trol improved as the application rate of 'FW.925' increased, at the expense of crop selectivity. Observations made in the preliminary work suggested that Matricaria spp. was resistant to low doses of 'FW.925'

Herbicidal efficiency of 'FW.925' at various doses

The percentage control of all weeds given by 'FW.925' increased with dose. 2.5 lb/ac of 'FW.925' was adequate for good control of Urtica urens, Lamium amplexicaule, L. purpureum, Poa annua, and Veronica spp; Polygonum persicaria was controlled at this dose but the control improved at the higher doses. The dose required for good control of Chenopodium album varied; in loam soils where C. album germinated quickly after treatment 2.5 lb/ac afforded control. 5 lb/ac improved the degree of control and this rate was needed where germination of C. album was slow. Both doses checked the growth of those C. album plants which were not killed upon emergence. The amount of water in which 'FW.925' was applied did not materially affect its herbicidal activity; the greater influence was found during the primary work to be the condition of the soil surface at time of spraying. Large lumps of soil shield the surrounding soil from 'FW.925' and through these untreated surfaces unimpaired weed germination occurs. In Table X applications of 'FW.925' onto a poor surface tilth showed that extra water - 80 gal/ac instead of 40 - could overcome this disadvantage.

Herbicidal effects of 'FW.925' mixtures

S. media is found in most soils and presents severe competition to crop seedlings - as do S. vulgaris and C. bursa-pastoris to a lesser degree. It was therefore necessary to enlarge the herbicidal spectrum of 'FW.925' by the addition of another herbicide at a dose low enough not to impair crop selectivity yet sufficient to control these weeds.

Three herbicides were tried:- chlorpropham as it is known to give control of S. media and C. bursa-pastoris at 1-2 lb/ac (Woodford 1960); CDEC, which although more efficient when incorporated into soil (Anon., 1961) had been observed in the primary work as effecting control of S. media and C. bursa-pastoris when applied at 2-3 lb/ac onto the soil surface; and '1983', an experimental residual herbicide, which had also shown activity against all three weeds.

On peat soils additions of 2 lb/ac chlorpropham to 'FW.925' gave control of S. media when rain fell after spraying (I) or if the mixture was applied in at least 150 gal water/ac (II). The same dose of chlorpropham was also necessary for control of S. media on silt loam (III). S. media and C. bursa-pastoris were well controlled on sandy loams (IV and V) by the addition of 1 lb/ac chlorpropham and on one trial on medium loam (VII) 0.75 lb/ac chlorpropham proved adequate for control of S. media.

CDEC was added to 'FW.925' on sandy loams (IV and V) where 2.35 lb + 2.5 lb 'FW.925'/ac gave control of S. media and improved control of C. bursa-pastoris; although the control of S. media was inferior to that given by 1 lb chlorpropham + 2.5 lb 'FW.925'/ac, and the control of C. bursa-pastoris inferior to that given by 1 lb chlorpropham + 5 lb 'FW.925'/ac. CDEC at 2.35 lb/ac was active against S. vulgaris in IV.

In addition of 1 lb/ac '1983' to 'FW.925' on sandy loams 'IV and V) gave reasonable control of S. vulgaris, good control of C. bursa-pastoris and moderate control of S. media. The addition of 2 lb '1983' resulted in a better control

of C. bursa-pastoris than that given by 'FW.925' + 1 lb chlorpropham. On a silt loam (III) 1 lb '1983' failed to give control of S. media and on peat soil (I) the degree of control of this weed given by 1 lb/ac '1983' was not as great as that given by 2 lb/ac of chlorpropham. 'FW.925' + 1 lb '1983' in trial III gave improved control of Chenopodium album as did 'FW.925' + 2 lb '1983' in trial IV.

Although further work must be undertaken to establish the efficiency of 'FW.925' mixtures on other species of weeds, of the three mixtures applied 'FW.925' + 1 lb to 2 lb chlorpropham gave very good control of S. media, whereas 'FW.925' + 2.35 lb CDEC and 'FW.925' + 1 lb to 2 lb '1983' were more active against C. bursa-pastoris and S. vulgaris.

The influence of soil types upon herbicidal activity of 'FW.925' and mixtures

With residual herbicides which are dependant upon soil entry for efficient herbicidal effect the soil type affects performance; the efficiency of the herbicide falls off as the degree of absorption increases from sandy loam to black fen soils. To reproduce the same effect upon Digitaria sanguinalis chlorpropham must be used in black fen soils at 64 times the dose it could be used at in sand (Holly, 1961). The peat soil at the site of trial I was a typical black fen soil where in the past the efficiency of residual herbicides had been questionable - due to the difficulty of the chemical in penetrating the soil and the high degree of absorption thereafter.

The primary work had indicated that the herbicidal activity of 'FW.925' did not depend upon penetration into the soil and on the peat soils (I and II) good control of Urtica urens was obtained by applications of 'FW.925' where rain fell shortly after apraying (I) and where it did not (II). 'FW.925' + chlorpropham gave better results - due to control of Stellaria media - but this was where extra water was applied (II) or where rain fell shortly after spraying (I). These conditions also resulted in a satisfactory performance of '1983' mixtures as the essential penetration of '1983' into the soil was facilitated.

On sandy loams (IV and V) where crop damage followed applications of residual herbicides is common, 'FW.925' was selective. 2.5 lb/ac 'FW.925' gave 66 percent control of all weeds with no damage to the emerged crop seedlings (IV). The addition of CDEC or chlorpropham or '1983' to 2.5 lb 'FW.925' increased the herbicidal activity of 'FW.925' alone but impaired its selectivity on the crops.

'FW.925' was herbicidally active on heavy, medium light or silt loams in tables III, VI, VIII and X and no effect of the particular soil type upon its action could be noted.

The effect of 'FW.925' and mixtures upon crops

Garden beet were not adversely affected by pre-emergence applications of 2.5 lb/ac 'FW.925' on sandy or light loams (IV, V and VI) nor by 5 lb/ac on silt or peat soils (I, II and III). Garden beet was damaged by 5 lb/ac 'FW.925' on heavy loam (VIII) as was sugar beet on medium loam. In sandy loams the addition of 2.35 lb CDEC or 1 lb '1983' did not affect garden beet nor did the addition of 1 lb chlorpropham or 1 lb '1983' on a light loam. On silt soil 1 lb chlorpropham gave no damage whereas on peat soils 2 lb chlorpropham could be added without damage. The addition of 1 lb chlorpropham or 1 lb '1983' to 2.5 lb 'FW.925' on a light loam (VI) did not affect the growth of garden beet nor

depress the yield upon maturity.

Brassicae were remarkably tolerant of 'FW.925'; on all soil types 5 lb/ac 'FW.925' could be used without damage, and on one trial (II) 10 lb was safe. This selectivity of 'FW.925' has also been recorded in many trials undertaken by market gardeners on their own holdings. The addition of 1 lb chlorpropham or 2.35 lb CDEC or 1 lb '1983' did not generally affect the selectivity of 'FW.925'

Lettuce were affected by low doses of 'FW.925' in some trials but on sandy loams where damage might be expected 2.5 lb/ac was safe. In some trials 1 lb to 2 lb chlorpropham or 1 lb '1983' when added to 'FW.925' did not cause crop damage. Peas were unaffected by 5 lb 'FW.925' on one trial (VII).

Without taking the treated crops to maturity - except in garden beet in VI - it would appear that on most soil types 2.5 lb/ac 'FW.925' may be tolerated by garden beet, 5 lb/ac 'FW.925' does not damage cabbage or Brussel sprouts on any soil type tested and 2.5 lb/ac 'FW.925' may cause damage to lettuce except on the peat soils.

Effect of FW.925 applied post weed + crop - emergence

Post-emergence applications appear of limited value because of poor weed control except on Urtica urens. Shoot growth of Calystegia sepium and Convolvulus arvensis can be killed and further work will be undertaken to determine whether there is an optimum period for application to obtain the maximum check to growth together with a minimum of regrowth.

Acknowledgements

Acknowledgement is made to the market gardeners who so readily provided facilities for these trials - in particular - Mr. Watkins, Messrs. F.M. & H.J.M. Darby, Mr. Righton and his staff, Mr. Van Daalen, and Mr. Craven.

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Discussion of preceding two papers

MR. J.G. ELLIOTT: Could Mr. Tyson tell us whether his chemical might be of use on potatoes.

MR. D. TYSON: We have information which indicates that potatoes are a tolerant crop. Some work on this crop probably will be done next year. One limitation may be the very poor surface tilth which is obtained by many potato growers. It is possible to get over this by increasing the amount of water to get a more complete cover.

DR. K. HOLLY: Is the effectiveness of 2,4-dichlorophenyl-4-nitrophenyl either reduced by the presence of a large number of stones on the surface of a stony soil, even though an otherwise good tilth has been obtained?

MR. D. TYSON: I have used it on stony soil. It is reasonably successful provided there is no disturbance of the soil surface after application, but in one case where rabbits or dogs had disturbed the stones considerably there was weed growth as in areas which had no herbicidal treatment.

MR. S.A. EVANS: Can Mr. Tyson tell us how long the herbicide remains effective on the soil?

MR. D. TYSON: Unfortunately, this was part of the work which ought to have been done but wasn't. We do intend next year to carry out weed counts at intervals throughout the first three months to determine how long it persists and to check whether in fact there is any erratic further germination occurring a month or six weeks after application.

DR. W.E. RIPPER: May we know whether either of the last two speakers has done any experiments on Polygonum aviculare. P. persicaria has become easier to control but P. aviculare is most important on my stony land. May I ask whether 'R.2061' and 'FW.925' have ever been tried against P. aviculare?

MR. D. TYSON: We did actually have a reasonable population of Polygonum aviculare in Onward peas (see Table VII). 5 lb/ac gave 74 per cent control. Most Polygonum spp. are well controlled.

MR. C.H.P. WOOD: My colleague Mr. Tyson has done the bulk of the work on 'FW 925' as you will have gathered, but I have also done some preliminary work on agricultural crops, particularly sugar beet. Volumes of 40 and 80 gal/ac were used which we felt were more realistic from the agricultural point of view. We have also been using the material on tilths probably not quite so fine and good as those often found in horticulture. The results in Table X show that Stellaria media was not very well controlled, but if you look at the results for weeds excluding S. media we did get up to 90 per cent control at the highest dose and volume, which was not markedly reduced at 40 gal/ac. In this trial there were a large number of Polygonum spp., largely P. aviculare, P. persicaria and P. convolvulus so I think I can confirm Mr. Tyson's point that the Polygonum spp. are particularly susceptible to 'FW 925'.

MR. B.H. BAGNALL: We would like to add that we have Polygonum aviculare in nine of our trials with 'R.2061'. Control ranged from 20 to 70 per cent. There is some susceptibility there but it needs additional compounds to help it.

SESSION 10

Part 2

THE EUROPEAN WEED RESEARCH COUNCIL

R. LONGCHAMP

(President of the European Weed Research Council)

L'histoire du Comité Européen de recherches sur le Désherbage commença en 1957 à Hambourg. A la suite du IVème Congrès International sur la Protection des Plantes, des pourparlers eurent lieu entre le groupe de travail néerlandais (Président Ir. W. KAKEBEKE de Rilland-Bath, Secretaire Ir. J.C. FRIEDERICH), le Professeur M. SLAATS et le Dr. J. STRYCKERS de la chaire de Phytotechnie de l'Institut Agronomique de l'Etat à Gand.

L'année suivante, ces quatre animateurs prirent l'initiative de reu coutrer les spécialistes du désherbage présents à Gand à l'occasion du Xème Symposium International de Phytiatrie et de Phytopharmacie, le 5 Mai 1958.

De cette réunion devait naître le Groupement International de Recherches sur les mauvaises Herbes dont le Dr. van der ZWEEP fut nommé secrétaire général permanent. Il fut demandé au Professeur Dr. B. RADEMACHER de bien vouloir assumer la présidence du groupement. La première réunion eut lieu à Stuttart-Hohenheim, en mars 1959, où le Dr. WOODFORD fut désigné comme nouveau président.

La seconde réunion eut lieu à Oxford en avril 1960 et c'est à cette occasion que furent précisés les statuts de l'organisation et adopté son nom définitif: rejetant l'idée d'une société Européenne de Désherbage il fut décidé de créer un Comité Européen de Recherches sur le Désherbage, officiellement "European Weed Research Council", dont la présidence allait être à nouveau assurée par le Professeur RADEMACHER.

La troisième réunion eut lieu à Paris et à Versailles en décembre 1961 et la quatrième à Bruxelles en août 1962.

Le Comité Européen de Recherches sur le Désherbage s'est fixé pour tâche de promouvoir, d'encourager et de faire connaître tous les travaux relatifs aux mauvaises herbes et à leur destruction, et de créer des liaisons entre les chercheurs travaillant sur ces sujets.

Trois moyens furent utilisés pour atteindre ces buts:

1) Création d'un réseau de correspondants en Europe,
2) formation de groupes de travail spécialisés chacun sur un sujet,
3) édition d'un journal.

I - Les représentants du Comité en Europe

La liaison entre les chercheurs européens est assurée par l'intermédiaire des membres du Comité européen à raison d'un représentant dans chaque pays. Ces représentants sont en principe désignés par leur gouvernement respectif.

Actuellement le Comité européen est constitué comme suit:

- un bureau dont le vice-président est M. VIDME, de Vollebekk en Norvège, Secrétaire, le Dr. Van-der-ZWEEP de Wageningen.

De ce fait, le siège officiel de l'association est fixé aux Pays-Bas à Wageningen, où réside également de Trésorier M. ZONDERWIJK.

- des représentants dans la plupart des pays européens:

Allemange (FGR: Dr. H. ORTH à Fischenich (Mrs. Köln), DDR: Prof. Dr. A. HEY à Berlin-Kleinmachnow); Autriche (Directeur du Budesandstalt für Pflanzen schutz à Vienne); Belgique (Prof. Dr. J. STRYCKERS à Gand); Danemark (M. Søren THORUP à Skovelunde); Espagne (Prof. Miguel BENLLOCH à Madrid); Finlande Dr. J. MUKULA à Tikkurila); France (Dr. R. LONGCHAMP à Versailles); Grande-Bretagne (Dr. WOODFORD à Oxford); Grèce (Prof. Dr. Basil D. KRIMBAS à Athènes); Irlande (M.B. CROMBIE à Thurles, Co. Tipperary); Italie (Prof. R. CIFFERI à Pavie); Norvège (M.T. VIDME à Vollebekk); Pays-Bas (M.P. ZONDERWIJK à Wageningen); Pologne (Prof. Dr. BIRECKI à Varsovie); Portugal (Dr. J.P. AMARO à Oeiras); Suède (Dr. GRANSTRÖM à Uppsala); Suisse (Dr. W. WURGLER à Lausanne); Yougoslavie (Secrétaire de la Chambre fédérale d'Agriculture à Belgrade).

Débordant les cadres européens, le Comité compte également des représentants dans 2 pays méditerranéens: Turquie (Dr. GÖKSEL à Ankara) et Israël (M. N. LIFSHITZ à Jaffa).

II - Les groupes de travail

Un tour d'horizon sur les problèmes actuels avait déjà permis en 1959 à Stuttgart de proposer différentes orientations pour les groupes de travail qui se retrouvèrent en 1960 à Oxford pour confronter les résultats obtenus.

Actuellement, ces groupes sont au nombre de quatre; un cinquième est en formation. Ils sont ouverts à des chercheurs de différents pays appartenant aussi bien à la recherche privée qu'à la recherche officielle. Ce sont:

1) Le Groupe de Travail sur les méthodes a pour secrétaire le Dr. JOHANNES de Braunschweig (Allemagne). Les pays qui en font partie sont l'Allemagne, l'Autriche, la Belgique, le Danemark, la Finlande, les Pays-Bas, la Norvège, le Royaume-Uni, la Suède, la Suisse et la Turquie. Les réunions ont eu lieu en 1960 à Braunschweig, en 1961 à Wageningen et en 1962 à Copenhague. Ce groupe s'est d'abord proposé comme premier but de standardiser les méthodes d'experimentation en plein champ, méthodes utilisables pour l'homologation officielle des produits. Seront ensuite étudiées les méthodes d'essais en laboratoire.

C'est ainsi qu'ont été définis les tests applicables aux céréales, aux cultures spéciales, aux betteraves, aux plantes fourragères, aux herbicides totaux. L'étude de la standardisation des recherches sur les graminées adventices perennes ou annuelles, et sur Tussilago farfara est en cours. En 1962 à Copenhague le groupe a étudié le mode d'expression des résultats au moyen des échelles de notation. Au cours de la prochaine réunion sear envisagée entre autres sujets, la définition des stades de développement des plantes cultivées.

2) Le groupe de travail consacré à la Fougère Aigle a pour secrétaire le Dr. E. RÖHRIG. Son activité a été brusquement interrompue le 12 décembre 1961

par son arrestation inattendue par les autorités de l'Allemagne de l'Est, à la veille de son départ pour Versailles où il devait présider la réunion de son groupe de travail. C'est le Dr. P. BURSCHEL de Hannoversch-Münden qui a bien voulu présenter le rapport.

Ce groupe s'était déjà réuni en 1960 à Oxford. Depuis, 23 essais ont été réalisés dans 7 pays différents. 2 types de Pteridium aquilinum ont été reconnus et caractérisés: l'un dominant à l'ouest de l'Europe, l'autre au Nord et à l'Est. 4 herbicides ont été essayés: dalapon, 4-CPA, amitrole et dichlobenil. Dans ces essais, le dalapon a été très irrégulier et en général peu satisfaisant, l'amitrole s'est révélé plus efficace. Le 4-CPA n'a pas confirmé les espoirs qu'il avait fait naitre après les premières applications. Le dichlobenil essayé dans quelques pays, s'est montré prometteur.

Ces essais se poursuivent. Ils ont fait apparaître le besoin de connaissances plus approfondies sur la physiologie du Pteridium et ses réactions aux divers herbicides.

3) Le groupe de travail sur la Folle Avoine a pour secrétaire M. ZONDERWIJK de Wageninger (Pays-Bas). Il s'est réuni d'abord à Oxford en 1960, avec la participation de 25 chercheurs appartenant à 8 pays differents.

Le groupe a mis au point un programme commun de travail pour étudier l'evolution de la faculté germinative des semences de Folle Avoine dans diverses conditions de conservation. Les semences récoltées dans 7 pays différents ont été envoyées a Miss THURSTON à Rothamsted pour identification des espèces. Des essais de destruction sélective de Folle Avoine ont été réalisés avec le diallate, le barbane et le dichlobenil.

Les rapports concernant ces essais ont été discutés à Versailles en décembre 1961. Le diallate et le barbane sont apparus comme prometteurs pour lutter contre la Folle-Avoine. Les différentes espèces et variétés de Folle Avoine de diverses origines ont été comparées quant a leur sensibilité aux herbicides. Ce travail a été fait par le Dr. DAAMS aux Pays-Bas. Mr. LUSH et le Dr. PFEIFFER en Grande Bretagne.

4) Le groupe de travail sur les plantes aquatiques a d'abord eu pour secrétaire le Dr. VAN der VEIJ de Wageningen, auquel a succédé le Dr. LHOSTE de Paris. Des représentants de la Belgique, de l'Espagne, de la Finlande, de France, de l'Irlande, de la Norvege, des Pays-Bas, du Royaume Uni, de la Suède, et de la Weed Society of America, assistaient à la réunion de Bruxelles en 1962.

Après avoir envisagé les conditions de la recherche sur les plantes aquatiques dans les différents pays, les méthodes de lutte employées furent ensuite examinées. Il apparaît que les moyens méchaniques ne sauraient être abandonnés totalement au profit des herbicides. Les produits utilisés sont le dalapon, le dichlorobutyrate, l'amitrole et l'amitrole TL, et les composes dipyridilliques.

Parmi les questions étudiées, notons: l'évolution de la flore de remplacement destinée à se substituer aux plantes détruites par les herbicides, l'utilisation du diquat et du paraquat pour lutter contre les plantes immergées. Le groupe pense qu'il serait souhaitable de rechercher des méthodes permettant d'etudier les réactions des poissons et de tenter de standardiser ces méthodes.

Les rapports sur l'activité de ces différents groupes de travail paraîtront

dans Weed Research au début de l'année 1963.

5) Un cinquième groupe est en cours de constitution qui s'occupera des problèmes de désherbage en montagne.

Sa création a été proposée à Paris en décembre dernier par le Dr. WÜRGLER. De nombreux pâturages de montagne sont tellement envahis par les adventices que leur rentabilité devient aléatoire. L'extirpation des plantes ligneuses à la main est très onéreuse et elle demande une main-d'oeuvre importante qu'il est le plus souvent impossible de trouver. Les espèces herbacées à fort développement radiculaire se multiplient à un degré tel qu'il n'est plus possible de les réduire par une fumure appropriée. Le recours à des herbicides s'impose donc mais le problème se complique quand il s'agit d'éliminer les repousses régulières de Salix, de Rosa, de Rubus, de Rhododendron. D'autre part, certaines espèces ont un intérêt touristique incontestable (Trollius europaeus, Narcissus exsertus), d'autres une valeur economique (Gentiana lutea). Il faut enfin tenir compte de la nécessité de ne pas trop dégarnir les pentes pour éviter l'érosion. Il est donc nécessaire d'utiliser des herbicides sélectifs.

Il a été demandé au Dr. WÜRGLER de prendre les contacts nécessaires pour former ce groupe de travail et d'établir un programme qui s'applique aussi bien aux montagnes humides (Jura, Alpes Centrales) qu'aux montagnes sèches (Alpes du Sud, Apennins).

III - Le Journal du Comité Européen: "Weed Research".

L'absence d'une publication spécialisée sur les mauvaises herbes et le désherbage, se traduisai par la dispersion des travaux sur ces sujets dans d'innombrables revues ou journaux.

La création de "Weed Research" a été décidée à Oxford en Avril 1960, précisée à Brighton en Novembre de la même année. Le premier numéro est paru en Mars 1961. "Weed Research" est publié régulièrement à raison de 4 numéros par an. Chaque numéro compte environ 72 pages.

Les articles sont rédigés en anglais, allemand ou français et sont accompagnés de résumés dans les 3 langues.

"Weed Research" ne publie que des articles originaux retenus pour leur intérêt, la valeur du travail décrit et la qualité de la présentation. Toutes les contributions sont les bienvenues, de toutes les parties du monde, pourvu qu'elles intéressent les aspects scientifiques ou technologiques du désherbage sous toutes ses formes.

Le nombre des abonnés est en progression constante: il atteint actuellement 531, répartis dans le monde entier.

Le comité Européen a décidé de faire en 1962 un effort particulier pour trouver de nouveaux abonnés. Leur nombre pourrait être certainement augmenté pour le plus grand bien du journal et de la vulgarisation des recherches sur le désherbage.

IV - Le symposium de Paris

En 1961, le Comité Européen en liaison avec le Comité français de lutte contre les Mauvaises Herbes (COLUMA) a organisé un Symposium international qui s'est déroulé les 13 et 14 décembre dernier au palais de l'Unesco à Paris.

Plus de quatre cents participants en ont suivi les travaux. Quinze communications ont été présentées sur des produits récents ou nouveaux: fenac, amiben, amitrole, nouvelles triazines, oxazolidines-diones, dichlobenil, 3-4 dichloropropionanilide, chlorophenocarb, diquat et paraquat, melange endothal + propham, di-allate, -EPTC, barbane, PCA, "Zytron", "Garlon", dalapon, "Solan" et uraciles substituées.

Le compte-rendu de ce Symposium, jumelé avec celui des journées françaises du Columa, est actuellement en cours d'impression.

La prochaine réunion du Comité Européen aura lieu vraisemblablement à Londres en juillet 1963.

Je ne voudrais pas terminer sans insister sur le fait suivant: si le European Weed Research Council est une réussite incontestable, il la doit au dévouement de l'équipe de ses animateurs. Je suis sûr d'être l'interprète de vos sentiments en leur exprimant à tous notre gratitude, spécialement à nos amis anglais, hollandais et allemands qui se partagent les tâches matérielles aussi qu'aux sécretaires des Groupes de Travail qui ont réussi à les animer de la façon la plus fructueuse. Je me dois de désigner tout d'abord le Dr. VAN der ZWEEP dont vous connaissez tous l'activité et l'inlassable dévouement et mes predecesseurs, le Professeur RADEMACHER et le Dr. WOODFORD.

C'est à Monsieur FRYER que vont nos remerciements pour la lourde tâche d'éditeur de "Weed Research" qu'il assume avec sa coutumière bonne humeur. S'il est aidé dans la revision des textes allemands et français par le Professeur RADEMACHER et moi-même, c'est lui qui supporte seul les soucis des rapports avec les auteurs et avec l'imprimeur. C'est en verité une place très inconfortable qui requiert un travail considérable. Nous devons également remercier l'Agricultural Research Council d'avoir permis à Monsieur FRYER de travailler à l'édition de "Weed Research".

Notre gratitude va également aux souscripteurs du fonds de garantie et tout spécialement au British Weed Control Council qui ont permis de régler les problèmes financiers posés par le lancement de "Weed Research".

Nous nous devons enfin de transmettre à la maison Blackwell les félicitations qu'elle mérite pour le soin avec lequel elle imprime "Weed Research", dans la tradition de qualité qui est sa règle habituelle".

SESSION 11

Chairman: Mr. A.W. Billitt

PLANT PHYSIOLOGY

CHEMICAL CONTROL OF PLANT GROWTH

Dr. Daphne J. Osborne.

A.R.C. Unit of Experimental Agronomy,
Department of Agriculture, Oxford.

First may I say that it is a great pleasure to have this opportunity to address the members of the British Weed Control Conference. I have listened with great interest during the conference to papers describing the chemical care you give to plants to make them grow worse or better, and it seems appropriate in this last talk that someone should say a word on behalf of the plants themselves.

This talk will describe some of the ways the plant controls and modifies its own growth and development by its own endogenous chemical regulators. As we increase our understanding of the natural control mechanisms which govern growth responses, so we may well be able to devise more direct, sure and efficient ways of interfering with these processes and thereby controlling plant growth in a precise and predictable way.

Three main groups of natural chemical regulators (or plant hormones) are established. They are the auxins, the kinins and the gibberellins. It is not unlikely that there are other groups of regulators still to be discovered. But we will restrict ourselves today to the ones which we are sure are present in plants.

The auxins and the gibberellins have been extracted from many plant materials and their chemical structure is established. Kinins have been isolated from plants, but so far no natural kinin has been obtained pure or chemically characterized with certainty. The next year should give us this information, as several groups of workers are nearing success with this enterprise. We do know, however, that a number of synthetic purine derivatives are effective substitutes for the so far impure kinin preparations and we have some justification for believing that the natural kinins belong to this class of chemicals.

The widely different chemical structure of these three groups of endogenous chemical regulators is shown in Fig. 1.

The natural auxin is an indole compound (Haagen-Smit et al, 1942, Berger and Avery, 1944) and auxins, both natural and synthetic are characterized by their stimulation of the rate of growth of stem cells and their ability to induce curvature responses in serial parts.

Gibberellins may be considered as modified diterpenes or isoprenoid derivatives (MacMillan and Suter, 1958), and are characterized by promoting greater total growth of shoot cells (not simply rate of growth). This effect is most marked in plants in which the dwarfing characteristic is controlled genetically

(Brian and Hemming, 1955). At least ten different gibberellins have been isolated from plants, each differing only slightly from the others in its chemical structure.

It seems that although it is probable that there is only one natural active auxin, there are many natural active gibberellins, and different plants respond specifically to different gibberellins (Brian et al, 1962).

All the synthetic kinins are substituted purines and are characterized by their stimulation of cell divisions in parenchymatous tissues of root and shoot. Kinetin was the first synthetic kinin to be discovered (Miller et al, 1955), and it seems to be active in all the species tested so far, but we have no idea at present whether all plants respond to the same natural kinin.

These three groups of endogenous chemical regulators are known to be active in all groups of green plants, including algae, liverworts, mosses and ferns.

How are these hormones distributed in the higher plants, and in which tissues are they made?

They are all present in relatively large amounts in seeds, where they form part of the storage reserves available for the young plant during germination. It has been estimated (Radley, 1958) that in a mature bean seed, there is about 0.5 ug of gibberellin in every 100 gram of dry seed, and approximately 60 times this amount in every 100 gram of immature green seed. It is further estimated that the auxin content of an immature maize seed can be as much as 1,000 times higher than that of gibberellin in immature bean (Avery et al, 1942). We do not know the kinin content of seeds except that it is relatively high in immature endosperm of maize (Miller, 1961), and coconut (Van Overbeek et al, 1944, Caplin and Steward, 1948), and we believe this to be associated with the considerable nuclear activity and cell division in these tissues.

Auxin distribution in the whole plant is now fairly well established. The highest content is found in the most rapidly expanding tissues, in young stems and unfolding leaves; but falls to levels too low to estimate in old and senescent parts of the plant. It is synthesized in green leaves in the light (particularly in the youngest leaves at the apex), and is transported from the leaves to the stems and the parts below. There it is known to be inactivated in a number of metabolic reactions. The resulting distribution is a falling gradient in auxin concentration from the young to the mature tissues (Thimann and Skoog, 1934; Shoji et al, 1951). Tissue cultures of plants will not grow, unless supplied with auxin, so it is clear that not all cells are capable of meeting their own auxin requirements. Auxin concentrations in green plants have been variously estimated between 10 and 0.1 ppm for young tissues.

Distribution of gibberellins is not so well mapped, but they are known to be present in both young and old tissues, and are in greatest concentration in apical buds and in young expanding leaves (Lang, 1960). The work of Lockhart (1957) suggests that gibberellin, like auxin, is synthesized primarily in the buds. We know too, that the nature and content of gibberellins changes in the plant as it ages, and as it progresses from the vegetative to the flowering condition (Harada and Nitsch, 1959). It is reported that tissue cultures contain endogenous gibberellins (Nickell, 1958), and certainly additional gibberellin is not necessary for their continual growth; it is possible, therefore, that all cells can make some gibberellin. We have no measurements of kinin contents in

different parts of plants, but experiments suggest that old tissues are low and probably deficient in kinins (Osborne, 1962). Since tissue cultures require the addition of a kinin for continued growth, it is unlikely that all cells have the capacity to synthesize kinins.

In what ways do these regulators affect plant growth?

Let us see first what happens if we apply them to the whole plant.

1. Auxins

You are all well aware of the effect that a spray of a synthetic auxin (2,4-dichlorophenoxyacetic acid or 2,4-D) will have. After 24 hours, the young parts of the plant, show interesting bends of leaf and stem. By another 4 or 5 days the apical bud is swollen and stunted and the stem is split, revealing cell proliferations and sometimes root formation in the cortex. More often than not the plant does not recover, and so remains permanently stunted and malformed.

If instead of 2,4-D you were to spray the plant with the auxin we extract from plants (indole-3-acetic acid or IAA) you would observe the twisting stage in the young parts, due, we believe, to an initial uneven distribution of auxin, but the plant would recover! And unless you applied a continuous source of the auxin no deformities would occur. This fundamental difference between IAA and 2,4-D is, we assume, partly due to the rapid metabolic inactivation of natural auxin (but not of the synthetic auxin) that occurs in plant tissues (Andreae and Good, 1957).

2. Gibberellins

The application of gibberellins to plants, particularly to those that are genetically-controlled dwarf varieties, results in a tremendous and prolonged increase in growth of the younger tissues. Dwarf peas will grow as tall as standard peas after the application of 1 µg of gibberellin, and internode growth of lettuces has been so enhanced that they have grown to look like twining vines. But no deformities are observed after a gibberellin treatment and these very tall plants mature and set viable seed. Gibberellins also stimulate flowering in certain plants, particularly those that require long day or cold treatment for flowering, and modify the growth of lateral buds (Brian, 1959), but we shall return to that later.

Auxins or gibberellins need only be applied to limited areas of the plant in order to induce responses in all the young aerial parts, showing that both these hormones are readily transported in the plant. Auxins, are moved most readily from apex to base in young tissues (van der Weij, 1932) i.e. their movement is strictly polar, whereas gibberellins will move with equal ease up or down a piece of stem tissue (Kato, 1958).

3. Kinins

Synthetic kinins differ from auxins and gibberellins in this respect. They appear to be immobilized (Mothes et al, 1959) in the parts to which they are applied, (although the natural kinins may well be mobile), but like the auxins, and gibberellins, the kinins cause growth responses in young rather than in old tissues. For instance, they induce greater increases in the growth of young leaves than mature leaves. I shall however, show you that the longevity

and functional life of a leaf is still under hormonal control, even though all visible growth in size has ceased. These hormones, in fact, must control the biochemistry of every cell in the plant from its time of production at cell division, until its ultimate senescence and death. We have seen that as the cells age there is a change in the levels of the different hormones in the tissues, and there is also a change in the actual environment of the individual cells. They become confined in what may be called a physiological straight jacket, which is determined by the type of differentiation and mechanical structure as a whole.

Let us see how these hormones regulate the growth of cells. We will look at this first in a young green pea plant. A section cut from just below the apex and put into a solution of sucrose and auxin will extent 60 per cent in 12 hours. Sections from older parts of the stem will extend by 30 per cent and mature tissues will not extend at all. There is, therefore, an age response to auxin (Fig. 2). This 'age' effect is composed of a change in sensitivity of the cells to auxin, and an increasing 'straight-jacket' effect of the surrounding tissues.

If we give gibberellin to any of these sections we find that they do not respond. There is little or no increase in growth. But auxin and gibberellin together give more growth than auxin alone (Fig. 3). From this, and many other experiments of this kind (Brian and Hemming, 1961), we conclude that both these materials are necessary for maximum growth. This also suggests that both gibberellin and auxin are present in sub-optimal amounts and that an insufficiency of these hormones limits growth in sections. Furthermore, gibberellin is not functional unless sufficient auxin is there as well.

Now let us see what happens in the whole pea plant (Fig. 4). Gibberellin will increase total extension of internodes when supplied along (Brian and Hemming, 1955). If auxin is added together with gibberellin, there is very little further increase, and auxin alone has no effect. We presume, therefore, that there is an adequate supply of auxin for growth of the cells in the stems of the whole plant.

We said earlier, that auxin is formed in the buds, so it is not surprising that if we cut off the bud, there is no growth response to added gibberellin. However, if we supply auxin to the cut tip (Brian and Hemming, 1958), gibberellin will again cause elongation (Fig. 5). Therefore, we conclude that in intact plants, the apical bud supplies an adequate amount of auxin to the stem, but that extension growth is, in some way, limited by a deficiency of gibberellin. In other words, some constraint on growth is alleviated by gibberellin.

There is some doubt as to the actual function of gibberellin in stem elongation. It has been suggested that gibberellin releases auxin from some unavailable form in the stem and so permits an increase in growth. Actual measurements of auxin content in gibberellin-treated stems are conflicting. Mayashi and Murakami (1957) have reported no change, while Nitsch (1959) has reported large changes in a very short time. It is possible also that gibberellin antagonizes an endogenous inhibitor of growth, which we have not yet identified. Most important, however, is the evidence which suggests that gibberellin controls particular phases of the growth of cells, and that its action is quite separate from that of auxin, although still dependent upon the presence of auxin. But before I talk about the effects of hormones on phases of growth of cells, I want to tell you of the effects of kinins and on the elongation growth of our green pea stems.

Now, the effects of kinins on stem growth of whole plants is rather variable. Slight stimulations have been reported, but more usually there is no response or some retardation of growth, and this is true also for sections of green tissue. When kinetin is supplied with auxin to green pea segments, the growth in length is less than that with auxin alone (Fig. 6). But this is a result which must be looked at carefully, for it is found that the growth in volume of the cells is not actually less, but is enhanced. Kinetin has caused an increase in the thickness of the section and less growth in length (Hashimoto, 1961). Kinetin causes similar reductions in length in gibberellin treated sections also, and it seems that kinins may be important in determining the orientation of the growth induced by auxins and gibberellins.

I hinted that evidence existed that the response of growth in length to applied hormones may be very much dependent upon the age or phase of development of the cells. In oat coleoptiles, for instance, (Fig. 7) it was found that the youngest cells showed the greatest response to gibberellin, older cells to kinetin, and in the last stages of growth the cells showed the greatest response to auxin (Wright, 1961).

One can think of the normal growth in size of stem cells, therefore, being under the multiple control of all these kinds of hormones; each one playing the major determining role in turn, but all of them being essential for full growth and differentiation of the cell, and none of them being fully effective without the others.

Let us now turn our attention to the control of cell division in the plant. We know that proliferations of the parenchyma occur in stem tissues following treatment with a synthetic herbicide, and sometimes roots are produced from the stem, sometimes a mass of undifferentiated callus is formed.

We said earlier that the kinins were characterized by their stimulatory effects upon cell division. The discovery of this group of hormones was the result of a search for the active material present in coconut milk, without which plant tissue cultures cannot survive. The active factor is not yet isolated, but kinetin, which is a synthetic product formed by degradation of DNA, was found by Miller and Skoog to be an effective substitute for the active factor of coconut milk. Kinins are, by definition, substances which will, in the presence of auxins, maintain continued proliferations of a plant tissue culture.

You will immediately notice in Fig. 8 a very important point, namely that kinetin, like gibberellin is not effective unless auxin is present also. Auxin is a necessary requirement for expression of both gibberellin and kinin activity. The cells of a freshly isolated tobacco pith will enlarge a little under the stimulus of the residual endogenous hormones in the cells, but will soon cease growth entirely. Only those cultures supplied with auxin and kinin together will continue to grow and divide indefinitely.

Work on tissue cultures over the past eight years, particularly that of Skoog and Miller (1957), has enormously widened our understanding of the hormonal control of morphogenesis. If pieces of pith tissue cut from the middle of tobacco stem are cultured under aspetic conditions in auxin or kinetin alone and in increasing concentrations of kinetin combined with the auxin, one finds the following remarkable responses (Fig. 9). In auxin alone the cells will expand and then cease to grow (they do not divide), in kinetin alone there is no growth at all. With low kinetin concentrations plus the auxin, the tissue will

enlarge, divide and produce numerous roots, at higher kinetin concentrations plus auxin a mass of undifferentiated loosely packed callus will develop but no roots, if the kinetin concentration is increased further, a callus tissue develops with numerous leafy bud-like outgrowths. The highest kinetin concentration together with auxin, causes the production of an undifferentiated callus with small, closely-packed cells. You see that by suitable modifications of the auxin/kinin balance similar original tobacco pith cells will produce tissues which are morphologically different.

You will have noticed already that the production of a loose callus, or the formation of roots occurs when the auxin content is high relative to the kinin content. This is the balance which we would expect to find in the stems of plants sprayed with 2,4-D, and may well be an explanation for the production of these deformities in plants treated with auxin herbicides.

Although some stimulation in the growth of tissue cultures has been reported, added gibberellins have little effect on these systems, and this may be because callus cells can make enough gibberellin of their own. Gibberellins do however have marked effects on cell divisions in intact plants. If gibberellins are applied to many rosette, or long-day plants, for instance, remarkable results occur. The normal rosette condition is changed. There is a stimulation of meristematic activity in the bud, the new internodes elongate and a tall stem is produced which will eventually flower (Lang, 1956). The effect on meristematic activity is rapid (Fig. 10). Within 24 hours of application of gibberellin to the bud of a Hyoscyamus plant, a three-fold stimulation of cell division is observed in the sub-apical meristem and about 70 per cent of these divisions are in a plane perpendicular to the stem axis, i.e. in the direction to give increased stem length (Sachs and Lang, 1957). Gibberellin therefore stimulates mitotic activity in these cells. Lang (1960) and Nitsch (1957) have confirmed that the endogenous content of gibberellins is increased during normal bolting and flowering in long-day plants.

So we see that here too, the course of cell division in the plant is controlled by the delicate balance of endogenous hormonal concentrations, and it is possible that the rosette form of biennial plants, is the expression of a deficiency of natural gibberellins.

Gibberellins also have marked effects on growth and dormancy in other kinds of buds, in potato tubers for instance, and in buds of certain woody species. A remarkable example of gibberellin control of bud growth has been reported for a stolon bearing plant, the potato, by Booth (1959).

If the apical bud of a potato plant is removed, and gibberellin is supplied to the cut end, the dormant buds below the apex will grow upwards as normal leafy shoots. If auxin alone is supplied, the growth of these buds is retarded, but if auxin and gibberellin are supplied together the buds will produce shoots with reduced, scale-like leaves and elongated internodes, which grow downwards towards the soil.

This property of mixtures of hormones to modify the growth habit of the whole plant could have a useful application in the weed control of particularly recalcitrant species. Perhaps if shoots of these species could be induced to develop in a way which is different from the normal pattern for the species the plants would then become susceptible to treatments with the very same weedkillers to which they are usually so resistant.

Let us now consider what effects these hormones have on the growth and development of leaves.

Intact leaves, particularly those of monocotyledons, show increases in size when treated with gibberellin. If one observes the response of individual parts of oat or wheat leaves of different ages, one finds that different responses occur at different stages of maturity. (Fig. 11). In the youngest parts auxin depresses growth, so that there is less growth when auxin and gibberellin are applied together than when gibberellin is applied alone. Both materials together cause a slight synergistic effect in the very young parts of wheat leaves, but a greater synergistic effect in older parts of leaves (Radley, 1958). In even older parts, auxin alone will give a small stimulation (Hayashi and Murakami, 1954). This demonstrates a changing response to gibberellin and to auxin as the tissues age. Applications of kinetin appear to be without effect on these leaves. It would seem, therefore, that in the youngest parts of the leaf, as in the intact stem, sufficient auxin is available but growth is limited by an insufficiency of gibberellin. In older leaf cells, external supplies of both auxin and gibberellin are required to initiate a growth response, and in even older parts, auxin alone would appear to be deficient. Although kinetin has little effect on the monocotyledonous leaf, the leaves of dicotyledonous herbaceous plants show considerable growth responses to kinins as well as to gibberellins. Increases in area are found in discs punched from young or immature radish leaves if they are supplied with kinetin or gibberellin alone, and an even greater response is obtained when kinetin and auxin, or kinetin and gibberellin are supplied together (Kuraishi, 1959). In each case, the growth is entirely the result of an increase in cell size. In the case of radish, both young and mature leaves react to gibberellin and kinin alone, although neither react to small amounts of auxin alone which suggests that a lack of auxin does not limit the expansion of these leaves.

It is perhaps relevant here to draw attention to a rather obvious point, namely, that the youngest part of the leaf, the part that is most likely to be damaged by additional auxin, is always protected by outer leaf bases in monocotyledonous plants. It is the older parts of leaf, which might even be requiring auxin, which catch most of a spray. In dicotyledons on the other hand, young leaves are directly exposed to a spray treatment and their growth and that of the bud can be seriously affected. It is important to mention here that excised pieces of monocotyledonous and dicotyledonous tissues respond to roughly the same concentration of applied hormones. The great differences in susceptibility are seen only in the intact plant!

Our own studies in the retardation of senescence in leaf cells by hormones have revealed some interesting new facts about hormonal changes that occur in leaves during the last stages of their lives.

If we cut off a leaf from a tobacco or Xanthium plant when it has ceased all visible growth in size, and put it in water, it will soon turn yellow and die. If the leaf is not too old, however, it will form root initials along its petiole before the leaf becomes yellow, and if this happens the leaf will stay green and live for years. It seems, therefore, that the presence of roots is essential for maintaining the life of leaves. But if we spray a leaf with kinetin, the treated parts will stay green and functional (Fig. 12) for many days without any formation of roots. Therefore, we deduce that roots supply a factor to the leaves, which keeps the leaf in a functional condition, and that kinetin replaces this 'root-factor' (Richmond and Lang, 1957; Osborne, 1962). The yellowing and

senescence of Xanthium leaves cannot be prevented by either auxins or gibberellins, only by kinins. A supply of kinetin will also stop a leaf yellowing if it is still attached to the plant, and we conclude from this that there is a deficiency of kinins in Xanthium leaves as they approach senescence.

We also believe that the relative change in hormone balance with age is not the same in all species. For example, we found that if cherry leaves are removed from the tree at different times during the year and kept in water, yellowing or other senescent changes can at no time be prevented by kinetin. From September onwards they <u>can</u> be prevented by an auxin (Fig. 13). The part of leaf which is treated remains green and metabolically active for several weeks after the untreated parts have turned yellow (Osborne and Hallaway, 1960). From April to September, however, auxin is effective only after considerable senescent change has already taken place. It is never immediately effective. We do not yet know which factor is required by leaves at this younger age but it is possible that they are relatively deficient in gibberellin in these early stages, and this is a thing we have to find out.

We know that deciduous species drop their leaves in the autumn as a response to a decreasing day length, and since we know that auxins are synthesized by green leaves in the light, a deficiency in auxin from September onwards, when day length is getting shorter, is not altogether surprising. In fact it provides an example of how the hormonal status of the plant can reflect the changes in external environment.

I have dealt with a very limited number of ways in which we believe the plant controls its own growth processes, by its own chemical regulators. As you have seen, we have investigated these processes, as far as we now understand them, by artificially altering the natural balances of these chemicals in the plant and observing what effect this has upon plant growth. I have tried to bring out in this talk how both the age of the plant and the environment in which it lives will change the balance of these endogenous growth regulators, and how they in turn, control the growth and development of the whole plant. It is not therefore surprising that variable responses to chemical weed killers are frequently found in practice, for these responses are, to a very great extent, determined by the physiological condition of the plant. We are only beginning to understand how cells grow and collectively give rise to parts and organs of different form and function, and as yet we have only a modest knowledge of how to modify these processes. But as our understanding deepens, we also increase our chances of being able to modify the growth processes of plants in ways which will be of the greatest usefulness and advantage to man.

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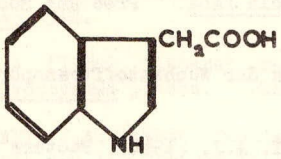
FIG. 1

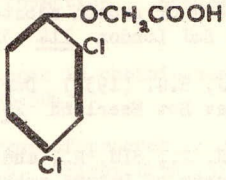
AUXINS



INDOLE-3-ACETIC ACID

IAA

(naturally occurring auxin)

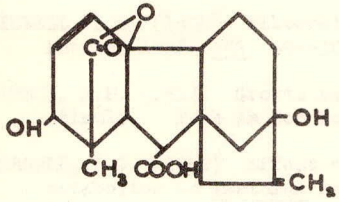


2,4-DICHLOROPHENOXYACETIC ACID

2,4-D

(synthetic auxin)

GIBBERELLINS

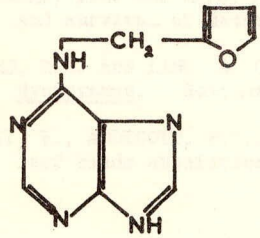


GIBBERELLIN A_3

GA

(naturally occurring gibberellin)

KININS



KINETIN

6-FURFURYLAMINOPURINE

K

(synthetic kinin)

FIG. 3

SELECTIONS FROM GREEN PEA PLANT

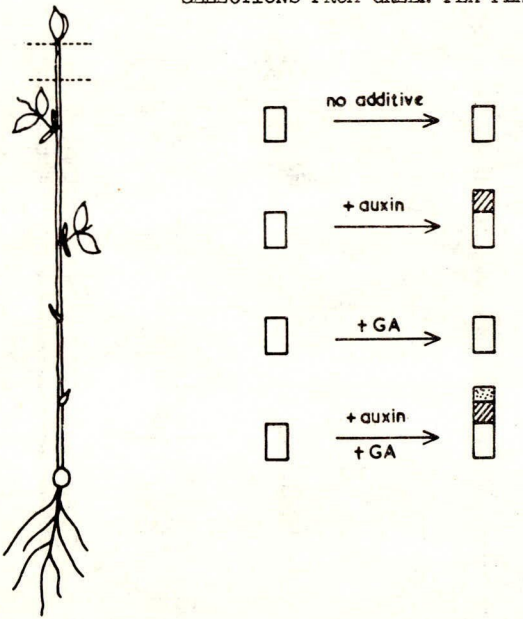


FIG. 2

GREEN PEA PLANT

Relative increases in length of segments of different ages in response to auxin

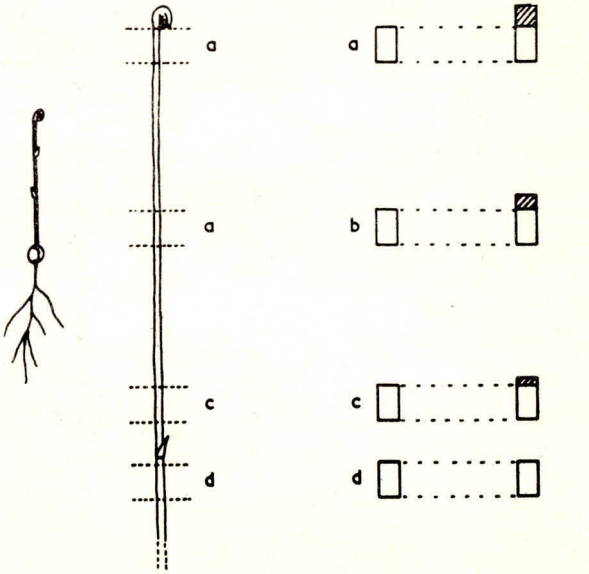


FIG. 5

DECAPITATED GREEN PEA PLANTS

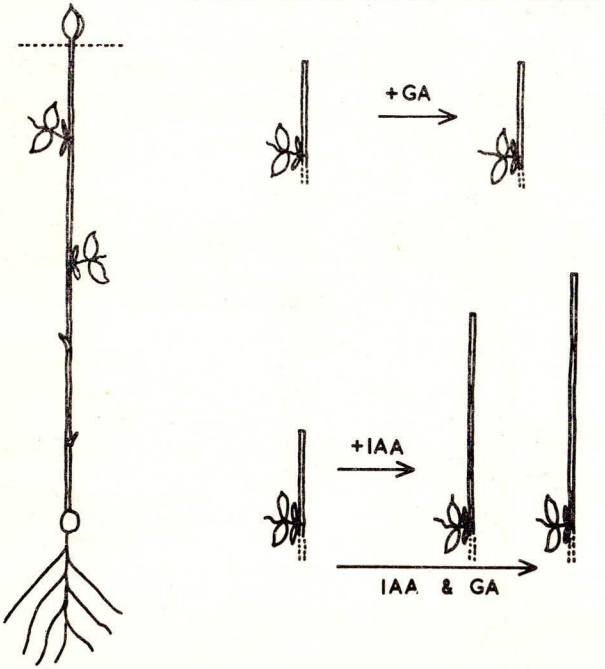


FIG. 4

INTACT GREEN PEA PLANTS

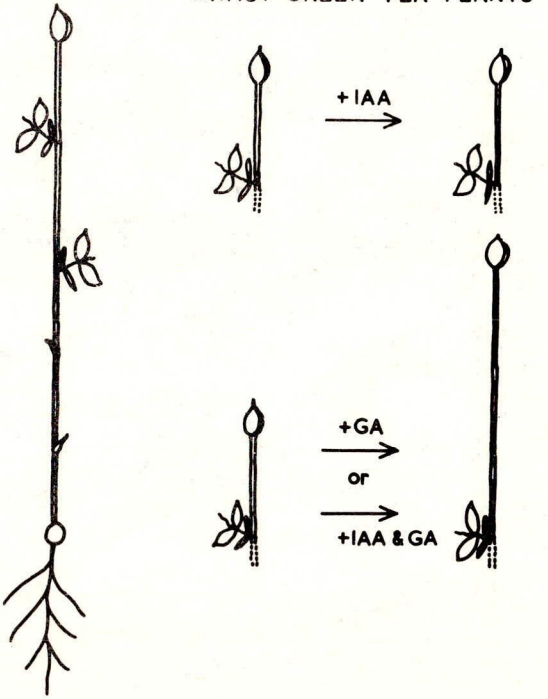


FIG. 7

GROWTH RESPONSES OF COLEOPTILES OF DIFFERENT AGES

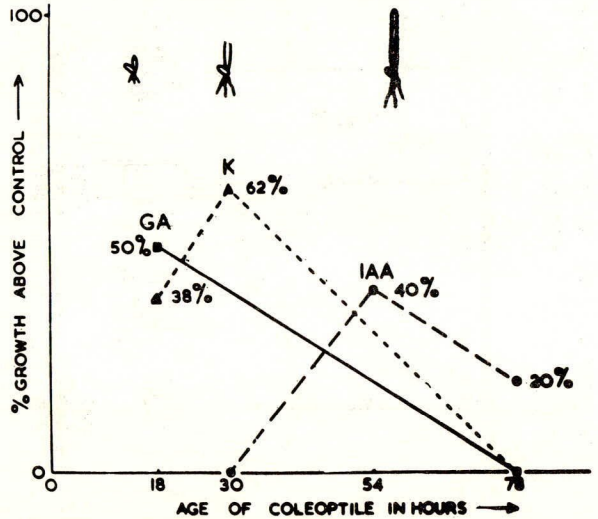


FIG. 6

GREEN PEA PLANTS

Effect of auxin and kinetin on growth of stem segments.

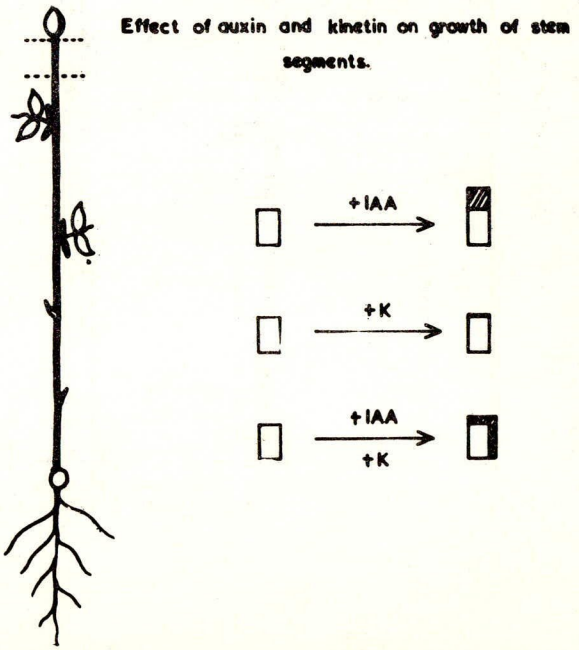


FIG. 8

GROWTH RESPONSES OF TOBACCO PITH TO AUXIN AND KINETIN

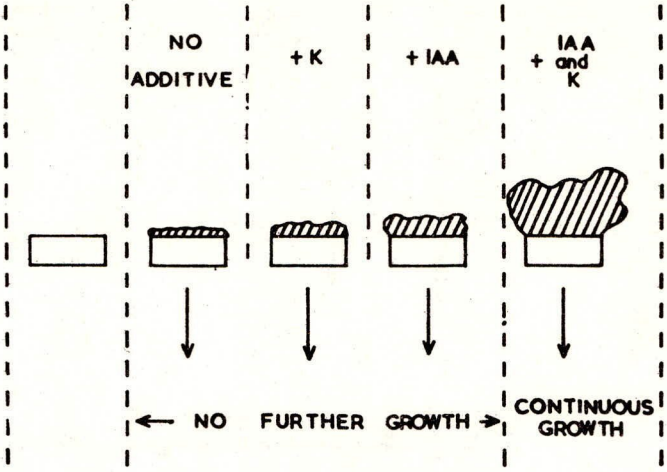


FIG. 9

MORPHOGENETIC EFFECTS OF AUXIN AND KINETIN IN TOBACCO PITH

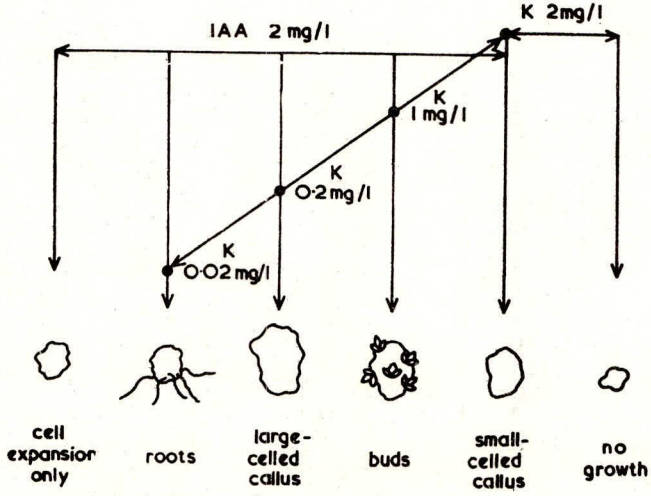


FIG. 10

EFFECTS OF GIBBERELLIN ON CELL DIVISION IN MERISTEM OF ROSETTE PLANT

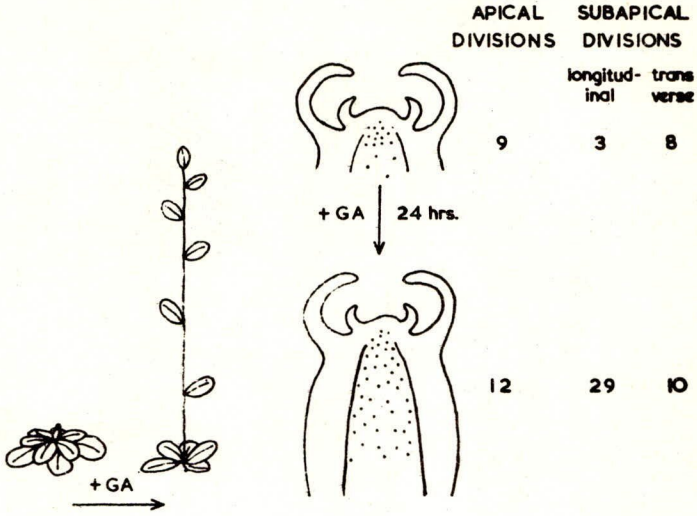


FIG. 11

EXPANSION OF LEAF SEGMENTS OF DIFFERENT AGES IN AUXIN, GIBBERELLIN & KINETIN

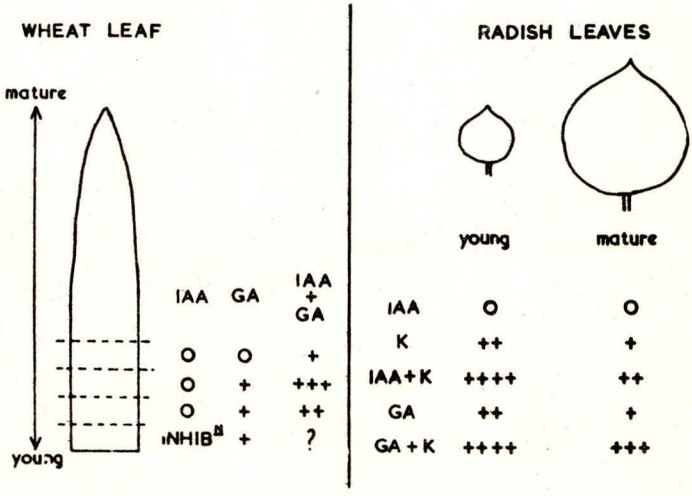


FIG. 12

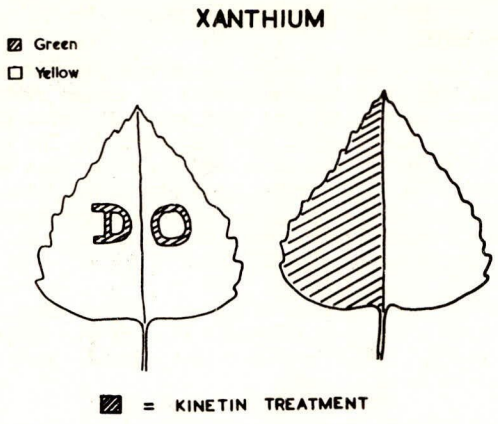
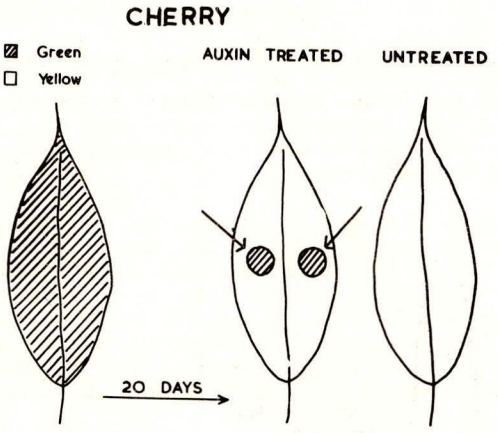

XANTHIUM
Green
Yellow
DO
= KINETIN TREATMENT

FIG. 13


CHERRY
Green
Yellow
AUXIN TREATED
UNTREATED
20 DAYS

Discussion of preceding paper

MR. A. LAMBLE I would like to refer to Dr. Osborne's point about the possibility of applying some materials to plants to change root form for instance. Some years ago, we followed up some work by Sexton which showed that atrolactic acid upset the geotropism of the root system. The experiments were tried with bean plants and the herbicide monuron and the idea was to bring roots up to the surface to see if plants treated with atrolactic acid were more sensitive to monuron applied to the soil surface than ones not treated. The experiments did not prove promising and were discontinued, but the idea was considered some while ago by a commercial firm.

DR. D.J. OSBORNE This is just the kind of thing I had in mind. Perhaps we can in some way make the plant grow in a different kind of way - upset its natural processes of growth control. But first we must find out about its natural processes, and then try to modify them.

PROFESSOR G.E. BLACKMAN With Salvinia we did in fact make the plants grow faster and bigger with 1,3-diphenyl urea, but only for a short time.

DR. D.J. OSBORNE This compound would have come under the heading of a synthetic kinin, since we know that 1,3-dimenthyl urea is a factor present in coconut milk, and has a weak kinin activity in tissue culture. Synthetic kinins are very effective in making leaf blades grow larger. This raises a very interesting possibility. We know there is a species specificity for gibberellin but we know very little about kinins. There may be a species specificity for kinins also.

PROFESSOR G.E. BLACKMAN The effect of kinetin on leaf expansion in Salvinia is critically dependent on their stage of development. If the leaves are very young their growth is stopped. If they are in the middle stage it makes them bigger. If they are fully expanded, there is no effect. With 1,3-diphenyl urea the stage of development is much less important.

DR. J.R. HAY I would like to commend Dr. Osborne for her fine presentation and to suggest that many of us who splash the herbicides around reconsider some of our concepts. For a long time we have known that there is an optimum time to apply herbicides. It has been widely assumed that this is due to translocation - perhaps this is an oversimplification and that the level of other growth regulators with which the auxin herbicides interact may regulate activity. Since we have difficulty in killing weeds with 2,4-D as they get older, I would like to ask Dr. Osborne if she thinks that the ageing can be reversed.

DR. D.J. OSBORNE The general process of ageing does not appear to be reversible although we may find ways of doing this in the future. As far as leaves are concerned, it seems that one can only arrest their ageing at a certain point, for a considerable length of time, but we cannot push the processes backwards to any appreciable extent. In none of the experiments so far has there been a case of leaves becoming younger. One can stop the clock but nothing else.

MR. G.F. MILFORD Dr. Osborne has dealt lucidly with more positive types of growth substances. However there have been reports of natural growth inhibitors. How does Dr. Osborne fit these into her scheme of chemical growth control, and does she think that for firms interested in discovering more efficient herbicides

a study of growth inhibiting rather than growth promoting compounds might be more profitable?

DR. D.J. OSBORNE Yes, your point is well taken. This might well prove a very fruitful field of research. Many people have incorporated inhibitors into their schemes of growth control. One of the suggestions that has been made for the growth stimulating action of gibberellins involves its function as an antagonist of a natural growth inhibitor. I did once do some work on the endogenous inhibition of growth that occurs when natural auxin is supplied to plants. They grow a little bit if they are supplied with a small amount of indole-3-acetic acid, but afterwards they are not so readily able to respond to a second dose of auxin. But this is not true of synthetic auxins, such as 2,4-D. However, it is more difficult to look for inhibitors than it is for materials with more positive responses and specific inhibitors are difficult to find and assay. But I do agree that this is a fruitful field of research and might well lead to materials which could be useful.

MR. F.A. ROACH I was interested in Dr. Osborne's talk and in Professor Blackman's remarks. They have a bearing on problems in apples. We have been doing some work with urea sprays and have noticed that they increase the flower buds the following year in spite of the fact that leaf analysis showed an adequate nitrogen level in the control trees. We thought that this might be having an effect in the hormone system. Might this clarify Professor Blackman's remarks? Are we getting the right balance of kinins and auxins?

DR. D.J. OSBORNE Urea itself does not show kinin activity, but have you thought of doing analysis for gibberellins? There might be a gibberellin change which results in the development of flower buds, rather than vegetative buds.

MR. A. PILSWORTH I thought it may be of interest to the speaker and the audience to know that for the past four years my colleagues and I have been working on the development of a method of using auxin type chemicals such as 2,4-D combined with trace minerals to obtain a growth stimulus which can be sustained to show significant increases in yield. Indeed as we learn more about the chemistry of physiological processes, it appears to us that not only will it be possible to obtain yield increases, but also to direct the pattern of growth, by inserting selected organics at the junctions of the various paths which these processes follow. Fundamental research work in Canada and the U.S.A. has shown how the stimulating effect of 2,4-D can be harnessed by applying, at the same time, mineral elements in a carefully balanced mixture, and similar work has already been sponsored in this country by my company.

DR. D.J. OSBORNE What was the material used?

MR. A. PILSWORTH 2,4-D

DR. D.J. OSBORNE This raises the point that if one can keep all of the plant growing very much better, one might get tremendous increases in yield.

MR. P. BRACEY Phtalamic acids sprayed on to plum shoots from which flower buds have been removed, appear to cause the production of another flush of bloom, in which the individual flowers are on long stems and not as short trusses of flowers.

DR. D.J. OSBORNE I'm afraid that at present we have no information on phthalamic acid effects on hormonal balances in the plant.

SESSION 12

Chairman: Mr. M. N. Gladstone

BUSINESS MEETING

MINUTES OF THE CONFERENCE BUSINESS MEETING HELD AT 3.15 P.M. ON THURSDAY, 8TH NOVEMBER, 1962 AT THE GRAND HOTEL, BRIGHTON

Present: Mr. M. N. Gladstone (Chairman)
Mr. H. S. Leech (Treasurer)
Miss C. Bloemink (Secretary)

together with about 50 members of the Conference.

Mr. Gladstone expressed apologies for absence on behalf of the President, Dr. H. G. Sanders, who was unable to be present.

1. MINUTES OF THE BUSINESS MEETING OF THE 1960 CONFERENCE

The Minutes of the meeting held at Brighton on 10th November, 1960, having been circulated to each Conference member, were taken as read, and agreed as a true record.

2. ELECTION OF PRESIDENT

Mr. Gladstone announced that, in accordance with the Constitution of the British Weed Control Council, Dr. H. G. Sanders, the President, retired from office after the Conference. Dr. Sanders had, however, agreed to present himself for re-election if nominated, and Mr. Gladstone asked for nominations for the office of President for the period of two years until the next Conference. Mr. Longmate proposed Dr. Sanders and Dr. Holmes seconded the proposal which was carried unanimously. Mr. Gladstone said he would convey this decision to Dr. Sanders and would also, on behalf of Council, express its appreciation of his services in the past and thank him for accepting office for a further two years.

3. SECRETARY'S REPORT

The Secretary's Report covering the activities of the Council since the 1960 Conference had been circulated to all Conference members and Mr. Gladstone asked for comments. There were none, and Mr. Hayhurst moved the adoption of the Report; the proposal was seconded by Mr. D. J. S. Hartt and carried unanimously.

4. FUTURE ACTIVITIES OF THE COUNCIL

Mr. Gladstone invited suggestions as to which way the Council should direct its future activities. Mr. K. W. Hole suggested that Council might look into the question of public relations in regard to either real or imagined dangers in the use of various chemicals on the land. This had been referred to already by some speakers at the Conference. Mr. Gladstone said that Council had this matter very much in mind and had taken due note of the suggestion made by Mr. B. R. Roberts the previous day to have a session or part of a session devoted to this particular aspect at a future Conference.

5. ANY OTHER BUSINESS

Mr. Gladstone reported that a Resolution had been tabled for consideration at the Business Meeting. The Resolution had been proposed by Mr. J. G. Elliott, seconded by Mr. G. B. Lush and supported by 21 signatories. It was therefore in accordance with Item 13(d) of the Constitution. It read as follows:

> " In view of the great difficulty encountered in obtaining experimental results in time to produce research reports of a sufficiently high standard at this and earlier Conferences, it is proposed that future Conferences be held after the end of November and it is suggested that the second full week in December be considered."

Mr. Elliott said that he, as proposer of the Resolution, would like to make the point that it had been extremely difficult for Session Organisers to arrange their sessions satisfactorily and in time owing to papers not being available by the deadline date. This was due to the fact that the date set was too early for the results of trials to be properly analysed and collated. Moreover, for this particular Conference, important research information regarding certain crops such as kale, potatoes and all the root crops could not be included because harvesting had been too late to allow for the necessary information to be made available. He felt that there was a danger of lowering the national and international reputation of British Weed Control Conferences through a general lowering of the standard of research reports. Dr. Holmes said that this matter of timing had frequently been discussed in Council. The view of the industry had always been that if the Conference were held later than the first week of November, it would not be possible to incorporate new developments and recommendations in trade literature for the coming year. He felt however that this was no longer the case and was in favour of the Conference being held later and suggested early in January. Mr. Gladstone and Mr. Hartt supported Dr. Holmes' views, Mr. Hartt also being in favour of early January as a suitable time. Dr. Holly suggested that January would not be suitable because of the tremendous onus on the secretariat and mentioned particularly the considerable amount of work that devolved on the Conference Programme Secretary and the fact that the greater part of his work would have to be done over the Christmas period. In reply to a suggestion from Mr. Gladstone that the end of November might be a compromise, Mr. Carpenter disagreed and said that even the middle of December was not quite time enough to bring papers up to the required standard. Mr. Fryer also spoke in favour of a later Conference as he felt that then a higher standard could be reached with a consequent increase in prestige of the British research worker. Mr. Lush felt that mid-December would at least give another four or five weeks for harvesting of trials and it was important that the result of the current year's work should be included. He was against early January, however, because he felt that research workers should be engaged on plans for the coming year. Mr. Gladstone said that commercial firms would probably find that their own industrial representatives would be too occupied with the coming year's sales or marketing plans to attend a Conference at this time of year. Dr. Woodford spoke in favour of mid-December as a suitable time and mentioned the successful French Weed Control Conference which had been held in mid-December, 1961. To assist in making a clear recommendation to Council, a ballot was held with the following result:

In favour of first week of November	1
In favour of mid-December	19
In favour of January	19

5. ANY OTHER BUSINESS (contd)

Mr. Gladstone said that the recommendations put forward at the business meeting would be placed before Council which would make the final decision.

In response to Mr. Gladstone's request for comments and criticisms on the 1962 Conference, Mr. Fryer said that, in his opinion, this Conference was an improvement on earlier Conferences as a correct balance had been struck. There was, however, general criticism that the discussions had been disappointing. Dr. Holmes put forward the suggestion that in future perhaps Session Chairman could be ready with one or two pertinent questions should the discussions be off to a slow start and Mr. K. W. Hole supported this view. Referring to the lively discussion which had been provoked at the previous session on the paper "Chemical control of plant growth", Mr. Gladstone suggested that this subject might have been usefully put earlier in the Conference programme when a larger audience might have been expected. Dr. Woodford however said that this was a rather specialised topic and he felt that at a future Conference such special subjects might with advantage be discussed at separate concurrent sessions. This idea was not favoured by other Conference delegates. Dr. Woodford spoke in favour of the procedure used in Canada whereby abstracts of research reports were reproduced by means of Xerography, thus saving much time and money, each delegate being given a bound copy of the reports. Both Mr. Bagnall and Mr. Carpenter felt however that it was more worth while to have fuller more detailed reports available to delegates for study as at present. Mr. Lush spoke of the difficulty of hearing foreign speakers, resulting from a combination of a foreign accent and poor acoustics, and suggested that such speakers might have a "trial round" before their actual session. There was some discussion on the timing of the last session of the Conference and of the Business Meeting and one suggestion was that the final session should end at 1 p.m. on the last day, the afternoon being devoted to the Business Meeting. Miss Thurston pointed out that the names on the Conference badges were not in a large enough type.

Mr. Gladstone thanked the meeting for the various suggestions put forward and said that due note would be taken of the points raised.

Mr. Gladstone then closed the Conference by expressing his thanks and appreciation to all those who had helped to make the Conference a success and particularly mentioned the management and staff of the Grand Hotel who had been most co-operative and helpful.

SECRETARY'S REPORT

ACTIVITIES OF THE COUNCIL SINCE THE 5TH BRITISH WEED CONTROL CONFERENCE.

MEMBERSHIP OF THE COUNCIL.

Changes in membership of the Council that have occurred are as follows:

Mr. W. S. Rayfield has replaced Mr. R.B. Ferro as headquarters representative of the Ministry of Agriculture, Fisheries and Food.

Dr. E. Holmes resigned as an A.B.M.A.C. representative on the Council due to his retirement and was replaced by Mr. H.C. Mellor.

Dr. E. Holmes was co-opted as an independent member of the Council.

Dr. H. Martin has replaced Mr. G.L. Baldit as representative of the S.C.I. on the Council.

The period of co-option of Col. J.F. Cramphorn (N.A.C.A.M.) and Mr. W.F.P. Bishop (N.A.A.C.) as members of the Council in their respective capacities of Chairman and Secretary of the 1960 Conference Organising Committee was extended to 31st December, 1962 to cover similar duties in connection with the 1962 British Weed Control Conference.

Mr. M.N. Gladstone and Miss C. Bloemink were re-elected as Chairman and Secretary respectively of the Council for a further period of two years, Mr. H.S. Leech was re-elected as Treasurer of the Council for a further period of two years.

Mr. W.A. Williams, Secretary of the A.B.M.A.C., has attended meetings of the Council during the past two years.

The full membership of the Council is therefore now as follows:

President: Professor H.G. Sanders

Chairman: Mr. M.N. Gladstone

Treasurer: Mr.H.S. Leech

Members

Dr. R. de B. Ashworth - M.A.F.F.
Mr. A.W. Billitt - A.B.M.A.C.
Mr. W.F.P. Bishop - N.A.A.C. (co-opted)
Mr. M.S. Bradford - N.A.C.A.M.
Dr. E.E. Cheesman - A.R.C.
Col. J.F. Cramphorn - N.A.C.A.M. (co-opted)
Mr. C.V. Dadd - M.A.F.F.
Mr. S.A. Evans - M.A.F.F. (co-oped)
Mr. D.J.S. Hartt - A.B.M.A.C.
Mr. R.G. Heddle - Department of Agriculture for Scotland.
Dr. E. Holmes (co-opted)

Mr. D.J. Columbus Jones - M.A.F.F.
Mr. R.E. Longmate - N.A.A.C.
Mr. H.C. Mason - N.F.U.
Dr. H.Martin - S.C.I.
Mr. H.C. Mellor - A.B.M.A.C.
Mr. F.W. Morris - N.A.A.C.
Mr. W.S. Rayfield - M.A.F.F.
Mr. D. Rhind - Dept. of Technical Co-operation
Mr. J. Rhodes - M.A.F.F.
Mr. D.W. Robinson - Ministry of Agriculture for Northern Ireland
Dr. R.E. Slade - N.F.U.
Mr. W.A. Williams -
Dr. E.K. Woodford - A.R.C. and A.A.B.

Secretary: Miss C. Bloemink

Full meetings of the Council have been held quarterly and, in addition, the various Committees of the Council appointed to deal with special aspects of the Council's work, have met at intervals during the past two years. Membership of these Committees are as follows:

Research and Development Committee

Mr. R.B. Ferro of the Ministry of Agriculture, Fisheries and Food who had been the Chairman of the Committee, resigned from the Council during 1960 and the Committee unanimously elected Dr. E.K. Woodford as its permanent Chairman in his place. The membership is as under:

Dr. E.K. Woodford (Chairman)
Mr. S.A. Evans (Secretary)
Mr. R. de B. Ashworth
Mr. C.V. Dadd
Mr. M.N. Gladstone
Mr. R.E. Longmate
Mr. J.S.W. Simonds
Dr. R.E. Slade

Recommendations Committee

The basic membership of the Committee was considered to be totally inadequate to do the business of the Committee; it had been found necessary to co-opt a large number of members and, in addition, the Committee had set up sub-Committees to deal with specific sections of the Handbook. It was therefore agreed that the membership of the standing Committee should be increased to a total of 15 members and that it should be constituted as follows:

Chairman

Secretary

A.R.C. Weed Research Organisation	1 rep.
Association of British Manufacturers of Agricultural Chemicals	1 "
Department of Agriculture for Scotland	1 "

Forestry Commission	1 rep.
M.A.F.F. Drainage Department	1 "
M.A.F.F. National Agricultural Advisory Service	1 "
M.A.F.F. Plant Pathology Laboratory	1 "
Ministry of Agriculture for Northern Ireland	1 "
National Association of Agricultural Contractors	1 "
National Association of Corn & Agricultural Merchants	1 "
National Institute of Agricultural Botany	1 "
National Institute of Agricultural Engineers	1 "
National Vegetable Research Station	1 "

Official invitations were sent out to the bodies listed asking them to nominate their representatives. Dr. E.K. Woodford and Mr. S.A. Evans were unanimously elected as Chairman and Secretary respectively of the Committee, which has the following membership:

Dr. E.K. Woodford (Chairman)
Mr. S.A. Evans (Secretary)
Mr. J.D. Fryer - A.R.C. Weed Research Organisation
Mr. D.J.S. Hartt - Association of British Manufacturers of Agricultural Chemicals
Mr. D.S.C. Erskine - Department of Agriculture for Scotland
Mr. G.D. Holmes - Forestry Commission
Mr. J.V. Spalding - M.A.F.F. Drainage Department
Mr. R.G. Hughes - M.A.F.F. National Agricultural Advisory Service
Mr. R. de B Ashworth - M.A.F.F. Plant Pathology Laboratory
Dr. D.W. Robinson - Ministry of Agriculture for Northern Ireland
Mr. M.S. Bradford - National Association of Corn and Agricultural Merchants (dep.Mr.J.S.W. Simonds)
Dr. P.S. Wellington - National Institute of Agricultural Botany
Mr. R.J. Coursbee - National Institute of Agricultural Engineering
Mr. H.A. Roberts - National Vegetable Research Station

Publications Committee

Mr. A.W. Billitt (Chairman)
Mr. H.S. Leech (Secretary)
Mr. F.W. Morris
Dr. E.K. Woodford

1962 Conference Organising Committee

Col. J.F. Cramphorn (Chairman)
Mr. W.F.P. Bishop (Secretary)
Mr. A.W. Billitt
Mr. C.V. Dadd
Mr. M.N. Gladstone
Mr. D.J.S. Hartt
Mr. H.S. Leech
Mr. H.C. Mason
Mr. F.W. Morris
Dr. E.K. Woodford

Finance Committee

Mr. F.W. Morris (Chairman)
Mr. H.S. Leech (Secretary)
Mr. M.S. Bradford
Mr. H.C. Mason

CONFERENCES, SYMPOSIA AND TECHNICAL MEETINGS

5th British Weed Control Conference, 1960

The Conference, organised by the British Weed Control Council, took place from 7th to 10th November 1960 at the Grand Hotel, Brighton. 461 delegates attended, 91 from overseas and the Conference was generally thought to have been very successful.

One-day Conference on Industrial Weed Control

A one-day Conference on Industrial Weed Control, under the sponsorship of the Council and with the assistance of the Pesticides Group of the S.C.I., took place on 30th June, 1961 at the Royal Commonwealth Society, London. The bias was more educational than scientific and emphasis was given to the safety aspect. The following papers were presented:

Economic Aspects of Chemical Weed Control on Non-Agricultural Areas
Weedkilling on Railways
Recent Advances in Chemical Weed Control
Local Government Approach to the problem of Weed Control
Weed Control in relation to Fire Risk
The Use of Herbicides by Electricity Authorities
Weedkillers for use on Industrial Sites
The Application of Non-Selective Herbicides

100 delegates attended the Conference which proved to be very successful and created considerable interest. Proceedings were not published, but each delegate received a full set of the papers presented and, in addition, a limited number of sets were also made available to non-delegates.

European Weed Research Council

The 2nd and 3rd meetings of the European Weed Research Council took place in Paris in December, 1961 and in Brussels in August, 1962 respectively. At each of these meetings the Council's activities since the previous meeting were reviewed. New officers were elected at the 1961 meeting and a draft Constitution of the Council was presented.

On the occasion of the 2nd Meeting the European Weed Research Council arranged an international meeting on Herbicides, the object being to give industry an opportunity of presenting to research workers information on new products. The meeting was most successful and a report has been published briefly in "Weed Research".

On the occasion of the 3rd Meeting, a special meeting of the Council's Committee on Aquatic Weed Control was arranged.

The British Weed Control Council has made a contribution towards the cost of publishing the European Weed Research Council's Journal "Weed Research".

One-day Symposium on "Crop Husbandry in a Weed-free Environment".

This was considered to be a most important topic to agriculture in general and warranted being made the subject of a one-day Symposium. The Symposium, organised by the Council, with assistance from the A.A.B. and the S.C.I. took place on 2nd October, 1962 at the Royal Commonwealth Society, London. The programme was arranged with a strong agronomy bias and the following is a brief outline:

The problem of weed seeds in the soil
Cultivation in the absence of weeds and the resulting effects.
Physical aspects - Oxygenation - Water
Acceptance - Fertilizer
Availability - Root Penetration
- Compaction - Erosion.

Biological Aspects
Crop Spacing and management under weed-free conditions
Crop situations where cultivation for weed control may be eliminated by use of herbicides - Agriculture - Hortilcuture - Forestry.

The Symposium proved very successful. 186 delegates attended and it was the general opinion that the papers submitted were most valuable and interesting and entirely justified the holding of a special Symposium on this important subject. The Proceedings will be published by Blackwell Scientific Publications Ltd., Oxford, in the same format as the Proceedings of the Symposium on Herbicides and the Soil.

6th British Weed Control Conference, 1962

In accordance with the Council's policy of holding a Conference biennially, the 6th British Weed Control Conference has been arranged to take place from 5th to 8th November, 1962 at the Grand Hotel, Brighton, the organisation being on similar lines to that of the 5th Conference.

PUBLICATIONS

Weed Control Handbook, 1960 (2nd Edition)

A new edition of the Handbook was published in November, 1960 by Blackwell Scientific Publications Ltd., Oxford 6,000 copies were printed of which approximately 5,000 have been sold at 17/6d. per copy. This edition continued to be sold until November, 1962.

Weed Control Handbook, 1963 (3rd Edition)

The Recommendations Committee of the British Weed Control Council have been working on a third edition of the Weed Control Handbook. This will again be printed and published by Blackwell Scientific Publications Ltd., and it is hoped that it will be on sale in February, 1963.

Proceedings, 5th British Weed Control Conference, 1960

The Proceedings of the 5th British Weed Control Conference held at Brighton in November, 1960 were printed and published by the British Weed Control Council in June, 1961. Delegates to the Conference each received a copy. Copies are still available from the Secretary, British Weed Control Council, 95 Wigmore Street, London, W.1. at a cost of £2.15s.0d. per copy.

Weed Abstracts

During 1961, the Council agreed that, in the interests of wider dissemination of the valuable information contained in "Weed Abstracts", the Commonwealth Agriculture Bureaux should take over responsibility for the journal. This take-over was effected as from 1st January, 1962. The A.R.C. Weed Research Organisation continue to be responsible for the production of the copy, but the C.A.B. have taken over the cost of production in the same way as their own publications. The journal costs £4.0s.0d. per year instead of £2.2s.0d. and appears bi-monthly. Distribution has gone up to 690 within this year.

GENERAL

Commonwealth Weedkiller Developments

It has been apparent for some time that Commonwealth research workers and agriculturists interested in weeds seem to have been unaware of British discoveries and developments in the field of weed control. By and large, British research has been more fruitful than American research and it was felt that there was a need for ways and means of wider dissemination in the Commonwealth, of information on the discoveries and achievements of Britain, British agriculture weedkiller practices and British products available for weed control. It was thought this could be best achieved through publication of a journal. With this objective, the Council sought co-operation with organisations such as the Colonial Office (now the Department of Technical Co-operation) and the Commonwealth Agricultural Bureaux, and a small sub-committee was set up within the Council consisting of representatives of the A.R.C. Headquarters and Weed Research Organisation, the Department of Technical Co-operation and the Council's Publications Committee. In discussions with the Commonwealth Agricultural Bureaux, it was agreed that the objective could be reached through wider distribution of the existing journal "Weed Abstracts". The C.A.B. agreed to take over the responsibility for the publication and distribution of "Weed Abstracts", a certain quota of the copies going to the Commonwealth, Letterpress production of the journal has brought it into line with other C.A.B. publications and, with their publicity, the circulation has been increased.

A further step in the direction of publicising British developments and achievements in the Commonwealth was taken by the Council in agreeing to be responsible for preparing an editorial section for Pesticides Abstracts and News Summary (published by the Colonial Presticides Research Committee) describing developments from British industry and this is already under way. It has been arranged to supply for each quarterly issue of P.A.N.S. a paper of up to 2,500 words, say, a review article dealing with some new product, technique, machinery etc. in the Commonwealth, particularly in tropical countries. The first two articles on diquat and barban have already been submitted.

Development of Chemical Control of Vegetation on Roads and Airfields Overseas.

The D.S.I.R. Road Research Laboratory had been looking into the use and control of vegetation on roads and airfields in Colonial and Commonwealth territories and approached the Council to consider the feasibility of chemical control. They prepared a paper on the subject which was considered by the Council's Research & Development Committee and, as a result, the Committee recommended the setting up of an ad hoc committee to meet representatives of the Road Research Laboratory to discuss the question and decide how industry could help. The Committee (subsequently made a standing Committee) was made up of representatives from industry together with representatives of the A.R.C. Weed Research Organisation and the first meeting was held in April, 1961. The conclusions reached were that industry would like to co-operate with the Overseas Road Research Committee on this problem and that this co-operation should be maintained through the Weed Research Organisation at Oxford. The first step would be the carrying out of trials, the results and information on such trials being made available to all interested parties. It was agreed meantime that Dr. Ivens of the A.R.C. Weed Research Organisation and Mr. Clare of the Road Research Laboratory should study the matter in more detail and prepare a joint paper giving more specific information on the ways in which chemicals can be used to control vegetation on roadsides and airfields. This report entitled "The Potentialities of Chemicals for the control of Vegetation on Roadsides in Tropical Countries" has been placed before the Council and it was the unanimous opinion that it gave an extremely good survey of the situation. The report has been circulated within member organisations of the Council and has been subsequently published as a Road Research Laboratory Bulletin.

Hazards in the Use of Herbicides

In view of the irresponsible statements which have appeared in the Press from time to time on the question of the safe use of herbicides, the Council are, through the A.B.M.A.C. Public Relations Committee, watching the position closely. Developments are taking place with regard to the whole problem. The N.A.A.C. have negotiated and drawn up a voluntary code of conduct for spraying operators and recommendations have been laid down for minimum standards for the use of herbicides in aerial spraying. A meeting at the end of 1962 will assess the outcome of the voluntary code.

Herbicide Usage Survey

Following the pilot survey in N.W. Oxfordshire undertaken in January/ February, 1959, the N.A.A.S. have carried out for 1959/60 a survey of a further four arable farming districts and the results were presented to the Council in a report entitled "Herbicide practice in arable farming districts". The report was most valuable and showed that the survey was very well worth doing. It was interesting to note that it revealed loopholes in the education of the larger farmer on the use of herbicides.

The report was circulated within the member organisations of the Council and appeared in a modified form in "Weed Research".

The N.A.A.S. have organised and carried out surveys in the grassland areas of Cheshire and Somerset and the results are being collated at Rothamsted.

The possibility of carrying out a survey in horticulture is being explored.

Interim Report on "The Control of Wild Oats"

It had been agreed that the Recommendations Committee would not produce an interim report in full but would submit to the Council reports of particular interest. Their interim report on "The Control of Wild Oats" was presented to the Council and included all the available information on the subject. The recommendations contained in the report will go into the 3rd edition of the Weed Control Handbook.

Liaison with Machinery Manufacturers

The Council consider that there is a need for liaison with the machinery manufacturers with a view to finding out how they can improve the designs and specifications of their spraying machines to meet the requirements for more precise application and more accurate spraying. The problem is being considered by the Council's Research & Development Committee before seeking liaison with the Agricultural Engineers' Association. It is thought that the best approach is for the Committee to find out what is wrong with existing spraying machines and this can be done with the assistance of the N.I.A.E. in carrying out series testing on ground spraying machines. The Committee are therefore working along the lines of (a) discussing with the N.I.A.E. the criteria to be observed in the testing of the machines and (b) following this testing, drawing up a document advising machinery manufacturers what is wrong with existing spraying machinery. It is hoped that in this way the problem can be resolved with benefit to the chemical manufacturer, the machinery manufacturer and the farmer.

Long Term Effects of Herbicides

The possibility of getting people interested in making a more detailed assessment of the long term effects of herbicides was raised through the Council's Research & Development Committee, the N.A.A.S. had been carrying out at Martyr Worthy a long term experiment which had been running for a number of years wherein herbicides had been applied each year to the same plots. However, assessment had been restricted to crop yields and it was felt that perhaps a study of effect on produce of the plots, weed population or soil condition might be useful. A long term experiment which has been laid down at Efford by the N.A.A.S. will be available for those interested to look at and assess. The A.R.C. Weed Research Organisation are putting forward proposals to official bodies to start more soil persistence experiments. These experiments will afford a good opportunity for research and industry to join forces and consider what can be done to assess the results of such experiments. A very interesting note on a long term herbicide experiment started in 1951 at Bridget's Experimental Horticultural Farm to study the effects of the continued application of chemical weedkillers on soil flora and fauna or on the nutritive value of the crops grown was made available to Council members.

Nomenclature for Herbicides

The Council considered that it was desirable that the development and adoption of common names for herbicides required the widest possible co-operation for maximum acceptance and effective use on a world-wide basis. It was felt that there was a possibility of conflict between the British Standards Institution Pesticides Nomenclature Committee and other bodies such as the Terminology Committee of the Weed Society of America and the American Standar