

OBSERVATIONS AND RESULTS WITH WEEDKILLERS AT ILLOVO

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Introduction

The first sample of 2,4-D was sprayed at Illovo in 1949, and since then considerable technical and scientific progress has accompanied the expanding use of chemical weed control. Current field practice is based almost entirely on the results continuously being obtained from a practical research programme which is designed to study both the factors affecting the efficacy of weedicide formulations and the intrinsic merits of each available chemical. Results have been most promising, under suitable conditions of soil and climate, even in the high altitude areas where germination and cane growth are extremely slow.

Pre-Emergent Spraying

Both the 2,4-D ester and the potassium salt of M.C.P.A. have been used extensively. At the rate of four pints per acre, control of broad-leaved weeds has generally been adequate, but even at the rate of 16 pints per acre, except in one dramatic small-scale experiment, the control of watergrass cannot be said to have been outstanding. Unfortunately, the majority of fields at Illovo have a high watergrass population, so that pre-emergent control is used primarily to reduce the weed population during the initial stages of cane growth, and, if possible, until the first cultivation is due. To do this, field applications of eight pints and even twelve pints of 2,4-D or M.C.P.A. per acre have been made with varying degrees of success. In experimental plots on the coast, applications of 16 pints per acre immediately after planting in a moist soil have given control of all weeds for as long as two months, but in the high altitude areas where watergrass is the predominant weed, high levels of 2,4-D and M.C.P.A. have never done more than to reduce the weed population to an obvious but still inadequate extent. Pre-emergent spraying after cultivation in watergrass areas has never yet proved to be effective.

Post-Emergent Spraying

The generally unpredictable results obtained with pre-emergent spraying, whether due to unsuitable soil conditions or the prevalence of resistant weeds, have led to post-emergent techniques receiving particular attention at Illovo, and it is in this field that the most promising results have been obtained. In fact, it is only during the winter period, when planting is practised on the high altitude sections, that a reasonable assurance of satisfactory results cannot be given.

P.C.P.

This chemical in combination with 2,4-D was used almost exclusively for post-emergent work during the late winter and early spring periods, before soil conditions were suitable for T.C.A. Effects were invariably positive on all the prevalent weeds, but adequate control seldom lasted longer than three weeks. As both germination and subsequent cane growth were slow during this time, further weed control was necessary long before any cultivation could be recommended. Second applications of the contact spray resulted in burning of the cane leaves. Even in summer, at the higher altitude, the period of control with P.C.P. has not yet been sufficient to warrant its use except when dry soil conditions have precluded the use of other weedkillers and the cane has not advanced far beyond the spike stage, although the recovery from burning effects are naturally much quicker in summer than in the colder winter period. On the coast in summer, however, the use of P.C.P. may be justified in that cultivation may be advisable by the time the effect of the weedicide has declined.

In field practice, P.C.P. was used at the rate of four gallons per acre with five pints of 2,4-D in 35 gallons of water. Experiments using three gallons with three pints of 2,4-D in 60 gallons of water per acre did not give better results. An experiment was sprayed in the high altitude area during October, using different combinations of P.C.P. and 2,4-D on a heavy watergrass population. Two gallons of P.C.P. with eight pints of 2,4-D gave very little control at all, whilst four gallons with five pints of 2,4-D and six gallons with two and a half pints of 2,4-D both gave inadequate control for a period of approximately three weeks, after which time there was very little difference between treatment and control.

T.C.A.

Wherever soil moisture conditions have been reasonably high T.C.A. has given satisfactory control of almost all weed types. Watergrass control has been excellent, lasting for two months and longer. Best results have been obtained on the young weeds when the cane has barely germinated, although good control has been obtained even on adult watergrass populations. The visual signs of control have been delayed for two weeks or more after spraying, but thereafter the kill has been rapid and complete.

Where pre-emergent spraying has been practiced, and broad-leaved weeds controlled, the standard application has been 20 lbs. of T.C.A. per acre in 35 gallons of water. A mixture of 15 lbs. of T.C.A. and five pints of 2,4-D is substituted where no pre-emergent spraying has been carried out. In experimental plots, 10 lbs. of T.C.A. alone and 5 lbs. with two pints of 2,4-D per acre have proved to be inadequate, although some measure of control was invariably obtained. In the high altitude area, a single post-emergent application of 15 lbs. of T.C.A. and five pints of 2,4-D has been sufficient to control the heavy watergrass population, until the first cultivation was recommended. T.C.A. has also been used to advantage as a post-emergent spray on watergrass after cultivation.

Sodium Chlorate

This weedicide has been used with T.C.A. in the recommended two to one ratio. Although chlorosis was induced in watergrass sooner than with T.C.A. alone, the ultimate results were disappointing and did not approach levels of adequate control. In experimental work, 20 lbs. of sodium chlorate was applied with 10 lbs. of T.C.A. and 10 lbs. with 5 lbs. of T.C.A. This was in September at high altitude, when T.C.A. alone on adjacent plots was highly effective. Further trials during the warmer weather, when better results may be possible, have not yet been carried out.

Dalapon

Dalapon has not yet been used on a field scale as the cost has been prohibitive, but it has been included in most of the experimental work since September last. It can be stated without reservation that watergrass control with this chemical has never failed, and when used in combination with 2,4-D it gives weed control that can be described as almost perfect. Used at 10 lbs. per acre with two or five pints of 2,4-D, control of weeds has varied from seven weeks to two and a half months. At 5 lbs. per acre with two pints of 2,4-D, control has been fairly good for a shorter period. It has been established that 10 lbs. of Dalapon per acre is essential to a high initial level of watergrass control, but experiments are in progress using 7 lbs. per acre in attempts to reduce the specific stunting effect which 10 lbs. has on the cane. It is of interest that this stunting is apparently temporary, and the cane subsequently has a very sturdy appearance, and a lush green colour. Leaf punch analyses from one experiment have indicated no significantly higher nitrogen levels in the Dalapon plots.

At the rate of 5 lbs. per acre, stunting has been far less noticeable, and two 5 lb. applications at a seven week interval gave very good control for about four months. Two 10 lbs. applications at a two month interval had an undesirable physiological

effect on the cane. The toxic effects of Dalapon generally take a little longer to develop than those with T.C.A., but the high degree of predictability of success with this chemical makes it a weedicide to consider should the price be reduced.

C.M.U.

This chemical has only been used in one experiment to date, and the indications are that 4 lbs. of C.M.U. per acre does not give control of watergrass to compare with that obtained with either 10 lbs. or 7 lbs. of Dalapon in combination with 2,4-D. However, this experiment is still in progress and a final evaluation has yet to be made.

Summary

Chemical weed control at Illovo is being developed to meet the requirements of widely varying conditions. Experience has led to emphasis being placed particularly on post-emergent techniques which will control watergrass for a sufficiently long period to preclude the necessity for weeding prior to the first cultivation. A combination of T.C.A. and 2,4-D has given adequate results in field practice, but the most promising effects have been obtained with Dalapon and 2,4-D on experimental plots.

Dr. McMartin (the Chairman) stated that control of weeds in cane fields had now become a very complicated matter. It was most important that weed control should be carried out early in the life of the crop. When these chemical weedicides first came on the market there was a tendency to assume that they would eliminate weeds. It was now known that complete elimination was not possible nor necessary, but control in the early stages of the cane's growth was. There were conflicting views as to the control of water grass, but he wondered if the use of the word "water grass" was not confusing because there was more than one type of a similar weed which was given the same name. There were two main types, one of which was more easily controlled by 2, 4-D. He asked Dr. Cleasby, who gave results up to eight weeks' control, what had been the final effect on the water grass population.

Dr. Cleasby said that the use of herbicides was confined to the early stages and thereafter cultivation was done in the ordinary way.

Mr. Barnes said these papers made no reference to the type of spraying equipment used. This was most important as it affected the efficacy of the applied material. It was difficult to compare results unless one knew the type of equipment, nozzle design and working pressure, and particularly if they were the same in each case. He suggested that this point should receive very careful attention in future work done on the subject.

Dr. McMartin said that this subject had received considerable attention and was certainly not neglected.

Mr. Stewart said that because of the terrain in Natal it was not possible to use anything other than a knapsack spray on most fields. For pre-emergent work 22 gallons per acre was sufficient for a knapsack spray, but for a post-emergent treatment at least 45 gallons per acre was necessary. He considered that the average pressure used in a knapsack spray could reach 50 to 100 lb. per square inch. Of course the pressure varied considerably.

Mr. Barnes said that Mr. Stewart had just stated that the pressure varied considerably. This was a most important point. He wanted to know if a pressurised portable type of equipment had been used here. The dispersion of material and the size of the droplets, for instance, had a great effect on the efficacy of the application.

Mr. Thompson stated that at Illovo they had hoses running into the middle of the field so that the knapsacks could be filled without returning to the edge of the field.

Dr. Cleasby said that jets and pressures used was a very specialised field, and he had not himself been able as yet to carry out experiments on this subject. He had relied upon manufacturers' specifications only.

Mr. Leclezio said that they had used chemical weed control in Mauritius for a long time and one of the difficulties was to reduce the population of a certain grass, *cyperus rotundus*, and he wondered if this was the same thing as was referred to in Natal as water grass. The dose of P.C.P. used here in mixture with 2, 4-D seemed to be enormous when compared with that of Mauritian practice.

Mr. Stewart said he understood that in Mauritius they used a more concentrated form of P.C.P. (15 per cent emulsifiable concentrate) which accounted for the lower concentration used in the fields.

Mr. Leclezio said that only one-third of a gallon per acre of P.C.P. was used in Mauritius.

Mr. Stewart said that South African practice was to allow the weeds to grow until a good stand was obtained before spraying, but he did know of cases where three or four gallons per acre was used with success.

Mr. Thompson said that he had tried two gallons per acre with 2, 4-D and this gave very poor results.

Mr. Stewart said the control of *cyperus rotundus* was better effected when the weed was suffering from drought conditions or not growing well, but unfortunately the time we wanted to control it was in spring when the cane was in the early stages of its growth.

Dr. McMartin asked Mr. Leclezio what was the formulation of the so-called Mauritian cocktail weedkillers.

Mr. Leclezio gave the formulation:

$\frac{1}{3}$ gall. P.C.P.; $1\frac{1}{2}$ lb. acid equivalent of amine salts of 2, 4-D; and 5 lb. T.C.A. per acre.

This was one cocktail. The second one was:

$\frac{1}{2}$ gall. P.C.P.; 2 lb. acid equivalent of 2, 4-D or M.C.P.A.; and 5 lb. T.C.A. per acre.

These cocktails were used in Mauritius on a very wide scale.

Dr. Dodds said that the rapidly-increasing use and numbers of weed killers had caused an important development in the application of chemical industry to agriculture. The number of chemical compounds used for this purpose had greatly increased, but most of them maintained the general chemical structure of the original 2, 4-D, that is to say a phenol ring with substituted chlorine atoms, and a side chain consisting of simple or complex esters of the lower fatty acids. A new series, of a substituted urea type such as C.M.U. has also been introduced, and is claimed to act more specifically on the roots than on the leaves of plants. This should be of particular value in the case of weeds having extensive and complicated root systems like water grass, but these hopes do not seem to have been fulfilled as yet at Illovo. Regarding the interesting subject of the mechanism of 2, 4-D and similar compounds, he believed it was suggested that they are decomposed by bacteria in the soil into compounds, not yet identified, that are very toxic to plant life, and that by using a bactericide such as borax with the herbicide, the life of the latter can be prolonged and thus made more effectual against large and perennial weeds. He would be very interested to know if Dr. Cleasby could give any further and more definite information on this aspect of the subject.

Dr. Cleasby said that the discussion on the toxic decomposition products of herbicides was often brought up. This was a long-term study and as yet we could only wait and see if they had any such effect. He asked Mr. Leclezio his experience in controlling weeds in ratoon cane. This was new in this country.

Mr. Leclezio said that the so-called cocktails were applied shortly after the cane was cut and this corresponded to a semi pre-emergent condition because there were always some weeds left in the field after the cane was cut. Special precautions were taken against the contact of these herbicides with the growing cane.

Dr. McMartin pointed out that in this country we had a special, very effective, means of combating weeds in ratoon cane and that was trash blanketing. As far as the effect of any decomposition products

in the soil was concerned, this had been investigated elsewhere. They had found that the decomposition of 2, 4-D took a few months and was accomplished by micro-organisms which then built up temporarily only. One danger in the use of selective herbicides meant that one might be destroying certain weeds and leaving behind a population of more resistant ones. This was something that could be found out in the future only.

Mr. Coignet asked if the fact that we allowed water grass to grow to a certain extent before treating it, would not have a very bad effect on the young, growing cane.

Mr. King said that recently he had heard of a large increase in the amount of borer in sugarcane. He wondered if this could be related in any way to the use of P.C.P., because peculiarly enough P.C.P. was one of the substances used in controlling borer in wood.

Dr. Dick stated that there was evidence, for example in Louisiana, that applications of weedkillers such as 2, 4-D might lead to increased infestation by sugarcane borers, on account of the toxicity of some of these materials to parasitic insects. Some growers were of the opinion that borer incidence in Natal was also being increased in this way but there was not yet sufficient evidence to enable a definite statement to be made. During the past season borers did appear to have been somewhat more numerous than usual, but this had been noticed in untreated as well as in sprayed fields.

Mr. Main had found that weedkillers worked much better in the colder months. He stated that his major problem was "uBabe" grass—*panicum maximum*. This weed grew extensively along irrigation furrows where it flowered and the seeds were water-borne all over the farm. He had found to get any control with any weedkiller mixtures tried yet, it was possible to kill the cane before one could kill the *panicum maximum*. He asked was it possible that we may in time get cane varieties which were more resistant to weedkillers than those used at present. Only such resistant types of cane would enable them to kill

panicum maximum with weedkillers. Was it possible to mix a dye with weedkillers so that the work done by farm labour could be checked to verify regularity of knapsack spray applications?

Dr. Cleasby stated that the post-emergent spray T.C.A. and dalaton had given good control, but at a price.

Mr. Barnes said that it was noticed that when the broad-leaved weeds only were destroyed the biological balance was upset so that the more resistant types had less competition.

Dr. McMartin said that it was often to be observed that after spraying, which killed off the broad-leaved weeds, the more resistant grasses had a much more healthy colour and he wondered if this apparently stimulating effect was due to release of nitrogen.

Mr. Thompson said that the same thing was noticeable with cane but he could not put forward any explanation for this.

Mr. Stewart suggested that as 2, 4-D was a plant hormone, small quantities might tend to stimulate, large quantities of course upset the metabolism of the plant, but in small quantities it might very well stimulate it.

Dr. Dodds said that relative to the query as to whether dyes could be used to shew where the weedkiller had been applied, the problem was to find a soluble dye which would be permanent under all types of adverse conditions. There were a few dye-stuffs which were outstanding such as monastral blue made by I.C.I., and turkey red and actually even indigo had great fastness under all conditions. He thought this was a line which might usefully be followed up with the help of a dye-stuffs chemist.

Mr. Udal enquired if the application of 2, 4-D as a pre-emergent spray had any retarding effect on the germination of cane.

Dr. Cleasby said that even with heavy applications he had found no difference in germination due to herbicides.