THE CONTROL OF WEEDS BY CHEMICALS. THREE EXPERIMENTS CARRIED OUT BY THE TONGAAT SUGAR COMPANY LTD.

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In this paper three experiments principally directed to control water grass (nut grass) in cane planted in the spring are reported. The experiments involve the use of a number of chemicals, and both pre- and post-emergent treatments.

Undoubtedly, the use of herbicides is now a permanent feature of sugarcane agriculture, but to apply these chemicals in a way which will produce optimum results is a matter of complexity only just being realised. Their action, on cane and weeds, is influenced by a large number of factors, principally time of application, locality, and the climatic conditions prevailing at the time. It must, therefore, be emphasised at the outset that the results from these experiments apply to a specific area and, more important, to a given set of climatic conditions. In other words, the experiments are incomplete as they stand, and by no means can be said to represent the behaviour of the chemicals described under all conditions prevailing in the sugar belt. The justification in publishing the results is merely the contribution they make to a subject which needs more information and research.

The chemicals investigated in these experiments are listed below. They are referred to by their chemical names, while some of those used commercially have been put in brackets.

1. Potassium salt of M.C.P.A. (Fernamine –4), 4 lb. acid eq. per gallon.
2. Sodium salt of trichlor-acetic acid (T.C.A.), 90 per cent.
3. Iso-propylester of 2, 4– dichloro-phenoxy-acetic acid ('D', Phordester 2, 4–D), 4 lb. acid eq. per gallon.
4. Pentachloro-phenol ('Q', P.C.P.), 5 per cent.
5. Sodium salt of dichloro-propionic acid (dalapon, dowpon), 85 per cent.

With the exception of penta-chlorophenol all the chemicals are systemic in their action, and show a degree of selectivity in the plants they kill. Trichloro-acetic acid and the sodium salt of dichloro-propionic acid are taken up by the plant roots, and the potassium salt of M.C.P.A. and iso-propylester of 2, 4–dichloro-phenoxy-acetic acid through the leaves and roots. They are translocated in the sap to all parts of the plant. Pentachloro-phenol is a contact herbicide, which destroys plant tissue where it comes into contact with it. The potassium salt of M.C.P.A. and sodium salt of trichloro-acetic acid are sufficiently soluble to be used in water, while the other chemicals are prepared in the form of an emulsifiable concentrate.

Details of the experiments in which these chemicals have been tested, and the concentration used are given below. As already mentioned three separate trials were carried out. In each case the treatments were replicated four times on 1/25 acre plots randomly distributed. All three experiments were planted on the same day. The main pre-emergent spraying was done the following day and the post-emergent treatments some four weeks later. This is much later than usual due to a drought which followed the planting, and held up both germination and weed growth. At the time of spraying the weed population was not dense. All the spraying was done at the equivalent rate of forty gallons liquid/acre.

EXPERIMENT I

Pre-Emergent Treatments

Planted: 11th October. *Sprayed:* 12 October.
1st Weed Count: 10th December.
Treatment:
1. 1 gallon/acre potassium salt M.C.P.A.
2. 1 gallon/acre potassium salt M.C.P.A. plus 10 lb./acre trichlor-acetic acid.
3. 1 gallon/acre potassium salt M.C.P.A. plus 20 lb./acre trichlor-acetic acid.
4. Control.
5. 2 gallons/acre potassium salt M.C.P.A.
6. 2 gallons/acre potassium salt M.C.P.A. plus 10 lb./acre trichlor-acetic acid.
7. 2 gallons/acre potassium salt M.C.P.A. plus 20 lb./acre trichlor-acetic acid.

EXPERIMENT II

Pre- and Post-Emergent Treatments

Planted: 11th October. *Sprayed:* Pre-emergent 18th October. Post-emergent 12th November.
1st Weed Count: 11th December.
2nd Weed Count: 2nd January.
Treatment:
1. Control.
2. 1 quart/acre ester of 2, 4–D as pre-emergent spray.
3. 2 quarts/acre ester of 2, 4–D as pre-emergent spray.
4. 4 gallons pentachloro-phenol, plus 1 quart 2, 4–D ester, as post-emergent spray.
5. 5 gallons pentachloro-phenol, plus 1½ quarts 2, 4–D ester, as post-emergent spray.
6. 6 gallons pentachloro-phenol, plus 2 quarts 2, 4–D ester, as post-emergent spray.

EXPERIMENT III

Post-Emergent Treatments

Planted: 11th October. *Sprayed:* 9th November.
1st Weed Count: 10th December.
2nd Weed Count: 3rd January.
Treatment:
1. Control.
2. 2 quarts 2, 4–D ester.
3. 15 lb./acre trichlor-acetic acid, plus 2 quarts/acre 2, 4–D ester.
4. 7½ lb./acre sodium salt of dichloro-propionic acid, plus 2 quarts/acre 2, 4–D ester.
5. 10 lb./acre sodium salt of dichloro-propionic acid, plus 2 quarts/acre 2, 4–D ester.

Spraying was done with the standard knapsack sprayer when there was little or no wind to introduce a drift effect of one treatment onto another. From the time of planting to the end of October only 0.5 inches of rain fell, so that cane germination and weed growth were very slow. During November adequate rainfall gave rise to rapid weed growth, and at the time of the first weed count there was a dense weed population on the control plots. This late weed growth was undoubtedly to the disadvantage of the pre-emergent treatments as will be seen later.

The time of post-emergent spraying is critical. Ideally the cane should still be at the spike stage, and the weeds, particularly water grass, well developed. Maximum benefit from post-emergent treatment is often not obtained through spraying too soon. In these experiments the water grass was well developed, and the cane beginning to, or just flagged.

Results

The results of the experiments were assessed eight weeks after planting, using a square yard frame which was put down at random in three positions on each plot. The weeds within the square yard were harvested, and divided into water grass, other grasses, and broad leaf weeds. The number of weeds were counted, and then weighed. To represent the degree of control on paper a factor has been introduced (weed factor), obtained by multiplying the number of weeds by their weight and taking the square root. On this basis the results of the experiments are recorded in Tables I, II and III, together with the cost of each treatment. Correlating the weed factors with the visual appearances of the plots showed that weed factors less than 5 represent cane virtually free of weeds, above 5 plots were in need of weeding, and greater than 10 they were very dirty. The results of the experiments are self-evident by reference to the above tables.

The costing given is only an approximate figure, as the price of the chemicals vary slightly depending on their source and the amount required. The figures are, however, accurate enough to give an idea of the economics of each treatment. An excellent account of this aspect of weed control, and comparisons with hand weeding, were included in a paper by Steward[1] at last year's Congress, and will not be dealt with further here.

To assess the length of weed control with the more successful treatments, a second weed count was made three weeks later, i.e. eleven weeks after planting. These results appear in Tables IV and V.

To determine whether the chemicals had any effect on the germination, or the growth of the cane, the number of shoots in two lines of cane from each plot were counted and measured. This showed that while the applied chemicals had no effect on the number of shoots, they certainly depressed the growth of the cane at eight weeks to varying degrees. This is shown diagrammatically in Figure 1. To determine whether or not a depression at this stage could have any effect on the final cane yield would not be easy, and as far as is known, is an aspect of weed control which has been lightly touched on.

The experiments, unfortunately, did not include a treatment in which plots were kept free of weeds by hand. This would have been interesting from the point of view of growth at the eight-week stage. The increased growth on the control plots may be explained partially by the cane being forced owing to weed competition, but the depression due to the various treatments appears to be chemical as it increases with the concentration of the chemicals applied.

TABLE I — **Results of Experiment I**

Treatment	Number of Weeds per sq. yard				Total Wt/sq. yd Kgms.	Weed Factor	Treatment cost per acre
	Water Grass	Other Grasses	Broad Leaf Weeds	Total			
1. 1 gall /acre pot. M.C.P.A.... ...	162	9	5	176	0.82	12	26/–
2. 1 gall /acre pot. M.C.P.A. + 10 lb./a. T.C.A....	127	4	6	137	0.65	9.5	56/–
3. 1 gall /acre pot. M.C.P.A. + 20 lb. T.C.A.	126	3	5	134	0.60	9	86/–
4. Control...	166	25	17	208	1.58	18	
5. 2 galls/acre pot. M.C.P.A.... ...	126	6	3	135	0.59	9	52/–
6. 2 galls/acre pot. M.C.P.A. + 10 lb. T.C.A.	143	3	4	150	0.58	9.5	82/–
7. 2 galls/acre pot. M.C.P.A. + 20 lb. T.C.A.	118	1	6	125	0.46	8	112/–

TABLE II — **Results of Experiment II**

Treatment	Number of Weeds per sq. yard: Water Grass	Other Grasses	Broad Leaf Weeds	Total	Total Wt/sq. yd Kgms.	Weed Factor	Treatment cost per acre
1. Control...	201	19	14	234	1.33	18	—
2. 1 qt /a ester 2, 4–D pre-emergent	147	11	11	169	1.08	13	6/6
3. 2 qts/a ester 2, 4–D pre-emergent	134	13	9	156	0.76	11	13/–
4. 4 galls/a P.C.P.+1 qt 2, 4–D post-emergent	59	9	4	72	0.29	4.5	24/–
5. 5 galls/a P.C.P.+1½ qts 2, 4–D post-emergent	30	9	1	40	0.16	2.5	32/3
6. 6 galls/a P.C.P.+1½ qts 2, 4–D post-emergent	24	6	1	31	0.12	2	40/–

TABLE III — **Results of Experiment III**

Treatment	Number of Weeds per sq. yard: Water Grass	Other Grasses	Broad Leaf Weeds	Total	Total Wt/sq. yd Kgms.	Weed Factor	Treatment cost per acre
1. Control...	206	13	13	232	1.32	18	—
2. 2 qts/a ester 2, 4–D	109	4	1	114	0.35	6	13/–
3. 2 qts/a ester 2, 4–D+15 lb./a T.C.A.	70	3	2	75	0.36	5	58/–
4. 2 qts/a ester 2, 4–D+7½ lb. sod. salt dichloro-prop. acid	86	5	2	93	0.16	4	69/3
5. 2 qts/a ester 2, 4–D+10 lb. sod. salt dichloro-prop. acid	72	9	1	82	0.10	4	88/–

TABLE IV — **Experiment II. Second Weed Count. Three Weeks after the First, i.e. Eleven Weeks from Planting**

Treatment	Number of Weeds per sq. yard: Water Grass	Other Grasses	Broad Leaf Weeds	Total	Total Wt/sq. yd Kgms.	Weed Factor	Treatment cost per acre
4. 4 galls/a P.C.P.+1 qt /a 2, 4–D	147	16	3	166	1.40	15	—
5. 5 galls/a P.C.P.+1½ qts/a 2, 4–D	124	20	5	149	2.72	20	—
6. 6 galls/a P.C.P.+2 qts/a 2, 4–D	176	17	5	198	1.72	18	—

TABLE V — **Experiment III. Second Weed Count, Three Weeks after the First. i.e. Eleven Weeks from Planting**

Treatment	Number of Weeds per sq. yard: Water Grass	Other Grasses	Broad Leaf Weeds	Total	Total Wt/sq. yd Kgms.	Weed Factor	Treatment cost per acre
3. 2 qts/a 2, 4–D+15 lb. T.C.A. ...	149	4	2	155	0.52	9	—
4. 2 qts/a 2, 4–D+7½ lb. sod. salt dichloro-prop. acid	252	7	3	262	0.65	13	—
5. 2 qts/a 2, 4–D+10 lb. sod. salt dichloro-prop. acid	137	9	6	152	0.63	9	—

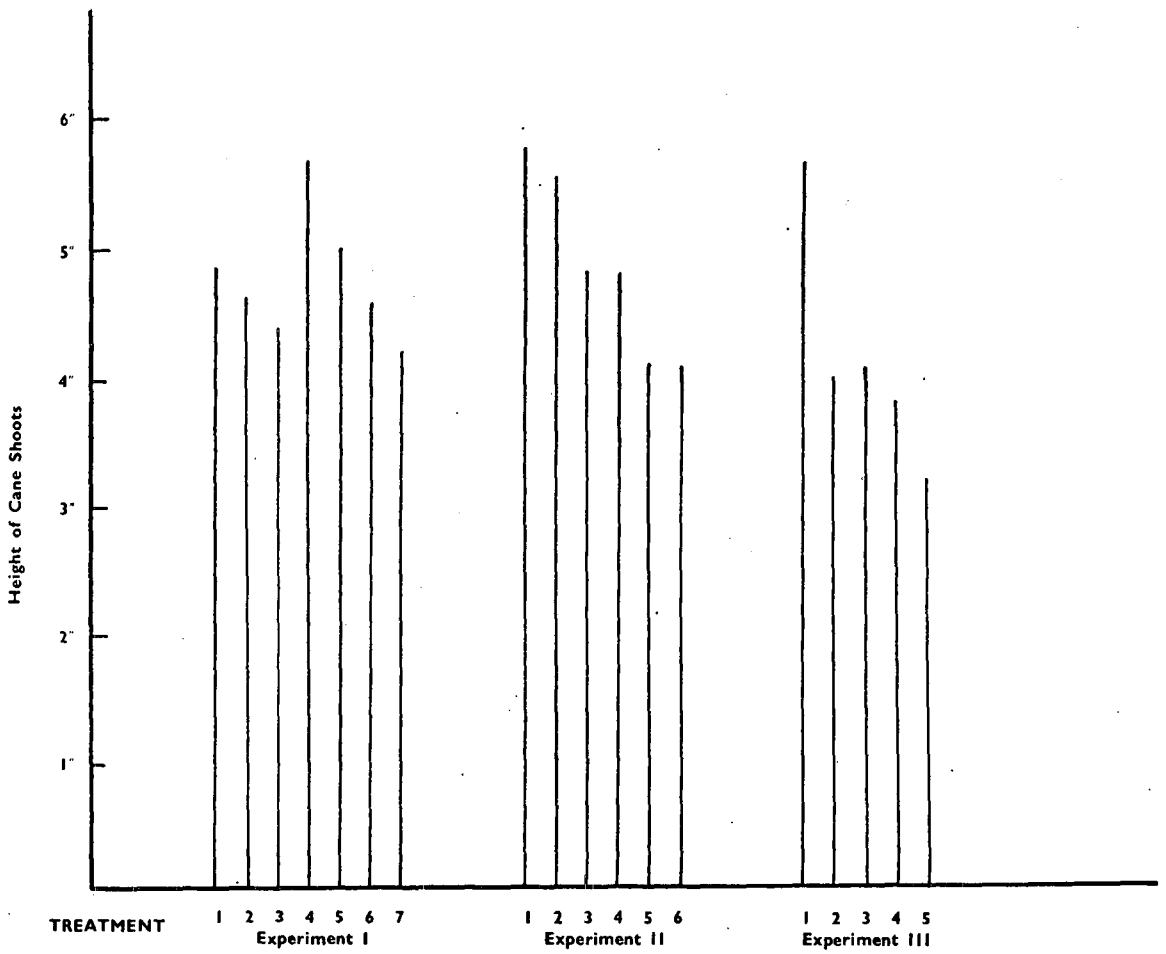
Conclusions from the Experiments

The results have not been subjected to statistical analysis, so that they can only be described as trends and not definite results.

1. Treatments which gave good control of water grass up to the first weed count (i.e. eight-week control) were all post-emergent sprays, and have been listed below:
   (*a*) 4 galls./a. P.C.P. +1 qt. ester of 2, 4–D.
   (*b*) 5 galls./a. P.C.P. +1½ qts. ester of 2, 4–D.
   (*c*) 6 galls./a. P.C.P. +2 qts. ester of 2, 4–D.
   (*d*) 15 lb. /a. T.C.A. +2 qts. ester of 2, 4–D.
   (*e*) 7½ lb. /a. sod. salt of dichloro-propionic acid +2 qts. ester of 2, 4–D.
   (*f*) 10 lb. /a. sod. salt of dichloro-propionic acid +2 qts. ester of 2, 4–D.

   The concentrations at which the chemicals were used had no significant effect on, or length of, weed control, except in the third experiment, where the higher level of the sodium salt of dichloro-propionic acid (10 lb./acre) appeared to give a reasonable control up to eleven weeks after planting, while the lower rate did not.
2. The weed count showed that pentachlorophenol +2, 4–D ester in the above concentrations did not control 'uBabe' grass (*panicum maximum*), while the sodium salt of trichor-acetic acid and dichloro-propionic acid gave very good control. This grass, which grows in large stools, was a major pest on all plots except those treated with these chemicals.
3. The comparative costs of spraying are given in Tables I, II and III, and need little comment. The pentachloro-phenol post-emergent treatments were undoubtedly the most economical for weed control up to eight weeks from planting, or four weeks after spraying. Other chemicals gave equally good control, and in some cases for a longer period. They are, however, more expensive, and will only be of use in the field if their advantages compensate for this disadvantage.

EFFECT OF CHEMICALS ON GROWTH OF CANE AT 8 WEEKS Figure I



Those which gave moderately good control up to the second weed count (i.e. eleven-week control), were only:

(*a*) 15 lb./a. T.C.A. +2 qts. ester of 2, 4–D.

(*b*) 10 lb./a. sod. salt of dichloro-propionic acid +2 qts. ester of 2, 4–D.

4. In comparing pre-emergent treatment with post-emergent, the warning note struck at the beginning must be repeated. Although in these experiments the post-emergent treatments show an overwhelming superiority, reports have been made of experiments in which the treatments used in Experiment I have given good control even in water grass areas. Undoubtedly, the climatic conditions played a part in their failure, but at the same time the experiments show there is an element of unreliability in pre-emergent spraying. Whether this degree of chance is offset by the greater convenience in spraying immediately after planting is difficult to say. Post-emergent treatment requires judgment regarding when to spray, and even then may be ruined by heavy rain immediately afterwards. However, it does have the advantage that the weed growth is visible, so that the attack can be regulated accordingly.

In conclusion, the aim at Tongaat has been to keep plant cane fields free from weeds, particularly water grass, by chemicals until the cane is large enough to cultivate in the inter-row. The necessity for doing this often coincides with an acute labour shortage, providing an additional reason, other than economics, for turning to herbicides. To fulfil this aim does not necessarily entail a particularly long control. In a reasonable growing season it is of the order of seven to eight weeks. The results of these experiments indicate that this can be done most efficiently and economically by post-emergent spraying with a mixture of pentachloro-phenol and the ester of 2, 4–dichloro-phonoxy-acetic acid. Also, that these chemicals are effective at the lower concentrations in which they were used.

Acknowledgments

The author would like to acknowledge the collaboration of three commercial firms in carrying out these experiments: Shell Chemicals Limited; Kynoch Limited; and The Standard Oil Company of S.A. (Pty.) Limited. All helped in the layout and spraying of the experiments, they were also generous enough to supply the chemicals used.

Summary

Three experiments are described, involving the use of various chemicals in different concentrations to control weeds, principally water grass (nut grass) in cane planted in the spring.

REFERENCES

[1] Steward, E. Control of Weeds in Plant Cane by Chemical, Spraying. S.A. Sugar Tech. Assocn. **13,** 125.

For discussion on this paper see page 126.