THE RESULTS OF PRE-EMERGENCE HERBICIDE SCREENING TRIALS FOR SUGARCANE IN NATAL

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Abstract

The results of seven pre-emergence herbicide screening trials involving 27 chemicals are presented. The experiments, which were conducted over a four-year period, differed with respect to soil moisture conditions, soil type and prevailing weed flora. Special attention was directed to the control of *Cyperus esculentus, C. rotundus* and grasses. Mean visual assessments of control of species or species-group are presented for each experiment. Two chemicals, C.P.50144 (Alachlor) and C.P.44939 gave consistently good results. C.P.50144 had a wide spectrum of broad-leaf weed and grass control, the latter being excellent even under relatively dry conditions. The product was also active on *C. esculentus*. No phytotoxicity to sugarcane from C.P.50144 was recorded. C.P.44939 gave outstanding control of *C. esculentus, C. rotundus* and the grasses, including *Panicum maximum*. Phytotoxicity to cane has not been fully evaluated.

Introduction

The use of herbicides for pre-emergent weed control in the South African sugar industry has steadily increased since 1961. The phenoxyacetic acids, primarily in the form of 2, 4-D amine, are the most important group of chemical weedkillers currently recommended for controlling a wide range of germinating annual grass and broad-leaf weeds. The present usage of this group exceeds 100 000 kg acid equivalent per annum, a figure that continues to rise each year and which indicates that satisfactory results continue to be obtained.

Unfortunately, the phenoxyacetic acids do not usually give any pre-emergent control of the important watergrass species *Cyperus esculentus* and *C. rotundus*. Satisfactory grass control is often dependent upon an optimum soil moisture status during and immediately after application. Screening trials are regularly conducted on selected new formulations in the search for a herbicide having a wider spectrum of activity, a longer period of control and being less dependent on soil moisture conditions.

It is unlikely that a recently developed herbicide would compete immediately with 2, 4-D on a price basis, but there are large areas within the industry where an effective, more expensive product might be valuable. The results of previous pre-emergence screening trials have been reported up to 1965[1, 2, 3, 4, 5]. This paper presents the results of seven pre-emergence herbicide screening trials carried out between 1966 and 1970.

Materials and Methods

The experiments are described and discussed individually but the techniques of herbicide application and assessment were common to all experiments. Full cover herbicide treatments were applied using a "Platz Frankonia" knapsack fitted with a "Spraying Systems" T.K.2.5 floodjet and a constant pressure valve. The pace of the operator was maintained so that approximately 280 litres per hectare were delivered at a pressure of 2.1 kg/cm^2, with the floodjet held 50 cm above the ground.

Visual scorings of weed control were carried out in the experiments using a scale of 0(=No weed control) to 9(=complete weed control). A score of 7 on this scale reflects adequate weed control such that further operations are not immediately necessary. Absolute values may vary according to the assessor but over a period of time a reliable assessment of the efficacy of a product relative to that of other products is obtained. Where the individual species were not uniformly distributed assessments of total weed cover were made. The preferred method, however, was by species or species-group (e.g. broad-leaf, grasses), because the selective herbicides used frequently altered the pattern and rapidity of succession, a species or species-group becoming dominant in the absence of any competitors.

Technical details of the herbicides used are given in Appendix I.

Experiments I and II

Description

The experiments were similar in design and contained the same treatments, but different in soil type, weed flora and water regime. Both were of a randomised block design with a plot size of 0.004 hectares, but treatments were replicated four times in Experiment I and six times in Experiment II.

Experiment I

This was conducted at Chaka's Kraal Experimental Farm on a Dwyka sandy loam. Setts of variety N:Co.376 were planted in October 1966, the crop being harvested 12 months later. Immediately after planting, the herbicides of low solubility were applied, after which the site received 25 mm of water by means of overhead irrigation. The more soluble herbicides were then applied. For the duration of the experiment supplementary irrigation was used to ensure that the soil moisture deficit did not exceed 25 mm.

The weed flora that developed in control plots con-

tained a wide range of species. The broad-leaf weeds *Galinsoga parviflora, Solanum nigrum, Nicandra physaloides* and *Commelina benghalensis* achieved an early dominance. There was more *Cyperus rotundus* present than *C. esculentus*, neither species becoming of significance, however, as the grasses, especially *Digitaria adscendens*, rapidly became dominant.

Experiment II

This was located on a Rydalvale soil at the Mount Edgecombe Experiment Station. Setts of variety N:Co.376 were also planted in October, but the crop was not harvested, the experiment being discontinued after four months. No irrigation water was applied but the soil moisture conditions were satisfactory for soil-applied herbicides during application and for some time afterwards.

Fewer broad-leaf weeds were present in this experiment than in Experiment I, and of these, *Bidens pilosa* and *Siegesbeckia orientalis* were dominant. The grasses, especially *Digitaria adscendens*, subsequently became the dominant species present. *Cyperus esculentus* was more abundant than *C. rotundus*, but again neither species became a serious problem.

Results

The mean visual scores for broad-leaf weed control in Experiment I are presented in Table I to illustrate the pattern of control obtained. Tables II and III present the 50-60 day mean value for the control of weed groups.

Discussion

In both experiments the product C.P.50144 was the superior herbicide. Even at low application rates, the control of broad-leaf weeds and grasses was excellent and persisted for over two months. Its activity on watergrass, though inadequate, was better than that of most other products and it was observed that *C. esculentus* appeared to be more susceptible than *C. rotundus*. No phytotoxicity to the crop occurred.

The "standard" chemicals, 2,4-D, Atrazine and Fenac, performed adequately under the optimum soil moisture conditions prevailing, but Atrazine gave unsatisfactory control of grasses. Banvel D was very good for general weed control in the second experiment but showed little selectivity between crop and weed. The product was rejected from further screening programmes due to its extremely severe phytotoxic effect on sugarcane.

Cotoran under irrigated conditions gave satisfactory control of broad-leaf weeds and grasses but showed no activity on watergrass and failed under the drier conditions of the second experiment. Ramrod failed to control the wider spectrum of broad-leaf weeds in Experiment I and in both experiments Sindone was relatively inactive. Sindone B at high rates of application was fairly effective.

Hand weedings which should have been performed in Experiment I when treatments failed, or no longer gave adequate control, were delayed and a major grass problem developed. Large yield differences be-

TABLE I

Experiment I Mean visual scores for broad-leaf weed control

0 = No control
7 = Acceptable control
9 = Complete control

Treatment		Days after application								Mean 0–50 days
Formulation	Rate (units/ha.)	12	21	28	33	47	56	63	75	
Sindone	2.2 kg a.i.	3	2	2	1	1	0	2	1	1.8
,,	4.5 ,,	1	0	1	0	2	0	2	2	0.8
Sindone B	2.2 ,,	5	6	4	2	3	0	1	0	4.0
,,	4.5 ,,	6	7	7	6	6	2	4	2	6.4
C.P.50144	2.2 ,,	9	9	9	8	9	7	6	6	8.8
,,	4.5 ,,	9	9	9	8	9	8	8	9	8.8
Ramrod	5.6 kg product	1	1	1	0	1	0	1	1	0.8
,,	11.2 kg ,,	3	3	1	2	1	0	0	1	2.0
Cotoran	2.2 kg ,,	8	8	8	7	8	5	5	5	7.8
,,	4.5 kg ,,	9	9	8	9	9	8	9	8	8.8
Banvel D	6.7 kg a.e.	2	4	2	2	1	0	2	1	2.2
,,	11.2 ,,	3	6	5	4	4	2	2	3	4.4
2,4–D amine	3.4 ,,	9	9	8	7	8	6	5	4	8.2
Atrazine	4.5 kg product	8	8	8	8	9	8	7	9	8.2
Fenac	2.2 kg a.e.	9	9	9	9	9	8	8	7	9.0
Control	—	1	2	1	0	0	1	0	0	0.6

TABLE II

Experiment I Mean visual scores for group weed control

Treatment		Broad-leaf 50–day mean	*Cyperus spp.* 50–day mean	Grass 60–day mean
Formulation	Rate (units/ha.)			
Sindone	2.2 kg a.i.	1.8	1.0	4.5
,,	4.5 ,,	0.8	0.4	7.8
Sindone B	2.2 ,,	4.0	1.8	6.3
,,	4.5 ,,	6.4	2.6	7.5
C.P.50144	2.2 ,,	8.8	3.0	9.0
,,	4.5 ,,	8.8	4.6	9.0
Ramrod	5.6 kg product	0.8	3.2	5.0
,,	11.2 ,,	2.0	3.2	6.5
Cotoran	2.2 ,,	7.8	0.8	4.5
,,	4.5 ,,	8.8	2.0	9.0
Banvel D	6.7 kg a.e.	2.2	3.4	1.5
,,	11.2 ,,	4.4	5.4	5.0
2,4–D amine	3.4 ,,	8.2	3.8	7.8
Atrazine	4.5 kg product	8.2	4.4	3.8
Fenac	2.2 kg a.e.	9.0	4.2	8.8

TABLE III

Experiment II Mean visual scores for group weed control

Treatment		Broad-leaf 50–day mean	*Cyperus spp.* 50–day mean	Grass 50–day mean
Formulation	Rate (units/ha.)			
Sindone	1.7 kg a.i.	3.6	2.9	3.5
,,	3.4 ,,	5.0	2.4	4.9
Sindone B	2.8 ,,	4.5	3.5	4.6
,,	5.0 ,,	7.4	5.6	7.4
C.P.50144	2.2 ,,	7.0	4.8	8.0
,,	3.4 ,,	7.3	5.6	8.0
Ramrod	6.7 kg product	7.3	4.2	6.5
,,	8.9 ,,	7.6	4.5	7.1
Cotoran	2.2 ,,	4.6	3.0	2.8
,,	4.5 ,,	6.0	2.4	3.5
Banvel D	5.6 kg a.e.	8.5	8.3	5.7
,,	11.2 ,,	9.0	9.0	6.5
2,4–D amine	3.4 ,,	8.0	5.4	5.9

tween treatments were recorded when the crop was harvested. Yields were higher from those treatments which had been relatively effective at the beginning of the experiment. The harvest data obtained cannot be interpreted too literally, but it is of interest that the "effective" treatments (C.P.50144, 2,4-D and Fenac) had a mean yield of 10.4 metric tons sucrose per hectare, compared with that of 5.5 metric tons sucrose per hectare obtained from the "ineffective" treatments (Sindone, Sindone B, Ramrod).

Experiment III

This was laid down in December 1967 on a Waldene soil at the Mount Edgecombe Experiment Station. After setts of variety N.Co. 376 had been planted the soil surface, which was extremely dry, was cultivated with a spike-tooth harrow to form a slightly moist seedbed more suited to the application of herbicides. Each treatment was replicated four times in a randomised block design, the plot size being 0.004 hectare.

The same scale for visual assessment was used but, due to the lack of species uniformity within the experiment, assessments were made on general weed cover and not by species group. Assessments were discontinued after three months, by which time all chemical control had ceased. The experiment was not irrigated and soil moisture was never satisfactory enough for total herbicide activity. Very dry conditions were broken eight days after herbicide application by 28 mm rain, but subsequently no further significant rainfall occurred for a long time.

Cyperus rotundus and broad-leaf species dominated the weed spectrum that developed. *C. esculentus* was rare and *Eleusine indica*, the only grass present, never became important. The major broad-leaf weeds were *Amaranthus spinosus* and *Portulaca oleraceae*.

Results

The mean visual scores for general weed control are presented in Table IV.

TABLE IV
Experiment III Mean visual scores for general weed control

Treatment		Days after application						Mean 0–50 days
Formulation	Rate (units/ha.)	24	30	45	52	64	72	
F.P.C. 9267	2.2 kg a.i.	5	4	5	4	2	0	4.5
,, ,,	4.5 ,,	5	4	4	4	2	1	4.2
C.P.31675	2.2 ,,	5	3	5	4	1	0	4.0
,, ,,	4.5 ,,	7	6	6	6	4	2	6.2
C.P.50144	2.2 ,,	5	4	5	5	3	1	4.6
,, ,,	4.5 ,,	7	7	7	7	5	2	7.0
H.210	6.7 kg product	6	6	6	6	2	3	6.0
H.255	4.5 ,,	6	6	5	5	3	1	5.5
H.210+ H.119	4.5 kg + 1.1 kg product	3	2	3	2	2	1	2.4
H.210+ H.225	4.5 kg + 1.1 kg product	5	4	4	3	1	1	3.8
Prefix	6.7 kg product	5	5	5	3	0	0	4.4
,,	8.9 ,,	3	2	2	0	0	0	1.4
Planavin	1.1 ,,	5	3	4	3	1	0	3.6
,,	3.4 ,,	4	3	3	3	1	2	3.2
C.6989	3.4 kg a.i.	5	4	6	6	3	2	5.2
W.L.9385	1.1 kg product	5	3	2	1	0	0	2.6
2,4-D amine	3.4 kg a. e.	5	5	5	4	2	0	4.8
Cocktail	*	5	5	6	7	6	4	5.6
Hand weeding	Twice	9	9	9	8	8	7	8.8
Control	—	4	2	1	0	0	0	1.6

* Cocktail consisted of 1.4 kg a.i.Bromacil/ha.
2.7 kg a.i. Diuron/ha.
3.4 kg a.e. 2,4-D/ha.

Discussion

Screening trials are usually carried out under conditions favourable for chemical weedkillers, and if a product fails under optimum conditions, it is not usually selected for further investigation. If a product performs satisfactorily it must then be tested under sub-optimal conditions before it may be recommended for general use. With the unreliability of rainfall in Natal, it is of paramount importance that a product be tested under conditions where soil moisture is limited.

This experiment may be considered as such a test, the herbicides having been applied to a fairly dry soil and application being followed by a dry period. Under these conditions the rate of growth of weeds is limited and hand-weeded treatments are favoured. Two hand-weedings were sufficient to maintain the relevant plots weed-free for nearly three months.

The pattern of weed control given by the mixture of 2,4-D, Diuron and Bromacil was indicative of the severity of limiting soil moisture. This mixture was relatively inactive for 40 days, after which time the first adequate rainfall was received. Twelve days later the effect of this cocktail was given a mean visual score of 7, but it failed to maintain this level of weed control.

C.P.50144 however, at a rate of 4.5 kg a.i./ha exceeded expectations and maintained a high score for a 50-day period. Broad-leaf species were eradicated and the population of *C. rotundus* was markedly reduced. Although the growth rate of surviving *C. rotundus* plants was retarded, the actual control of this species by C.P.50144 would not normally be commercially acceptable. No symptoms of phytotoxicity to sugarcane were observed.

The two products, C.P.31675 (4.5 kg a.i./ha) and H.210 (6.7 kg a.i./ha) failed to give satisfactory control but had mean visual scores exceeding those of the cocktail. *Amaranthus spinosus* was recorded as being resistant to H.210.

Experiment IV

This experiment was located on a Waldene soil at the Mount Edgecombe Experiment Station. The weather conditions that prevailed followed closely those of Experiment III. The crop (variety N:Co.376) was not harvested, the experiment being discontinued after four mouths. The design was as a 4 × 4 lattice with a plot size of 0.004 hectare. There were four replications of each treatment but selected treatments (C.P.50144, 2,4-D and hand-weeded) were replicated eight times.

The trial was not irrigated and the dry conditions were somewhat more severe than those of Experiment

III. After the setts had been planted (in October 1968) there was no sign of impending rain, and the trial was therefore left for 12 days, at which time 34 mm of rain fell. Inter-rows were lightly harrowed to produce pre-emergence conditions for weeds (but not crop) and the herbicides were applied. No rainfall of any consequence was received for 16 days following this operation.

Cyperus esculentus was the dominant species present. Broad-leaf weeds never attained any significance and it was only at the closing stages of the experiment that grasses (species of *Digitaria, Setaria, Eleusine* and *Cynodon*) started to compete with *C. esculentus*. Visual assessments on the effectiveness of weed control refer mainly to *C. esculentus*, but an assessment specific to grasses was carried out 35 days after herbicide application.

Results

Under the extremely dry conditions and with the dominant species being *C. esculentus*, no chemical treatment performed satisfactorily. Table V shows treatments, rates of herbicide application and mean visual scores of efficacy. Hand-weeding was again most effective, although the two weedings carried out during the 50-day period were barely enough for adequate control.

TABLE V
Experiment IV Mean visual scores for weed control

Treatment		*Cyperus esculentus* 0–50 days	Grasses 35 days
Formulation	Rate (units/ha.)		
Asulam	3.5 kg a.i.	3.0	3
,,	4.0 ,,	3.0	3
Actril D	2.5 litre product	3.8	3
,,	4.8 ,,	3.0	5
Urox B	2.6 ,,	4.3	6
,,	3.6 ,,	5.8	9
Daxtron	0.6 kg a.i.	4.0	3
,,	0.9 ,,	3.8	6
Diuron	4.2 kg product	3.5	5
Cotoran	3.4 ,,	4.0	4
H.210	3.1 kg a.i.	3.3	4
C.P.50144 1	2.2 ,,	4.8	9
C.P.50144 2	2.2 ,,	4.8	8
2,4–D 1	3.4 kg a.e.	3.5	4
2,4–D 2	3.4 ,,	4.5	4
Weeded 1	Twice	6.0	5
Weeded 2	Twice	5.8	5
Control	—	2.8	1

Discussion

It would appear that the soil moisture present during the early stages of the trial was sufficient for the germination of *C. esculentus* tubers but was inadequate for herbicides to be effective. The fact that none of the chemicals gave any measure of control again emphasises the absolute necessity for optimum soil moisture régimes if pre-emergence herbicides are to be successful.

C.P.50144 which was used only at the low rate of 2.2 kg a.i./ha failed to control *C. esculentus*, but its activity on the grasses remained excellent. It is suggested that the majority of the grass seeds, which normally germinate in the upper 15 mm of soil, can be controlled with this product. The locus of absorption is primarily between the seed and the first node of germinating seedlings[6]. Under dry conditions, where there is no downward movement of active material, seeds or tubers germinating below 15 mm will absorb relatively little active material and may grow through the herbicide layer.

Urox B, a liquid formulation of Bromacil, appeared at 3.6 l/ha (equivalent to 1.4 kg a.i. Bromacil/ha) to be the best herbicide treatment. This is in accordance with earlier observations[4, 5] that the substituted uracils are often effective under sub-optimal soil moisture régimes. Although in this experiment only slight phytotoxicity symptoms on the crop due to the substituted uracils were observed, these chemicals are considered to be too hazardous for general use in plant cane.

Experiments V, VI and VII

Three experiments were laid down in the Mount Edgecombe area during November 1969 to screen herbicides under fairly similar climatic conditions. Each was sited for a specific weed problem. Experiment V was located on a Rydalvale soil where a mixed population of *Cyperus esculentus* and *C. rotundus* could be expected. Experiment VI was located on a Milkwood clay in an area known to have a heavy infestation of *Panicum maximum*, and Experiment VII was sited on a Lytton sand where *C. rotundus* was known to be the dominant weed species (see Table VI).

TABLE VI
Soil and flora characteristics of experiment sites V, VI, and VII.

Experiment	V	VI	VII
Soil series	Rydalvale	Milkwood	Lytton
Description	Black clay	Dark brown clay	Red loamy sand
Per cent clay (0–15 cm)	41	44	15
Per cent silt (0–15 cm)	16	20	3
Per cent sand (0–15 cm)	41	34	82
Dominant weeds 1.	*C. esculentus*	*P. maximum*	*C. rotundus*
2.	*C. rotundus*	*R. exaltata*	

The experiments were of a similar randomised block design. Treatments were replicated five times in Experiment V, which had a plot size of 0.002 hectare, and four times in Experiments VI and VII which had plot sizes of 0.005 and 0.004 hectare respectively. Sugar cane (variety N.55/805) was present only in Experiment VI where the weedkillers were applied after the crop had emerged.

The soil was disc harrowed prior to herbicide application in all of the experiments to ensure representative conditions for pre-emergent herbicide usage. Soil moisture was satisfactory at the time of application and the pattern of rainfall which followed was ideal for soil-applied herbicides. Visual assessment of treatment efficacy was made primarily on the dominant weed species. The experiments were discontinued after four months.

Experiment V

Cyperus esculentus developed to a greater extent than did *C. rotundus* and, of a wide spectrum of broad-leaf weeds. *Portulaca oleraceae* and *Bidens pilosa* were most common. The grass spectrum was made up of *Digitaria adscendens, Eleusine indica, Setaria verticillata, Cynodon dactylon* and *Paspalum vaginatum.*

Results

The mean visual scores for control of the relevant species groups are presented in Table VII.

TABLE VII
Experiment V Mean visual scores of weed control thirty days after herbicide application

Treatment		Species or Species group			
Formulation	Rate (units/ha.)	*C. rotundus*	*C. esculentus*	Grasses	Broad-leaf
C.P.50144	2.2 kg a.i.	6	6	9	8
,,	4.5 ,,	8	8	8	9
C.P.44939	5.0 ,,	9	8	9	8
,,	6.5 ,,	9	9	9	9
P.P.493	0.6 ,,	4	4	4	3
,,	1.0 ,,	5	4	6	5
Urox B	4.5 l. product	5	5	8	9
2,4-D+ Diuron	3.4 kg a.e. + 4.5 kg	6	7	9	9
2,4-D	3.2 kg a.e.	4	3	6	7
Control	—	4	4	4	1

Discussion

Two days after the herbicides were applied a cloudburst occurred during which 65.6 mm rain fell in an hour, causing soil wash within the experiment. From the flora that developed, however, it was apparent that treatments remained discrete, and little or no lateral movement of any of the herbicides occurred.

Most of the chemicals performed extremely well, but the product C.P.44939 (an analogue of C.P.50144) was outstanding. Maximum scores were given for its control of all the species groups and this continued for three months, by which time any control exhibited by other herbicides had ceased. Observations indicated slightly better control of *C. rotundus* than *C. esculentus.*

The maximum scores given for broad-leaf weed control by C.P.44939 require comment. All the frequently occurring species were eradicated except for *Bidens pilosa,* which was totally resistant. In the absence of competitors, this species thrived and a dense infestation solely of *B. pilosa* developed. It was ignored for assessment purposes because the efficacy of the herbicide for general broad-leaf weed control would have been incorrectly assessed. The population of *Paspalum vaginatum* was small and was not uniformly distributed, but observations suggest that this stoloniferous grass was fairly tolerant of C.P.44939.

C.P.50144 again performed satisfactorily, having maximum scores for broad-leaf and grass groups. Under the good rainfall conditions it controlled the *Cyperaceae* at 4.5 kg a.i./ha but rates lower than this again proved inadequate. The suitable moisture régime was also instrumental for the good general weed control obtained from mixtures of 2,4-D and Diuron.

Experiment VI

The timing of the harrowing which was performed on the interrows prior to herbicide application was possibly ideal for a mechanical method of control, because the expected grass problem never really developed. The grasses that eventually emerged were mainly *Panicum maximum* and *Rottboellia exaltata,* other grasses present being *Sorghum verticilliflorum, Digitaria sanguinalis* and *Cynodon dactylon.* Broad-leaf weeds present included *Bidens pilosa, Siegesbeckia orientalis, Commelina benghalensis* and *Oxalis latifolia.* There were few specimens of the *Cyperaceae* present on the site.

The mean visual scores for grass control are presented in Table VIII.

TABLE VIII
Experiment VI Mean visual scores for grass control

Treatment		Days after application				Mean value 0–50 days
Formulation	Rate (units/ha.)	19	25	43	54	
C.P.50144	2.5 kg. a.i.	7	7	7	5	6.5
,,	4.6 ,,	8	7	7	6	7.0
C.P.44939	4.3 ,,	7	7	8	6	7.0
,,	6.0 ,,	8	9	9	9	8.8
P.P. 493	0.6 ,,	7	8	8	6	7.3
,,	1.2 ,,	7	9	9	9	8.5
Urox B	4.2 litre product	8	8	9	8	8.3
2,4-D+Diuron	3.5 kg a.e. +4.7 kg	7	8	9	8	8.0
Hand weeding	Once	5	9	7	4	6.3
Control	—	5	4	3	1	3.3

Discussion

This experiment also received the heavy rainfall (65.5 mm) discussed in Experiment V, and the herbicides again remained discrete with no apparent lateral movement from plot to plot. Because vigorous grass growth was lacking, treatment differences were small and one hand-weeding was sufficient to maintain a relatively weed-free environment in the appropriate plots.

All chemicals gave adequate control. C.P.44939 at 6.0 kg a.i./ha was the best treatment for the control of *P. maximum* and *R. exaltata. Bidens pilosa* again proved resistant to this product. The plant cane, which had emerged before spraying (2-3 leaves produced; ± 35 cm canopy height) showed stunting due to a phytotoxicity effect. Recovery by the sugarcane was good and growth differences between treatments disappeared within 60 days. C.P.44939 has not, however, been evaluated pre-emergent to cane and this should have high priority in future trials.

C.P.50144, although satisfactory, was poor in relation to other herbicides. This was primarily because

Rottboellia exaltata was resistant and the control of *Panicum maximum* did not persist beyond the first germination flush. The other grass species present were well controlled however, and no phytotoxicity symptoms were observed on the crop.

In this experiment, the product P.P.493 was active, and warrants further screening for perennial grass control. With the excellent rainfall distribution that prevailed, the mixture of 2,4-D and Diuron proved to be entirely satisfactory.

Experiment VII

Conditions were ideal for screening trials on *Cyperus rotundus* as this grew vigorously and for some time was the only species present. *Setaria verticillata*, *Eleusine indica* and a few broad-leaf weeds developed later but *C. rotundus* always remained the dominant species.

Results

The mean visual scores for the control of *C. rotundus* and for the grasses are presented in Table IX.

TABLE IX

Experiment VII Mean visual scores for *Cyperus rotundus* and grass control

Treatment		*C. rotundus*-days after application			Grass 30 days
Formulation	Rate (units/ha.)	6	16	30	
C.P.50144	2.3 kg a.i.	5	7	6	4
,,	4.6 ,,	5	7	7	5
C.P.44939	2.2 ,,	6	9	9	9
,,	4.3 ,,	6	8	9	9
P.P. 493	0.5 ,,	4	4	4	4
,,	1.1 ,,	4	4	3	2
Urox B	4.2 l. product	4	4	5	9
2,4-D+ Diuron	3.4 kg a.e.+ 4.6 kg	5	6	5	8
2,4-D	3.2 kg a.e.	5	5	5	3
Control	—	4	4	4	3

Discussion

The outstanding control of *C. rotundus* by C.P.44939, previously observed in Experiment V, was repeated. Maximum scores were obtained even at the low application rate of 2.2 kg a.i./ha and on this Lytton sand full control lasted for over two months. Both grass species were highly susceptible but *Amaranthus spinosus* and *Xanthium spinosus* were, in addition to *Bidens pilosa*, recorded as being resistant.

C.P.50144 was effective and at rates exceeding 3 kg a.i./ha should prove useful for *C. rotundus* control on light sands. *Setaria verticillata* appeared to be resistant to C.P.50144 but this species may have been an invader after the herbicide was inactivated. Although the *C. rotundus* growing in plots treated with Urox B was markedly chlorotic, adequate control was not achieved. Control of *S. verticillata* was satisfactory both with this herbicide, and with the mixture of 2,4-D and Diuron.

Conclusions

Only two out of a large number of prospective pre-emergent herbicides have performed consistently well in the screening trials reported. The product C.P.50144, for which the proposed common chemical name is Alachlor, has, over a four-year period, consistently been superior to other products both under optimal and sub-optimal conditions of soil moisture and on different soil types. At the rates of application used no phytotoxicity to sugarcane has been observed. The product appears to have a wide spectrum of activity on broad-leaf weeds and has always been found satisfactory, even under relatively dry conditions, for pre-emergence grass control. It must be noted, however, that *Rottboellia exaltata* is resistant and that some resistance has been exhibited by *Panicum maximum*. C.P.50144 is active on watergrass, especially on *Cyperus esculentus* but it could not be generally recommended as an economic control measure where watergrass is likely to be the only species present. The rate of application for general weed control when no additives (such as 2,4-D) are used should not be less than 3 kg a.i./ha and the minimum rate for grass control should be 2 kg a.i./ha.

C.P.44939, which is an analogue of C.P.50144, is the outstanding herbicide selected from the most recent screening trials. It gives better control than C.P.50144 both on broad-leaf weeds and grasses, including *P. maximum* and *R. exaltata* and is, in addition, extremely active on watergrass. The long-term control of *C. rotundus* given by this product has also been reported from Australia and Tanzania[7]. However, the product has not yet been fully evaluated for phytotoxicity to sugarcane. With excellent results being obtained at the application rate of 2.2 kg a.i./ha, there is a possibility that good weed control will be obtained at even lower application rates, and these may be economically warranted.

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APPENDIX I
Herbicides Used

Approved Common name	Code/Trade name	Supplier/Manufacturer	Formulation
Propachlor	C.P.31393:Ramrod	A.E.&C.I./Monsanto	65% w.p.
Fluometuron	Cotoran	K.O.P./Ciba	80% w.p.
Dicamba	Banvel D	Shell/Velsicol	480 g a.e./l
2,4-D	Fernimine 7	A.E.&C.I./A.E.&C.I.	725 g a.e./l
Atrazine	Atrazine	Fisons/Geigy	80% w.p.
Fenac	Weedac	A.E.&C.I./Amchem	185 g/l
Diuron	Karmex	Agricura/du Pont	80% w.p.
Bromacil	Hyvar X	Agricura/du Pont	80% w.p.
Bromacil	Urox B	A.E.&C.I./Allied Chem.	400 g a.i./l
(Alachlor)	C.P.50144:Lasso	A.E.&C.I./Monsanto	480 g a.i./l
	C.P.44939	Monsanto/Monsanto	480 g a.i./l
	C.P.31675	A.E.&C.I./Monsanto	75% w.p.
	Sindone	I.C.P./Amchem.	200 g a.i./l
	Sindone B	I.C.P./Amchem.	200 g a.i./l
	F.P.C.9267	Fisons/Fisons	80% w.p.
	S.D.11831:Planavin	Shell/Shell	75% w.p.
	Prefix	Shell/Shell	75% w. p.
	H.119	Lodemann/B.A.S.F.	50% w.p.
	H.210	,, ,,	,,
	H.225	,, ,,	,,
	H.255	,, ,,	,,
	C.6989:Preforan	K.O.P./Ciba ,,	36% a.i.
	P.P.493	A.E.&C.I./Plant Protection	200 g a.i./l
	W.L.9385 D	Shell/Shell	w.p.
	M-3174:Daxtron	Dow/Dow	180 g a.i./l
	Asulam	Maybaker/Maybaker	60% w/v
	Actril D	,, ,,	350 g a.e./l

a.e. = acid equivalent a.i. = active ingredient

Discussion

Mr. Hebblethwaite: Have you noticed any difference in the relative control of the two *Cyperus* species according to the soil type.

Mr. Richardson: I have not examined the relative control according to soil type in detail, but on the heavier soils, and where both species were present, the control of *C. esculentus* by C.P.50144 was generally better than that of *C. rotundus.* I have the impression that for *C. esculentus* the control was slightly better on heavier soils than on medium soils, but this species was unfortunately absent on the very light sands.

Mr. Gilfillan: You mentioned that Fenac did not do well on *Cyperus.* Has it been tried in conjunction with other herbicides and has it been given a fair trial.

Mr. Richardson: I think that some of the early products could reasonably be tested in combination with other products using the mini-logarithmic sprayer method.

Mr. Moberly: Fenac caused a certain amount of cane damage.

Dr. Thompson: It caused cane damage to the young cane at Pongola but no effect was noticed at the time of harvesting. It gave a longer period of control than 2,4-D but it was very expensive.

Mr. Richardson: In four out of six trials Fenac caused phytotoxicity symptoms on the cane.

Mr. Wilson: Can Mr. Richardson confirm that in Table VIII the figure of 5 is correct for the hand-weeding treatment at 19 days.

Mr. Richardson: The figure of 5 is correct. Being a pre-emergent trial, sprays are applied to bare ground. If no treatment is applied, the weed population develops and the assessment rating starts to fall. The single-hand weeding was carried out at the 25-day period, immediately producing a "weed-free" rating of 9.