Dr. Chilton summarised the main points and described the field work (1947–1952) on which the results were based. He stressed the need for preliminary cultivations for eliminating the rhizomes of Johnson Grass before any weed killers were applied. This might involve 6 separate ploughings and might cost $15 per acre. Reinfestation of the land by seedlings could then be prevented by the use of 2,4-D and T.C.A. The first was best applied in the drill in a 24 to 30 ins. band, at the rate of 2–3 lb. per acre. Depending on the rainfall, the procedure might destroy 75–80% of the weed seedlings. A winter covercrop might then be planted 3 to 4 weeks afterwards. In spring and summer, various other weed-killer treatments were applied, and these were fully described in the paper. They involved the use of 2,4-D and T.C.A., as well as pre-emergence sprays and sodium chlorate for dealing with Johnson Grass rhizomes that might have developed in the stubble crops.

The Chairman agreed that the pre-emergence stage was the most vulnerable for the control of weeds by the herbicides described, as experienced in Hawaii. He asked for further information on the use of T.C.A.

Dr. Chilton reported that in Louisiana best results with T.C.A. were obtained at 20 lb./acre, broadcast basis. The substance was more effective when applied over wet areas than over dry.

Mr. Stender stated that in his territory at least two estates would have gone out of production because of grass weeds (Bermuda Grass and Panicum repens) except for the use of T.C.A. as weed-killer. The substance was used at a rate of 20 lb./acre and applied during ploughing and discing, although sometimes up to 8 or 10 treatments, amounting to 100 lb. per acre of T.C.A., were needed for full control.

In the absence of the authors, Mr. Innes presented the following paper.

**Paper**

**OBSERVATIONS ON CHEMICAL WEED CONTROL IN THE BRITISH WEST INDIES**

R. C. TINCKNELL and A. C. LOWE

**INTRODUCTION**

Extensive work has been carried out to evolve techniques for removing weeds from sugarcane crops by the application of chemical herbicides (1–13). In common with most of the cane-growing areas of the world these materials are gradually gaining acceptance in the British West Indies as their advantages become recognised and relevant techniques are evolved. Here, the work of Blackburn, Hanschell and Clarke has considerably clarified the problem, particularly in relation to the conditions prevailing in Trinidad.

During the summer of 1952, a series of herbicides trials was initiated in British Guiana, Trinidad and Jamaica with the co-operation of sugar estates throughout these territories. The programme involved laying down some 70 trial plots, most commonly 2½ acres each in size, embracing a wide range of cultural conditions; the experimental aspect of the work was mainly devoted to adapting existing techniques and knowledge to the widely varying conditions under which sugarcane is cultivated. The progress of the trials was closely observed in many cases, continuously from the time immediately preceding planting until the cane had reached the “covered in” stage.

**EXPERIMENTAL SECTION**

The purpose of the work undertaken was to amplify the widely accepted basic principles of chemical weed control in relation to the specific conditions encountered in the British West Indies.

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It is generally accepted that weed competition is most injurious during the initial period of crop establishment, and accordingly most investigations on herbicides have been carried out in plant cane.

Generally advocated practice in the use of chemical weed control in sugarcane involves a treatment of the soil with herbicides some time shortly after planting but before the plants have emerged, and subsequent treatments applied later as weed conditions and cultural operations dictate. In certain areas, where climate and soil conditions require that heavy cultivations are carried out some time before planting, it is often considered advisable to prevent weed growth on the land lying fallow during the period preceding planting.

Hitherto, most treatments in the B.W.I. have been confined to applications of the systemic herbicide 2:4-D though limited amounts of the contact herbicide pentachlorophenol and the systemic herbicide sodium trichloroacetate have also been used where the grasses have predominated in the weed flora.

For most of the work which follows, 2:4-D, sodium trichloroacetate (T.C.A.) and pentachlorophenol (P.C.P.) were used either alone or in various combinations. 2:4-D was applied mainly in the form of its dimethylamine salt, chiefly on the grounds of convenience of dilution, but in certain cases 2:4-D sodium salt was also applied for purposes of comparison. The pentachlorophenol was used mainly in the form of a 25% solution in oil, emulsifiable in water. Water soluble sodium pentachlorophenate was also used in combination with certain oils emulsified in the spray mixture. The sodium trichloroacetate used was a commercially pure material, readily soluble in water without formulation, save that a small amount of wetting agent was added to the dilute wash to assist spreading and penetration of the herbicide.

Nearly all of the applications of herbicide were made by knapsack sprayers; these were of the "pump yourself" variety rather than the pressure-tank type. Hand operated knapsack sprayers have an advantage over tractor-mounted sprayers since they may be used at all stages of the cane's growth and when the soil is too wet to support wheeled equipment; steeply cambered beds, drainage trenches, and contour cultivations in the British West Indies sugar growing area frequently make mechanical spraying impractical or uneconomic. Moreover, the particular programme of work described in this paper did, of course, demand that simple and versatile spraying equipment should be used.

Throughout their programme of work, the authors were impressed with the importance of jet characteristics in spraying. In the interests of economy, an attempt was made to reduce the volume of spray liquid per acre to the minimum consistent with good coverage. For most applications, 20 gallons per acre was an adequate volume both for pre-emergence and post-emergence spraying, providing the jet was capable of delivering a fine spray, well distributed across the swath.

The jets provided with the knapsack equipment were unsuited to precision spraying of herbicides and it was necessary, therefore, to obtain and fit separate brass nozzles and jets which were of American manufacture. Depending upon the type selected, these jets gave a fan shaped pattern of spray in an arc of from 60° to 150°, covering a swath varying in width from 3 ft. 6 ins. to 5 ft. and delivering from 10 to 40 gallons of spray per acre. However, it was not felt that these represented the very best that could be achieved, and Long Ashton Research Station, England, generously advised on the construction of prototype spray booms equipped with ceramic tips. These models were constructed in the form of three jets placed along a 3 ft. length of brass tubing held parallel to the ground.

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surface at a height of about 2 ft. With these jets excellent results were obtained using only 15 gallons volume per acre for pre-emergence 2:4-D applications and using as little as 1¼ lbs. per acre of 2:4-D acid equivalent. Apart from their improved distribution in comparison with the more conventional jets, they had the added advantage of greater durability since jet orifices made of brass may be enlarged rather rapidly by continued passage of the spray. The ceramic tips on the other hand, are much less liable to mechanical erosion by minute particles in the spray fluid and completely resistant to corrosion by chemicals such as pentachlorophenol, which is corrosive to brass. These initial findings concerning the influence of jets on results, seem sufficiently significant to justify further inquiry. In particular, it is felt that a more detailed understanding of the effect of particle size on coverage and volume required per acre, is urgently needed.

It is probably no exaggeration to say that the most commonly employed herbicide treatment in sugarcane at the beginning of crop establishment in a pre-emergence application of 2:4-D within a fortnight of planting. This method has already been studied extensively in the British West Indies, particularly in Trinidad. Good confirmatory results were obtained with this technique, but where cane was planted near the surface, retarded germination of the cane, as a result of direct contact of the herbicide with the buds of the planted set (seed) was sometimes observed. For most of the applications 2:4-D was used in the form of its amine salt, at 2 lbs. acid equivalent per acre. There has been some controversy as to whether this form, whilst admittedly easier to handle is superior in its action, weight for weight of 2:4-D acid content, to the cheaper sodium salt. The opportunity was taken to lay down a limited number of comparative trials, applying 2:4-D in both forms but at the same rates of acid equivalent per acre. Only indifferent distinctions were observed and for pre-emergence applications it is considered that the amine salt offers only questionable advantages over the sodium salt. This conclusion is confirmed by Hawaiian Work.

The precise conditions which predispose 2:4-D damage in cane are imperfectly known. However, provided that the cane is actively germinating with buds on the sets turgid and the first rootlets developed, and provided that the rate of 4 lbs. of 2:4-D acid equivalent per acre is not exceeded, the risk of damage from 2:4-D is very slight. Moreover, cane sets planted as deep as 4" appear to be entirely immune to the effects of 2:4-D in British West Indian soils, although planting at this depth is often impracticable for fear of water logging. Soil type has often been referred to as a factor affecting the incidence of 2:4-D damage and open and sandy soils have been held particularly suspect. More as a corollary rather than a contradiction of this view, the authors consider that soil/moisture relationships are more important than soil types as a factor predisposing 2:4-D damage. For example, damage was noted most frequently where the soil was unduly dry and the cane set dormant as a result.

On some estates the danger of retarded germination had previously been recognized and spraying delayed until the sets were showing their first emerged "spikes". This delay avoids risk of retarded germination of the cane, but suffers from the weakness that weeds, particularly annual grasses, frequently become established during the time between planting and spraying and cannot then be controlled by the use of 2:4-D alone. Accordingly, the use of pentachlorophenol in place of 2:4-D was investigated. Since the action of pentachlorophenol is not systemic, retarded germination of the cane would not be expected and this actually proved to be the case, even where the pentachlorophenol was sprayed direct on to the buds themselves. Furthermore, pentachlorophenol not only

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showed excellent pre-emergence effect, but also controlled emerged grass seedlings against which 2 : 4-D treatment would not have been effective. In this application, 3 lbs. of pentachlorophenol per acre was applied as an emulsion of its oil solution in water at spray rates varying from 15 to 25 gallons per acre. The persistence of pentachlorophenol treatments appears to be of similar duration to those of 2 : 4-D, although further experience is required to confirm this.

Like 2 : 4-D, pentachlorophenol treatments function best when the foliage of established weeds does not shelter the underlying soil from the spray. Unlike 2 : 4-D, however, care should be taken to avoid application after the cane spikes have broken to show green flags since they can be severely "scorched". The unbroken spikes are not harmed in any way however, since they are adequately protected by an almost impermeable sheath.

Pentachlorophenol alone was not entirely satisfactory in removing a heavy cover of weeds susceptible to 2 : 4-D if these were present at planting time. In order to overcome this difficulty, 2 : 4-D at the rate of 1 to 1½ lbs. acid equivalent per acre was included in the spray. In particular, the use of a mixed pentachlorophenol/2 : 4-D spray was highly effective where water grass (Commelina spp.) and nut grass (Cyperus rotundus) were amongst the predominant weeds. Provided the cane set buds are not exposed above the surface of the soil, no retardation of germination was experienced by using this reduced quantity of 2 : 4-D.

Pentachlorophenol, either alone or mixed with 2 : 4-D, has also shown promise for the treatment of cultivated land before it is planted. In some cases, it was observed that where 2 : 4-D alone had been used as a pre-emergence control on weed-free land, no weeds had developed on the untreated control area during the period in which the effect of the 2 : 4-D could be expected to persist. Under these circumstances, the application of 2 : 4-D had virtually been wasted. Yet had such treatments been delayed until evidence of weed germination was observed, emerged grass seedlings would have escaped and covered the land in the absence of other competing weeds. The inclusion of pentachlorophenol in the spray as well as 2 : 4-D enables the application to be delayed until young weed seedlings actually appear, and the degree of infestation is apparent.

Soil and climatic conditions markedly affect the performance of any kind of pre-emergence treatment. A relatively smooth tilth is desirable to avoid the sheltering effect of large clods of soil and in general, it was found that pre-emergence treatments worked best on the more fertile soils where weed growth was most vigorous. Most important of all, it is considered, was the moisture condition of the soil during the first fortnight after application. To assist the spreading of both pentachlorophenol and 2 : 4-D, wet soil is desirable at the time of application but it is even more important that the soil should not dry out after the application. In certain parts of Jamaica, during the late summer of 1952, rather spasmodic rainfall was experienced which caused the soil to dry out on occasions to a depth of as much as 2 inches before the next storm of rain. In these circumstances, it was found that weed seeds germinated from a corresponding depth rather than from the surface half inch, with the result that when the seedlings reached the film of herbicide, they were sufficiently well established to be resistant; this was particularly true of young grasses. Where the soil remains wet relatively near the surface, the germination of deep seeds is inhibited by the much less permeable layer of wet soil overlying them, whereas drying out of the surface of the soil causes sufficient aeration, presumably, to stimulate germination of seeds from a greater depth.

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Where such variable moisture conditions were anticipated, it was invariably found that improved control was obtained by allowing germination to proceed until seedlings were emerged before applying herbicides; if any grasses were present amongst the young seedlings, a mixture of pentachlorophenol and 2 : 4-D was used, although care was necessary in timing such an application, since it could not be used once the emerging 'spikes' had broken into green leaf.

It is considered that rain following pre-emergence treatments was generally beneficial, provided that the soil was not moved bodily by extremely heavy showers. Whilst it cannot be recommended as a regular practice, excellent results were obtained even when rain fell during the application of a pre-emergence spray, provided there were no established weeds to kill at the same time.

Subsequent applications of herbicide are required to follow the treatments at planting time, after the cane has become established and until it closes in. Where only 2 : 4-D susceptible weeds are present, post-emergence applications of 2 : 4-D may be made at any time at the rate of 2 lbs. acid equivalent per acre, preferably in the form of amine salt, without any danger of cane damage. From results of a number of comparative trials between amine and sodium salt 2 : 4-D as post-emergence treatments, results with the amine salt were consistently superior, especially on weeds which were regarded as partly resistant to 2 : 4-D. Most notable in its difference of response was Nut Grass, where in one case only 50% kill was obtained by using 3 lbs. of 2 : 4-D sodium salt per acre, as compared with the almost complete kill, at least 98%, with the amine salt. It was also found that among the common dicotyledonous weeds, Cleome ciliata, Amaranthus spp. and Portulaca oleracea showed greater response to 2 : 4-D amine salt. Most sedges, it was found, are more effectively controlled with the 2 : 4-D amine salt and although the reasons for this improved control with amine salt are imperfectly known, it is felt that the effect is due to the increased power of penetration of the amine over the sodium salt. The relatively inactive crust of 2 : 4-D sodium salt which forms on the leaf surface through the drying out of the spray is presumably less readily absorbed than the amine salt which does not solidify in the same way.

Normally, applications in the growing cane are not merely made as weed conditions dictate, but have to be timed to follow hoe-moulding, where this is carried out. Hoe-moulding, which is known as "bank breaking" in Trinidad and Jamaica, is achieved by pulling down some of the soil from the ridge of the inter-row down into the furrow in which the young cane is growing. Successive mouldings as the cane grows taller work down the ridge of the "bank" and build up the furrow, so that the cane bed finally presents an even surface. When "full banks" are broken and the surface of the soil is left even at planting time, the timing of subsequent applications of herbicides is not, of course, governed by moulding.

In the process of hoe-moulding any non-rhizomaceous grasses are normally buried; the common annual grasses cannot survive uprooting and burial so that further weed control may be achieved by a soil application of 2 : 4-D either as its sodium salts or as its amine salt. By the time full banks are broken and the final application of 2 : 4-D made, no further weed control will normally be required.

Where no cultivation is carried out once the cane has been planted, grasses often become established in the young plants in spite of a pre-emergence application at planting time. Further treatment with 2 : 4-D alone will be of no avail in controlling these grasses which will thrive in the absence of competition from weeds susceptible to 2 : 4-D.

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Eradication of such grasses may be effected by an application of pentachlorophenol, although such a treatment is best preceded by a superficial hand-weeding where isolated but well established stools of grass have grown amongst the cane.

In common with all contact herbicides pentachlorophenol will produce “scorch” of the cane leaves which, if excessive, will bring about some retardation of the cane in consequence of reduction of the leaf surface area. In practice, the most successful results in spraying pentachlorophenol in young cane less than 12 weeks old were achieved by using jets which threw a pattern of spray covering only half the inter-row. Whilst such a method doubles the labour costs, it has the great advantage that each man only has one side of the spray pattern to watch intently. The inevitable variation in inter-row spacing and cane height make it almost impossible to avoid spraying cane if the operator is using a jet which covers the whole width of the inter-row. It is generally desirable to include some 2 : 4-D in the spray when treating established cane, to control not only the true grasses but also nut grass and broad-leaved weeds if they are present. For this type of work, a mixed spray containing 1 1/4 to 2 lbs. of pentachlorophenol and 1 1/4 lbs. of 2 : 4-D acid equivalent was used with good results.

In addition to using pentachlorophenol at this stage, a limited number of applications of T.C.A. were made to control true grasses in young cane. In particular, Bahama Grass (Cyanodon dactylon) proved very susceptible to T.C.A., and effective control of a mixed stand of Bahama Grass and Piano Grass (Themeda arguens) was obtained by applying it at the rate of 10 lbs. per acre, using jets which threw a narrow pattern of spray as described in the account of the use of pentachlorophenol.

Although very little cane damage as the result of using T.C.A. was observed at any time, leaves with which it comes in contact are scorched, although to a lesser degree than by pentachlorophenol. From experience of the use of T.C.A. for total control of perennial weeds on rights of way etc., the authors anticipate a systemic disorder of the cane if very heavy applications are used. Undoubtedly, further work is required to define the limits within which T.C.A. can be used safely under conditions in the British West Indies. Such work would be most valuable, especially since T.C.A. was so effective against those grasses which were completely unaffected by 2 : 4-D and only retarded but not killed by pentachlorophenol. T.C.A. has shown considerable promise for the control of graminaceous weeds in cane in Hawaii, and it is understood that it is gaining wide acceptance there.

A number of specific weeds can modify the typical treatments mentioned above. Firstly, the presence of sedges, and in particular Nut Grass, necessitates a departure from typical treatments because they cannot be controlled by pre-emergence treatments with 2 : 4-D or pentachlorophenol by virtue of their deep and generally vegetative mode of reproduction. Throughout the British West Indies, localised but extremely heavy infestations of Nut Grass were observed and in many cases, these were sufficiently severe to interfere with the growth of cane. It was found that post-emergence treatment of 2 : 4-D in the form of its amine salt provided an effective method of killing Nut Grass. Treatment of Nut Grass should be delayed until the majority of nuts have germinated, in order to reduce the need for second treatments. It is important not to omit the earlier pre-emergence treatment in young cane, however, because post-emergence control of the Nut Grass may reveal a stand of 2 : 4-D resistant grass seedlings which will rapidly become established in the absence of competition from Nut Grass. Although the appearance of heavy infestations of Nut Grass necessitates additional applications of herbicide, it is considered that the long term eradicant effects of the treatments offset the initial cost.

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Sensitive Plant (*Mimosa pudica*) is another weed that may cause difficulties and necessitate deviation from normal practice. It is often difficult to control by pre-emergence applications and neither 2:4-D nor pentachlorophenol alone are completely effective in eradicating it. Where it did occur, however, it was found that a mixture of these two herbicides in equal proportions gave a good kill when applied at the rate of 1½ lbs. each per acre.

Because of the difficulty of controlling them by other means and the corresponding simplicity of controlling them with 2:4-D, mention must be made in this section, of vines (*Ipomoea, Momordica* and *Convolvulus spp*), Water or Caana Grass, (*Commelina spp*) and Cowitch (*Mucuna Pruriens*), in well established cane. These weeds are extremely susceptible to post-emergence treatment with 2:4-D, at the rate of 1½ lbs. of 2:4-D acid equivalent per acre and it is normally necessary only to use a “spot” spray on the centres of infestation.

Incursion of weeds, particularly perennial grasses, which are already established on the traces, intervals or dam beds, sometimes presents a serious problem and especially in plant cane. Such weeds will often spread rapidly into land which is lying fallow in preparation for planting or into young cane before it covers in. Notable examples include Elephant grass (*Pennisetum purpureum*) in parts of British Guiana, Bamboo grass (*Paspalum fasciculatum*) in Trinidad, Para grass (*Panicum spp*), and Seymour grass (*Andropogon pertusus*) in Jamaica.

These perennial grasses are difficult to eradicate in cane, itself a perennial grass, and it is desirable therefore that control should take the form of prevention rather than cure. The best preventative measure is undoubtedly the removal of the sources of infestation on traces, intervals and dam-beds and the only really effective material for the control of such grasses, it is considered, is T.C.A. This material was applied at the rate of about 30 lbs. per acre to the established grasses and whilst the ensuing kill might not be complete for as long as six weeks, its effect embraces the whole root system rather than just the above-ground vegetation. Applications were best made on a sunny day and, if the growth was very rank, it was found to be preferable to cut it back and to wait for a fortnight or three weeks until the vegetation had resprouted, before applying the herbicide. The high rates of application of T.C.A. necessary to control heavy infestations of perennial grasses are expensive but should be regarded as eradicant rather than frequently applied routine treatments.

In all post-emergence work, be it with pentachlorophenol, 2:4-D or T.C.A., a fine day during the application is desirable to avoid excessive washing of the herbicide from the foliage of the weeds. It was found that pentachlorophenol was the herbicide which was most sensitive to the effects of rain during application and, in fact, its action appeared to be considerably enhanced by bright sunlight. Maximum benefit from a post-emergence application of pentachlorophenol was generally obtained when a whole day of sunny weather followed. Weather conditions did not affect T.C.A. and 2:4-D treatments to the same extent and applications were normally successful when as little as two to three hours of fine weather followed application of these materials.

**CONCLUSIONS AND FUTURE TRENDS**

In summarising the information obtained, it is considered that where canes are planted deeply and the soil surface is moist and of good tilth, 2:4-D in the form of its sodium salt provides an effective treatment during the initial establishment of the crop. Where canes are planted very near the surface, however, the use of pentachlorophenol obviates the danger of cane damage but nevertheless...
Planting gives excellent pre-emergence weed control with the additional advantage over 2:4-D that any emerged grass seedlings are adequately controlled. Where a heavy cover of established weeds is present at planting time, the inclusion of a little 2:4-D with the pent is considered desirable. When the soil is liable to dry out appreciably after the applications a joint spray of 2:4-D and pentachlorophenol, applied only when young seedlings have already emerged, is preferred. All treatments involving pentachlorophenol, however, should never be applied after the young spikes have broken. Subsequent treatments may either consist of pre-emergence applications of 2:4-D following hoe moulding or post-emergence applications of 2:4-D to established weeds where subsequent cultivations are not undertaken. Predominance of true grasses in the weed flora may necessitate the application of pentachlorophenol, in which case, care should be taken to avoid extensive contact of the spray with the young cane leaves. T.C.A. has also shown considerable promise for the treatment of grass infestations in cane.

Severe infestations of nut grass may modify standard routine since they can only be treated by post-emergence applications of 2:4-D.

For pre-emergence work the sodium salt 2:4-D is preferred on the grounds of economy but for post-emergence work, the amine salt has proved more effective, particularly against nut grass.

Rates of application are somewhat modified by local conditions but it has been found that 2:4-D is best applied at 2.0-4.0 lbs per acre of acid equivalent when used alone but may be reduced to 1.0-3 lbs per acre when used with pentachlorophenol, itself used at the same rate. Pentachlorophenol alone is generally applied at 3 lbs per acre. T.C.A. although requiring further experiment appears to be best used at 5 lbs per acre in cane up to two months old though this rate is best doubled as the plants become more mature.

In all cases, 20 gallons volume of liquid per acre has proved adequate provided the spray is well distributed.

In spite of the work already carried out in connection with chemical weed control in sugar cane it is considered that a good deal more research can profitably be undertaken. Of the many problems which require investigation it is considered that in particular there is need for further investigation of the factors which affect the pre-emergence applications and that improved methods for controlling true grasses in cane are required.

On this first subject, it seems certain that there is no universally applicable answer, but that varying climatic conditions and the species of weed seeds present in the soil play an important part and that soil types of themselves may be influential. In particular the physical or chemical absorption of herbicides by the soil and the capacity of its microflora to decompose the chemicals must have an important effect. Although much work has been carried out in other parts of the world on this subject, it appears that there is no published work relating to British West Indian soils.

On the second subject, it is felt that much remains to be done to discover improved techniques for dealing with severe grass infestations of cane by chemical treatment. The problem is inevitably a difficult one, since cane is a grass itself, although it is already partly solved by the application of treatments before the cane has emerged and by the use of pentachlorophenol and sodium trichloracetate on established grasses. The use of pentachlorophenol in cane could be greatly facilitated by the introduction of jets which enable the herbicide to be placed more judiciously, and a study of the ultimate effects of pentachlorophenol scorch on cane growth would undoubtedly be of great benefit. T.C.A., on the other hand, would seem to be the only effective herbicide against established perennial grasses and here again further information is required to define the limits of its use. With extensive use of 2:4-D grasses are almost certain to assume greater prominence in the weed flora of cane fields and a study of methods of controlling them assumes new importance.

Indeed, it is considered that in adopting the use of chemicals to control weeds, it would be well to aim for total weed control of all species present rather than the predominant ones. The results initially obtainable by using herbicides are often dramatic and frequently provide a solution to problems which have hitherto been insoluble by conventional methods. But unless the problem of weed control is regarded as a unity, relief from weed infestation may well prove to be temporary only. In the absence of competition, those very weed species which are not affected by existing herbicides and which may not formerly have constituted any problem, may well become a major difficulty in the absence of their earlier competitors.

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References p. 304.
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DISCUSSION

The Chairman stated that 2-4 D damaged the cane-sets when used on certain soil-types in Hawaii but not when used on others.

Dr. Burr explained this in terms of the varying capacity of different Hawaiian soils to permit penetration into them by solutions of 2-4D; this could be investigated in the laboratory. Those solutions which allowed deep penetration usually showed greatest destruction of seedpieces by 2-4D solutions; those which were resistant to deep penetration might show increased penetration when the amount of water was increased.

Dr. Humbert asked about the effectiveness of 2-4D on Nut Grass. He said great difficulty was experienced in trying to eradicate Nut Grass in Hawaii.

Mr. Innes stated that fair control of Nut Grass could be obtained with the sodium salt of 2-4D, and good control with the amine. Difficulty was also experienced in Jamaica in the eradication of Nut Grass. The grass might go brown after treatment but recovered soon afterwards.

Dr. Evans described experiments with Nut Grass in Mauritius. It was necessary to distinguish between eradication and control. All forms of 2-4D had been tried, but best results on Nut Grass were obtained with solutions in Diesel oil, applied at the rate of 10 lbs/acre of 2-4D. This effected 90 to 95% eradication but was uneconomical. Spraying with the sodium salt, at the rate of 1 ½ to 2 lbs 2-4D per acre, killed the above-ground parts but not the tubers. If the land was then left undisturbed, no more shoots appeared, but if it was cultivated, the tubers at once sprouted again.

Mr. Hall reported that effective control of Nut Grass was obtained in the Dominican Republic by 3 to 4 applications of 2-4D applied every 2 months, though the treatment did not destroy the tubers. These might sprout again after 6 weeks, but if the treatment was then repeated the plants were practically all destroyed.

Mr. Rouillard asked about the relative efficacy of the ester of 2-4D as compared with the amine.

Mr. Moir stated that both were found to be equally effective in Hawaii, but that the ester damaged the crops if improperly applied.

Mr. Potter asked Dr. Burr the reasons for damage by weed killers of cane seed-pieces, and how to identify soils that were easily penetrated by solutions.

Dr. Burr suggested referring to the published local articles on the subject. He stated that the method consisted briefly in the determination by the absorption spectrograph of the concentration of 2-4D in a standard solution after it had percolated a layer of the soil in question of known thickness.