effective in Scottish soils where the organic matter contents would preclude their use if the label instructions were in fact carried out to the full. Added to this the increased moisture in the soil tends to give a better effect where such materials can be used in Scotland as one does not get the drying out and lack of activity that occurs in England.

Other effects in the North which may need special evaluation would be varietal differences within crops. The predominance of Golden Promise as a barley variety in the North would not have changed were it not for the newer cereal mildew fungicides that enable the crop to be safely grown in the South. Returning to Raspberries one can obviously see the future of Glen Clova and related varieties as being very promising in the Scottish raspberry crop. This will need to be taken into account in the evaluation of any new herbicide.

Returning to the weed flora itself one effect that we have mentioned can be the difference in growth patterns between similar weed floras. In the South certain weed species tend to be short-lived, proliferate rapidly and do not grow through the whole life of a crop. It is very seldom for example that one finds any Veronica species after the end of May. Similarly one can think of fat hen (Chenopodium album) which has seeded by the end of July in the South. This is a factor which may not apply under wetter conditions which favour those species already mentioned that are able to grow throughout the season. Thus the difference in climate can give us a different approach to the crop/weed relationship and a different requirement for any one herbicide. This can only be successfully determined if trials are carried out in the Northern areas.

The amount of trials carried out in the Northern environment.

The amount of trials work carried out in the development of any product varies according to the nature of the herbicide itself. Where there is a simple relationship between environment and application - one can think for example here of contact herbicides such as paraquat, then the need to do specific programmes of work in the North may not be required once these factors are known. Some major crops in the North are covered by the trials carried out by the colleges in Scotland, Regional Staff of Northern ADAS and the Ministry of Agriculture in Northern Ireland. One can think for example of the development work carried out by the Scottish colleges in the Swede crop. Some of this work led to a revolution in our approach to the use of TCA that has now spread to the whole of the British Isles. Raspberries in Scotland has also been mentioned but the crop itself has gained immeasurably by trials carried out by the Scottish Horticultural Research Institute. One can think also of the work carried out on the problem of Docks (Rumex spp) in grassland with respect to chemical weed control by the West of Scotland College of Agriculture and also the Ministry of Agriculture for Northern Ireland. Corn marigold (Chrysanthemum segetum) is also a problem which has been tackled in comprehensive trials in Northern Ireland.

The value of this type of trials work is high because not only does it give basic data on new compounds but they invariably compare several of the market leaders alongside new compounds and keep a very good watching-brief over the current situation in any crop weed problem. Their authority also adds greater weight to data obtained by a manufacturer in these areas.

Having said this one must then turn to the grey areas where products are not included in regional development programmes for a variety of reasons and the manufacturers are not supporting this by trials in the field. This unfortunately tends to happen all too frequently. The problem may start where colleges and regional staff are not able to carry out trials in a specific area of weed control due to political reasons or the fact that it is a minor crop or that they feel that there is no need for a particular compound in view of several similar ones already available to the grower. This then puts the development responsibility completely on the manufacturer. Sometimes the result is a full and detailed programme of work carried out in Northern areas and to the complete satisfaction of everybody concerned. On the whole however, with the majority of technical staff stationed in South-east England would tend to get all the trials work carried out in areas well outside those we are concerned with in this Symposium. Only a few companies station staff permanently in Scotland and it is from these that one sees the specific Scottish recommendations arising. This seems a little strange when one considers:

a) that the cost of maintaining staff in South-east England is considerably higher than in any other part of the country

and

b) that a major portion of the United Kingdom crop acreages occur in the Northern areas.

Table 1 Per cent Distribution of Major Crops and Commercial Technical Staff in the United Kingdom 1972/73

CROP	Northern England	England (incl. N.England)	Wales	Northern Ireland	Scotland	Total United Kingdom acreage in 1,000's
Barley	17	78	4	2	16	5,666
All cereals	15	83	3	2	12	9,333
Potatoes	15	76	3	6	15	555
Crops for stockfeed	12	66	6	4	24	672
Horticulture	8	94	0.5	1.5	4	681
Total crops	14	84	2	2	12	11,722
Total grass incl. rough grazing	11	36	10	20	34	36,369
Total agricultural land	12	47	8	16	29	48,091
% of technical/ trials staff		92.5		1	6.5	Total staff 121

The crop figures given in Table 1 must only be taken as approximate due to rounding-up. The figures of technical development staff in industry are taken from the 11 leading development companies in the United Kingdom but exclude scientific staff attached to pure research stations run by the commercial firms concerned. The staff are not necessarily herbicide specialists but have to also carry out trials on insecticides, fungicides and other crop protection materials.

Looking at each area separately the figure for Scotland looks if anything the best but is weighed to allow for staff based in England travelling to carry out major projects in Scotland. It is significant however that only one company in the United Kingdom has a pure trials establishment in Scotland and of the other three companies with technical staff in Scotlnand the people concerned have beside their trials commitment advisory and liaison functions to perform. This situation seems erroneous when one compares it to the fact that Scotland alone has 15% of the United Kingdom Potato market, 12% of the cereal market, 24% of the Stock feed market and 34% of Grass in the United Kingdom.

The position in Northern Ireland would appear to be much worse than that even in Scotland. There are no technical staff attached to Northern Ireland at all except from one subsidiary company and it is understood that this person also has liaison and advisory functions to fulfil. This seems strange when Northern Ireland has 20% of the grass acreage of the United Kingdom. In general servicing Northern Ireland development comes within other United Kingdom areas, either associated with a Scottish Area as in 5 of the companies or associated with another area such as West of England or North of England. No company in the United Kingdom has any base for work in Northern Ireland. This situation is not helped by the fact that there are only two officials in Northern Ireland able to carry out comparative herbicide trials in this area.

Northern England - In this context one considers the two ADAS regions of Northern England and Yorks and Lancs. They are perhaps the best off of all of those in the Northern environment. This is largely due to several major pesticide companies being organised technically in England on a regional basis. There is an equal distribution of staff between all regions in these companies. This is fortunate for development but unfortunately, like Northern Ireland, the actual regional ADAS staff available to carry out trials is sadly out of balance with the crop acreages concerned.

The distribution of technical staff would indicate that clearly with 92½% of all technical trials staff in England the majority of results would be obtained without reference to the Northern areas especially Scotland and Northern Ireland. The outcome is heavy reliance on college trials in Scotland or simply as indicated above, ignorance of any differences that may exist. The reasons for this distribution of technical staff is difficult to explain when as stated above it is far more expensive to maintain staff in the South-east especially when set against the vast acreages in the Northern areas. Added to this the future cost of travel from the South-east bases of such staff must certainly question the value of central organisation of trials.

The Approval of Recommendations for Use in the Northern environment.

The result of this inbalance in development is that it causes a considerable problem when it comes to granting approval. In order to minimise the lack of data considerable liaison is continually maintained with the Institutes and Colleges in the North to try and make full use of any available data and to liaise in the arrangement of trials so that they are sited in the most useful places and designed to give the maximum amount of information. The result is that official bodies generally carry out the lion's share of the development work doing the replicated phytotoxicity studies whilst the manufacturers concentrate their efforts on extension work and grower applications. The result can be a particularly useful integration of effort. This is much valued by the Approval Scheme and is of direct value to the officials in the North giving them considerable information on herbicide performance. It is also valuable to be able to show growers on the spot demonstrations of new compounds as they come onto the market.

In order to further this liaison the Approval Scheme has official liaison officers which are appointed by Departments to assist the scheme. These are at present Dr D Graham in Scotland, Professor McKee in Northern Ireland and G Stell for the Isle of Man. Northern England coming within the Ministry of Agriculture, Fisheries and Food and ADAS is serviced directly by the Approval Scheme. The liaison officers do not in fact play as great a role in herbicide liaison as they do in insecticides and fungicides. They are none-the-less appointed to assist regional development and are therefore able to aid manufacturers in getting work done in their various regions. To this end a circular letter was sent in June 1969 to all manufacturers stressing the need to cover all the growing areas in their development work and giving them the names and addresses of the respective liaison officers if they required assistance from specialists in these areas to help them with their trials. The results of this continued liaison has been quite fruitful in recent years. Many companies now regularly carry out development work in the Northern environment in order to satisfy the needs of the scheme. This still leaves many small recommendations that are put onto labels without proper development work in the North and it must be stressed that were it not for the requirements of the scheme these materials would be marketed without any consideration of the requirements of the North and certainly without trials being carried out in this area. The fact that we will not give them approval for any part of the United Kingdom unless they satisfy these requirements has helped to make them aware that there is a market in the North and that it needs its own development. Our reliance on our colleagues in the areas concerned is important in maintaining this stand with the manufacturers and it is vital that sufficient staff are maintained in the colleges and regions of the North in order that they may continue to carry out the extremely valuable work they have so far done in the development of new herbicides. There is no chance in the foreseeable future of this role being taken over by the Approval Scheme and indeed we would not wish to duplicate the expertise that already exists. Considerable advantage however could be gained for the growers in the Northern environment if this liaison is enhanced and if the effort in fact could be increased.

Approval and Forestry

So far in this paper I have not mentioned Forestry. The Forestry Commission for many years has carried out a very full and detailed research programme into the role and effectiveness of herbicides in the Forest environment. The Forestry Commission itself is divided into Northern and Southern Conservancies. In the case of the Northern environment the Northern Conservancy of the Forestry Commission, based in Edinburgh, covers both North England and Scotland. The acreage involved is included in table 2.

For most of the post-war years herbicide needs in Forestry have been relatively low. The siting of forestry in areas with adequate manpower have restricted the use of herbicides to specific situations where they had a clear advantage over hand work. This in the early days covered tree killers such as 2,4,5-T and ammonium sulphamate. Latterly however the growth of the private forest industry has created a need for advice on all aspects of forest husbandry and also loss of labour in some areas and increasing cost of labour have made the use of herbicides much more attractive than hitherto. The forest nursery situation is one which has rapidly taken up the use of residual herbicides, especially simazine, and there is still need for other more selective materials. In freshly planted and establishing forests there is also now a need for herbicides as manual clearance of weeds from young trees cannot be contemplated on the scale hitherto carried out. The result is that many herbicides have now found a use in forestry. One can think of the use at this time of such compounds as paraquat, dalapon, dichlobenil, chlorthiamid, asulam, dicamba and atrazine.

Table 2. Approximate Acreage of Forest in the Control of the Forestry Commission 1971/72.

	England acres	Wales acres	Scotland acres
Area under nurseries	250	250	500
Area planted in year ended 31.3.72.	10,300	6,000	48,500
Area under plantations	587,000	315,900	946,850

With the greater complexity in the range of herbicides being used in forestry and also with the associated need to advise the private forest industry the forestry commission has encouraged many manufacturers to gain approval for products with respect to forestry use for several reasons. The most obvious is that any approved product bears a comprehensive label summarising all the uses and all the precautions required for the use of that product. This means that within the Commission foresters using products away from technical advice can turn to the label and find clear instructions in an acceptable manner with all the risks of use indicated both in terms of phytotoxicity and safety. Our liaison with the Forestry Commission is at different levels according to the different problems envisaged. In herbicide work the Silviculturists responsible for this development have been most helpful in both aiding manufacturers in finding sites and also in liaising with us in respect of their own trials work. In the North we have several examples of new herbicides being compared alongside each other and also of manufacturers themselves carrying out trials on sites provided by the Commission. We aim to promote this liaison and may be able to help the Commission, advising them on the potential of these herbicides since many of them already have existing approved uses in other crops. The benefit to the Scheme is immediate. The Commission's data is accurate and reliable and there are several products which have been approved for forestry use purely on the basis of work carried out by the Commission. Another benefit to the Scheme is that products become available to the community which would not otherwise be available were it not for the Commission and as part of this development it is agreed that approval would not be granted unless the recommendations on the proposed product are in agreement with the results that the Commission have obtained in their trials.

In Forestry in the Northern environment one cannot complain that it is inadequately serviced. Conditions of course are extreme in many of the Northern forest areas and this in itself produces a need, as we have stated above, for trials to be carried out there. Some problems are related entirely to the climate a typical one being the problem of heather (Calluna vulgaris), competition in young forest trees both from the competitive aspect and also from the antagonism that heather shows towards certain tree species. Bracken (Pteridium aquilimum) is not such a great problem in the North as in the West and South West. Grass weeds are not so difficult to control as the grass and herbaceous type of perennial weed encountered in the forest areas of the South.

In Table 2 one can see the acreages of forestry and from the areas involved clearly there is a large potential for herbicide usage. One can take the figures of Scotland and add onto this approximately a third of that from England which would be in the Northern environment considered by this symposium. As regards

herbicide use the most important area would be the new planted forests, figures there show the annual planting for the year ended 31st March 1972. All this land will need some herbicides, possibly treatment during establishment in order to get the trees to grow quickly so that they can form a canopy which would then compete with weeds for the rest of the life of that forest. The use of herbicides must increase in this area and therefore one can look forward to greater liaison with the Commission.

Future Changes.

In the immediate future there is no likelihood of any major changes to either the Safety or the Approval Scheme. Any changes that do come about are most likely to arise as part of regulatory requirements from the Common Market Commission in Brussels. It is unlikely at present that statutory schemes will be introduced along the lines of those existing in the old E.E.C. countries. Slight changes may come about for other reasons that could involve pesticides. The most important of these will be the possible imposition of minimum acceptable residue levels in food crops arising from the application of pesticides. This could affect some rates of application of herbicides and would certainly impose harvest intervals with respect to some post-emergence herbicides and to herbicides applied to short-lived horticultural crops. This however is conjecture but I make these points in order to illustrate a possible effect of such minimum tolerance levels.

Effects on the development of compounds should not change although we may see the adoption of agreed methods of trials procedures and assessments, Something of the nature of these methods has been shown to us already in the misapplication of the so-called E.W.R.C. 1 - 9 scale. This demonstrates what happens when a method is not properly established as an international scale and is improperly used as a result. There is in existence a draft document entitled Guide lines for the testing of herbicides. Like the other publications above it concentrates on trial design and lay-out and gives no guidance on regional differences in planning trials programmes. Another project at present under sonsideration is a new scale for the definition of cereal growth stages. It is hoped that such agreed methods will enhance weed control but we must ensure that they are based on sound scientific principles and not turned into rules from which we cannot deviate in order to tackle local problems, such as those we are discussing in this symposium.

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DISCUSSION

Mr. M. G. O'Keefe

We have been discussing the problems of weed control in specific situations of minority acreages which can be described as specifically as we wish, this leads onto the consequent problems of making the label recommendations referred to by Mr. Makepeace. With farmers and herbicide manufacturers economics must eventually be the judge of how much development work is done with products; in particular weed and crop situations it depends how much detail it is possible to write upon the label without leading to confusion.

I believe, that for 3 or 4 reasons, we are at the moment at a crossroads in herbicide usage; many compounds are nowcoming off patent and are becoming more freely available, we are facing shortages of raw materials and in addition competition for these raw materials with other industries beside the pesticide industry.

Because of the drastic change in the economics of agriculture farmers have more money available for weed control, and, as you have heard today, there are indications of more specific demands for herbicide usage. These factors will all effect the usage of herbicides.

What is going to happen? Will there be more mixtures of herbicides which are no longer patented, or will the opposite occur? If it is the former there may be more opportunity to look at minority users, but by whom? Both Mr. Makepeace and Mr. Forrest make the point that there must be an economic uptake of herbicides in order to justify examinations in any particular situation.

If the latter possibility occurs will companies lose interest in existing compounds and go on to develop completely new compounds, meaning that all their development staff and resources will be taken up by new compounds leaving none available to look at minor acreage problems.

Mr. C. M. Graham

In answer to one of Mr. Forrest's questions, if a farmer is in the middle of cutting silage and he has some spraying to do, he should employ a spraying contractor!

I would like to ask him a question about the programming of herbicides. It was mentioned in connection with Mr. Lawson's name, should we be thinking in terms of the programmed use of say two herbicides in order to control a difficult Scottish weed because herbicides that are imported to Scotland are better suited to English conditions.

Mr. J. D. Forrest

Without any doubt I think that there is a tendency towards, you say programming, I might say sequential treatments, this is already showing with wild oats where farmers are using two applications to try and get on top of the wild oat problem and are prepared to pay something like £12 per acre to obtain good results. I think Mr. Lawson's work points out the need to plan ahead in terms of cropping in order to ensure that the situation does not arise where a particularly difficult weed dominates a crop of the same family, for example the use of desmetryne may mean that the end result is shepherds' purse in a brassica crop with virtually no herbicide available for selective removal.

Dr. T. Batey

I would like to put a question to Mr. Stovell about soil temperatures, I got the impression that where there was a difference in chemical action in a Northern environment, and that you thought this was due to differences in soil temperature. The question is therefore is there in fact a difference in the between-season performance of these chemicals in the North compared to the South and if not I would have expected it to be a more fundamental property of the soil rather than temperature. I would have expected a cold season in the south to have soil temperatures somewhat similar to a warm season in the North. I assume that you do record soil temperatures in your trial work.

Mr. F. R. Stovell

Yes we do record soil temperatures. I did not think I was making too much of a point about soil temperatures in the effect on the herbicide. The effect is rather greater on the growth of the plant itself and most certainly we do get these effects in some seasons in the South.

Mr. J. R. McPherson

I would like to ask Mr. Forrest about his remarks on Pea herbicides, he stated that there was a preference for the D.N.B.P. type as opposed to residuals, I am based in Yorkshire where the situation is reversed and is 60% residuals and 40% D.N.B.P. is Mr. Forrest's figure a national figure or is it for Scotland only.

Mr. J D. Forrest

I was mentioning Scotland only, but I did carry out a survey and found that the national breakdown was roughly as you have said. I did have a little more in my papers about soil acting herbicides but the session organiser removed it because the paper was intended to be only about foliar acting herbicides.

Mr. J. M. Mackenzie

Mr. Stovell mentioned that generally in the North larger doses of herbicides can be tolerated and, while this is good for the manufacturers, does it follow that from a user point of view lower doses are more effective than in the South.

Mr. F. R. Stovell

Generally there is a shift in selectivity, in other words although the crop will tolerate a higher dose, so will the weeds, so it is not possible to manage with a lower dose.

Mr. J. D. Forrest

I think that a good example is the use of lenacil on strawberries, where there have been some failures, tied up with organic matter and where the use of phenmedipham can be used as a supplementary treatment.

Mr. R. J. Makepeace

Of the 400 odd products I have approved, I cannot think off hand of any product where there is a separate rate recommendation for the North, although it is there for other reasons such as, soil type, organic matter etc. but not specific regional differences.

Mr. J. M. Mackenzie

The question was asked relating to forestry, because we find that in the North lower doses of Prefix are as successful as higher doses in the South, this is possibly not directly comparable because the sites will not have the same vigour of vegetation and there may be a slight flexibility in timing, where it may be possible to apply a lower dose later which will be as effective as a higher dose applied earlier in the South.

Mr. R. J. Makepeace

Is it possible that this is due to a different flora in the South where there are more woody weeds and broad leaved weeds in the spectrum.

So not only would you get a quicker breakdown in the temperature but when the grasses have been killed out, there will be ingress by other weeds that will remain at that dose level. Is it possible that this is the answer rather than a climatic one?

Mr. J. M. Mackenzie

It is possible but I am thinking generally of fairly similar kinds of vegetable composition.

Mr. I. Main

We have heard a lot about temperature and organic matter in the soil effecting herbicides, both soil acting and foliar, but what about light intensity, does this have any effect upon either a herbicide or its use.

Mr. J. C. Casely

I think light intensity could have an effect because it would increase the transpiration rate, in the leaves, and hence the greater the number of sunshine hours the greater the amount of transpiration.