# *A Comparison Between the Effectiveness of Some Pre-Emergence Herbicides Applied in Planting Strips of Hevea brasiliensis on a Sandy Soil*

P. RIEPMA KZN

*A report is given on trials comparing the effectiveness of a range of pre-emergence herbicides when applied to planting strips on a sandy soil where* Paspalum conjugatum *was the main weed. On average, Simazine, at 5 lb per acre and 10 lb per acre, extended the period of control by 11.5 weeks and 14.4 weeks respectively compared with hand-weeding, and by 6 to 7 weeks compared with what would be expected with a normal spraying schedule. Atrazine gave similar results, while other triazine compounds, Atratone, Prometone and Prometryne, were more persistent in their effect and merit further investigation. Neburon showed promise, and Banvel D (2-methoxy-3, 6-dichlorobenzoic acid) was effective against* Paspalum conjugatum. *Alipur (a mixture of substituted urea and carbamate compounds), Banvel T (2-methoxy-3, 5, 6-trichlorobenzoic acid), and Shell WL 3379 (2,6-dichlorobenzonitrile) gave poor results in single trials. Amitrole showed pre-emergence activity and when applied in mixture with Simazine enhanced the latter's effect. Dalapon was found to be ineffective.*

Up till now it has been common practice on Malayan rubber estates to eradicate established vegetation by hand or mechanical weeding methods, or by spraying the plants with contact or translocated herbicides. In general, weed regeneration after application of these chemical herbicides has been fairly rapid.

In recent years herbicides have been developed, which, instead of acting on established vegetation, prevent the germination of weed seeds when applied to the bare soil. These chemicals are termed 'pre-emergence' herbicides and one of their advantages is that weed growth is checked in the first stage of growth. Thus seeding is prevented which is not always the case when applying contact or translocated herbicides.

The effect of pre-emergence herbicides is impermanent because of leaching and decomposition in the soil, and repeated applications are required to maintain weed free conditions. The work described below has been carried out to determine whether the degree of persistence of weed control achieved by these chemicals is sufficient to present advantages over hand-weeding or over spraying with contact or translocated herbicides.

Of the chemicals tested, most are only effective against germinating seeds and will not affect creeping weeds which may encroach on the treated area and root into the soil. In these trials, carried out on planting strips on a sandy loam soil of the Sungei Buloh series at the R.R.I.M. Experiment Station, only the action on seed germination has been studied.

## METHODS

In *Table 1*, the designs, number of replications, dates of spraying and sites of the experiments are summarised. Details of the herbicides used are summarised in *Table 2*. All chemicals were applied in 100 gal. of water per acre.

In all experiments the plot size was 1/200 acre, plots being laid out along planting strips

which were hand-weeded or sprayed with the contact herbicide Paraquat* (Experiments 1 and 2), before application of the pre-emergence herbicides.

Where the creeper *Mikania scandens* was present in the inter-row areas, this plant was sprayed out with 2 lb per acre of Fernoxone (a 2,4–D formulation) to prevent it from encroaching on the planting strips. Encroaching legume creepers were thrown back by hand occasionally, so as to avoid interference with the experiments in which only the control of weed seed germination was to be studied.

Observations on growth were recorded regularly after spraying by estimating visually the percentage of soil surface covered by weeds, with 100% cover as the maximum.

*Estimation of Weed Control*

For a single weed species growth with time may be expressed by:

$$C = Ae^{mt} \qquad \ldots\ldots\ldots (1)$$

For a mixture of species, growth will undoubtedly vary much more and this simple formula cannot be used to describe accurately the growth of the vegetation. Nevertheless use is made of this formula with C representing % cover of the soil and t the time in weeds; to estimate levels of control from regression lines, equation (1) is transformed into the logarithmic form where log A and m are the parameters.

$$Y = \log C = \log A + mt$$

From the calculated regression equations between log % cover and time in weeks, the mean number of weeks may be calculated at which weeding by hand (when 5% of the soil is covered by weeds) or by spraying with contact or translocated herbicides (when 50% of the soil is covered by weeds) would be necessary again. These figures have been chosen since a common standard is required to compare experiments on different sites; 5% cover regeneration is indicative of a breakdown in the herbicidal action and at this stage the fresh growth can be easily controlled by hand-weeding. Before control of the regenerated growth by contact or translocated herbicides would be economically justified, however, it is considered that there should be 50% cover. Observations in both the control and treated plots enable an estimate to be made of the advantage in weeks given by herbicide treatment, from which the economic advantage may be calculated.

## RESULTS

The calculated regression equations for all experiments are given with the experimental data in *Figures 1 – 5*. In *Table 3*, data are given on the degree of general control obtained with all the different chemicals tested, while *Table 4* gives data on the susceptibility of *Paspalum conjugatum* to these chemicals. *P. conjugatum* was the main weed present in all the experiments, constituting 50% of the total cover in the control plots, while some 30 other weed species, each contributing 0 – 10% of the cover, were reported in the different experiments. Variation in density between experiments for these latter weed species was so great, however, that it was not possible to draw firm conclusions concerning their relative susceptibilities to the herbicides under test.

*Effect of Pre-emergence Herbicides on General Weed Cover. Comparison of Simazine and Atrazine (Experiment 1)*

This experiment was originally sprayed with pre-emergence herbicides on 15.8.60, but by March 1961 the regenerated weed growth had become very dense and it was decided to respray the area. After existing weeds had been sprayed out on 14.3.61 with 1 gal. of Paraquat per acre, the pre-emergence herbicides were applied on 17.3.61 at rates of 5, 10, 15 lb per acre. One of the two sets of control plots received fertiliser, so that the effect of fertilisers on weed growth could be determined.

The results of this experiment are presented in *Figure 1* together with the corresponding regression equations between log % cover and

* Now sold in Malaya under the trade name Grammoxone.



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time in weeks. Atrazine was found to be increasingly effective with increase in dosage, 10.5 weeks elapsing after spraying at 10 lb per acre before weed regeneration produced 5% ground cover, and 13.8 weeks elapsing after spraying at 15 lb per acre (*Table 3*). An unexpected result with Simazine was that whereas an application of 10 lb per acre was more effective than one of 5 lb per acre (16.4 and 11.6 weeks respectively to the 5% ground cover stage), an application of 15 lb per acre gave a reduced effect, only 5.3 weeks elapsing before 5% regeneration of general weed cover was recorded. *Table 4* shows that the regeneration of *Paspalum conjugatum* after application of 15 lb of Simazine per acre was very similar to that found with the 5 lb per acre treatment, and it is possible that this anomalous result was due to variable distribution of a non-susceptible weed species, *Digitaria longiflora*.

In general, however, little difference was found between Atrazine and Simazine, 50% ground cover regenerating with both herbicides after about 25 weeks for all dosage rates.

Application of fertiliser was found to increase the growth rate of weeds in the control plots, indicating that soil nutrient status should be considered when assessing field experiments on different soil types.

*Comparison Between Simazine, Atrazine, Prometone and Atratone (Experiment 2)*

The herbicides, applied at dosage rates of 5 and 10 lb per acre (*Figure 2*) had a significantly greater effect than the control in each case. There was no significant difference between the concentrations, so that in general 5 lb per acre gave as good results as 10 lb per acre and the slopes of the regression lines are nearly parallel. The level of control achieved by the different herbicides however varied considerably. Atratone and Prometone were found to be much more active than Simazine and Atrazine; with the latter two herbicides 5% ground cover regenerated after about 16 weeks while this only occurred with Prometone and Atratone after 20 – 24 weeks (*Table 3*). With applications of 5 and 10 lb per acre of Simazine, and 5 lb per acre of Atrazine, 28 – 30 weeks elapsed before the 50% ground cover stage was reached, while with application of 10 lb per acre Atrazine, and with both rates of application of Atratone and Prometone, this stage was only reached after 32 – 37 weeks.

*Effects of Simazine, Dalapon and Amitrole When Used Alone or in Mixture (Experiment 3)*

Herbicides that kill established vegetation by contact or translocated action may possess residual activity in the soil (RIEPMA, 1962). This could be of importance in formulating chemicals or mixtures of chemicals that could destroy established vegetation and at the same time prevent regeneration from roots or seed. The most promising of such mixtures might be one whose activity in the soil is long lasting, and a trial was therefore carried out in which amitrole and dalapon, alone and in mixtures, were compared with Simazine (*Figure 3*).

In this experiment both Simazine and amitrole had a significantly greater effect than did the control, and 10 lb per acre of Simazine was more effective than 5 lb per acre (*Table 3*). Dalapon at 5 lb per acre was no more effective than the control. Compared with 5 lb per acre of Simazine alone, a mixture of 5 lb of Simazine and 5 lb of amitrole per acre extended the period to 5% regeneration by 6.6 weeks, and the period to 50% regeneration by 4.9 weeks; the corresponding extensions over amitrole alone were 8.5 weeks and 6.7 weeks. Mixtures of Simazine with dalapon gave only slightly better control than Simazine alone at the 5% ground cover stage, and poorer control at the 50% ground cover stage.

The poor effect of dalapon in this experiment might have been due to the fact that the main weed species was *Paspalum conjugatum*, against which dalapon is much less effective than amitrole (RIEPMA, 1962).

*Comparison of Simazine With Other Chemicals (Experiments 4 and 5)*

In these experiments Simazine and a number of pre-emergence chemicals other than the triazines were tested for their suitability to control weeds in planting strips and in legumes. The results obtained with Simazine agree with those discussed previously but Prometone at 5 lb per acre was not found to be significantly better than Simazine, nor did the addition of 5 lb per acre of amitrole to 5 lb per acre of Simazine give better results (*Table 3* and *Figures 4* and *5*). Prometryne however seemed promising, the period of control to the 50% regeneration stage being slightly longer than for Simazine, a surprising effect considering that in the temperate zone Prometryne is said to have a persistence in the soil of only six weeks. Neburon at 4.5 lb in Experiment 50 gave as good an effect as Simazine, but the other chemicals, Alipur and Shell WL 3379, were disappointing. It is possible that the chosen dosage rates for Alipur were too low and in the case of Shell WL 3379 much of the chemical may have been lost to the atmosphere since this volatile herbicide was not worked into the soil. When assessed at the 5% ground cover stage, Banvel D and Banvel T gave poor control of the mixed weeds compared with Simazine, but when *Paspalum conjugatum* alone is considered, Banvel D gave a significant degree of control at the 5% ground cover stage, and was more effective than Simazine.

*The Effect of Chemicals on Paspalum conjugatum Alone*

The summarised data in *Table 4*, giving the percentage of ground covered by *Paspalum conjugatum* at the end of each experiment, enables the effectiveness of the different chemicals on this grass to be compared. Experimental variation was large, due to the time of recording, when variation between plots was high, and probably also because of original variation in seed distribution in the soil. Nevertheless, Shell WL 3379 and dalapon were ineffective, while Simazine gave some control in all experiments. The effectiveness of Simazine was increased by applying it in mixture with amitrole, while amitrole on its own was more effective than Simazine. Prometone, Atratone, Prometryne and Banvel D all gave promising results.

## DISCUSSION

The experiments described above can be considered as screening tests of potential pre-emergence herbicides and firm conclusions regarding possible commercial usage can be drawn only for Simazine which was tested in all the five experiments. It must also be emphasised that the results can apply only to areas sited on sandy soils similar to the Sungei Buloh series, and on which *Paspalum conjugatum* is the main weed.

From *Table 3* it can be seen that in the control plots an average of 3.4 weeks elapsed before weed regeneration had produced 5% ground cover, the stage at which it is considered necessary to carry out a hand-weeding round. The application of Simazine at 5 lb per acre and 10 lb per acre increased this period of control on the average to 14.9 and 17.8 weeks respectively, so that it can be said that these treatments gave an advantage over hand-weeding of 11.5 and 14.4 weeks respectively: equivalent to three and four rounds of monthly hand-weeding.

Regeneration to the 50% ground cover level took, on average, 21.4 weeks in the control plots, and 27.6 and 28.4 weeks in the 5 lb per acre and 10 lb per acre Simazine treatments respectively. Fifty per cent of ground cover is regarded as the stage at which a round of normal spraying with contact herbicide would be required, and this advantage of 6 – 7 weeks would hardly seem to justify the use of the more expensive pre-emergence herbicide. The slight advantage in control obtained with 10 lb per acre Simazine, over that given by 5 lb per acre Simazine, would be offset by the higher cost of application, and use of the higher rate could not be recommended.

Of the other chemicals tested, Atratone, Prometone and Prometryne appear worthy of

further investigation, while the degree of pre-emergence activity shown by amitrole will enhance its value as a general herbicide. Neburon shows promise and deserves further study, particularly since this chemical can be sprayed safely over young leguminous cover plant seedlings. Banvel D, Alipur and Shell WL 3379 appear to have less promise than the other chemicals tested.

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*Soils Division*

*Rubber Research Institute of Malaya*

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TABLE 1. SUMMARY OF EXPERIMENTS

All experiments were carried out in Field 23 at the R.R.I.M. Experiment Station in young rubber budded in 1957

| Experiment No. † | Design | Replicates | Spraying dates | Treatments (quantities per acre) |
|---|---|---|---|---|
| 1 (2/61) | Random blocks | 6 | 17.3.61 | 0, 5, 10 and 15 lb Simazine<br>0, 5, 10 and 15 lb Atrazine |
| 2 (8/61) | Two interlocking Latin squares | 5 | 12.4.61 | 0, 5, 10 lb Simazine<br>5, 10 lb Atrazine<br>0, 5, 10 lb Atratone<br>5, 10 lb Prometone |
| 3 (24/61) | Two interlocking Latin squares | 4 | 9.6.61 | 0, 5, 10 lb Simazine<br>5 lb Simazine + 5 lb amitrole<br>0, 5 lb dalapon<br>5 lb amitrole<br>5 lb Simazine + 5 lb dalapon |
| 4 (50/61) | Youden square | 5 | 12.9.61 | 5, 10 lb Simazine<br>0.5 – 1.0 gal. Alipur<br>12 lb Shell WL 3379<br>4.5 lb Neburon<br>5 lb Prometone<br>5 lb Simazine + 5 lb amitrole<br>5, 10 lb Prometryne |
| 5 (57/61) | Youden square | 4 | 5.10.61 | 5, 10 lb Simazine<br>0.5, 1.0 gal. Banvel D<br>0.5, 1.0 gal. Banvel T |

TABLE 2. COMPOSITION OF CHEMICALS TESTED AS PRE-EMERGENCE HERBICIDES

| Commercial name | Compound | Formulation and content of active ingredient (a.i.) |
|---|---|---|
| Simazine | 2-chloro-4,6-bis(ethylamino)-1,3,5-triazine | 50% wettable powder |
| Atrazine | 2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine | 50% ,, ,, |
| Prometone | 2-4-bis(isopropylamino)-6-methoxy-1,3,5-triazine | 50% ,, ,, |
| Atratone | 2-ethylamino-4-isopropylamino-6-methoxy-1,3,5-triazine | 50% ,, ,, |
| Prometryne | 2-methylmercapto-4,6-bis-(isopropylamino)-1,3,5-triazine | 50% ,, ,, |
| Shell WL 3379 | 2,6-dichlorobenzonitrile | 50% ,, ,, |
| Amitrole | 3-amino-1,2,4-triazole | 50% ,, ,, |
| Dalapon | Sodium-2,2-dichloropropionate | 85% a.i. water soluble powder |
| Neburon | N-(3,4-dichlorophenyl)-N′-butyl-N′-dimethylurea | 50% wettable powder |
| Alipur | 16.5% O M U N-cyclo-octyl-N,N′-dimethylurea<br>11.5% B i P C butinol-N-(2-chlorophenyl) carbamate | |
| Banvel D | 2-methoxy-3,6-dichlorobenzoic acid | 4 lb per U.S. gal. |
| Banvel T | 2-methoxy-3,5,6-trichlorobenzoic acid | 4 lb per U.S. gal. |

TABLE 3. NUMBER OF WEEKS FOR WEED REGENERATION TO COVER 5% AND 50% OF THE SOIL SURFACE

| Treatment (quantities per acre) | Experiment 1 | | Experiment 2 | | Experiment 3 | | Experiment 4 | | Experiment 5 | | Average of five experiments | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 50 | 5 | 50 | 5 | 50 | 5 | 50 | 5 | 50 | 5 | 50 |
| Control | <0 | 18.0 | <0 | 21.9 | 1.1 | 18.7 | 7.3 | 21.8 | 8.7 | 26.5 | 3.4 | 21.4 |
| Simazine 5 lb | 11.6 | 24.9 | 16.2 | 30.3 | 12.6 | 26.0 | 16.0 | 26.6 | 18.0 | 30.3 | 14.9 | 27.6 |
| Simazine 10 lb | 16.4 | 25.2 | 16.8 | 28.0 | 16.8 | 26.8 | 18.1 | 29.5 | 20.8 | 32.5 | 17.8 | 28.4 |
| Simazine 15 lb | 5.3 | 25.3 | — | — | — | — | — | — | — | — | | |
| Atrazine 5 lb | <0 | 24.9 | 15.4 | 28.6 | — | — | — | — | — | — | | |
| Atrazine 10 lb | 10.5 | 26.8 | 16.9 | 37.1 | — | — | — | — | — | — | | |
| Atrazine 15 lb | 13.8 | 26.4 | — | — | — | — | — | — | — | — | | |
| Prometone 5 lb | — | — | 20.7 | 34.8 | — | — | 16.4 | 27.2 | — | — | | |
| Prometone 10 lb | — | — | 24.9 | 37.2 | — | — | — | — | — | — | | |
| Atratone 5 lb | — | — | 20.5 | 32.9 | — | — | — | — | — | — | | |
| Atratone 10 lb | — | — | 22.8 | 35.8 | — | — | — | — | — | — | | |
| Simazine 5 lb + amitrole 5 lb | — | — | — | — | 19.2 | 30.9 | 17.4 | 26.8 | — | — | | |
| Simazine 5 lb + dalapon 5 lb | — | — | — | — | 15.1 | 22.7 | — | — | — | — | | |
| Amitrole 5 lb | — | — | — | — | 10.7 | 24.2 | — | — | — | — | | |
| Dalapon 5 lb | — | — | — | — | 2.4 | 18.3 | — | — | — | — | | |
| Alipur 0.5 gal | — | — | — | — | — | — | 9.9 | 28.5 | — | — | | |
| Alipur 1.0 gal | — | — | — | — | — | — | 12.1 | 25.6 | — | — | | |
| Shell WL 3379 12 lb | — | — | — | — | — | — | 11.5 | 22.8 | — | — | | |
| Neburon 4.5 lb | — | — | — | — | — | — | 15.8 | 27.2 | — | — | | |
| Prometryne 5 lb | — | — | — | — | — | — | 18.8 | 30.1 | — | — | | |
| Prometryne 10 lb | — | — | — | — | — | — | 20.2 | 31.5 | — | — | | |
| Banvel D 0.5 gal | — | — | — | — | — | — | — | — | 15.9 | 36.6 | | |
| Banvel D 1.0 gal | — | — | — | — | — | — | — | — | 17.9 | 33.3 | | |
| Banvel T 0.5 gal | — | — | — | — | — | — | — | — | 13.8 | 27.6 | | |
| Banvel T 1.0 gal | — | — | — | — | — | — | — | — | 14.3 | 27.3 | | |

The estimated minimum 5 per cent significant differences between two treatment means, in weeks, are:

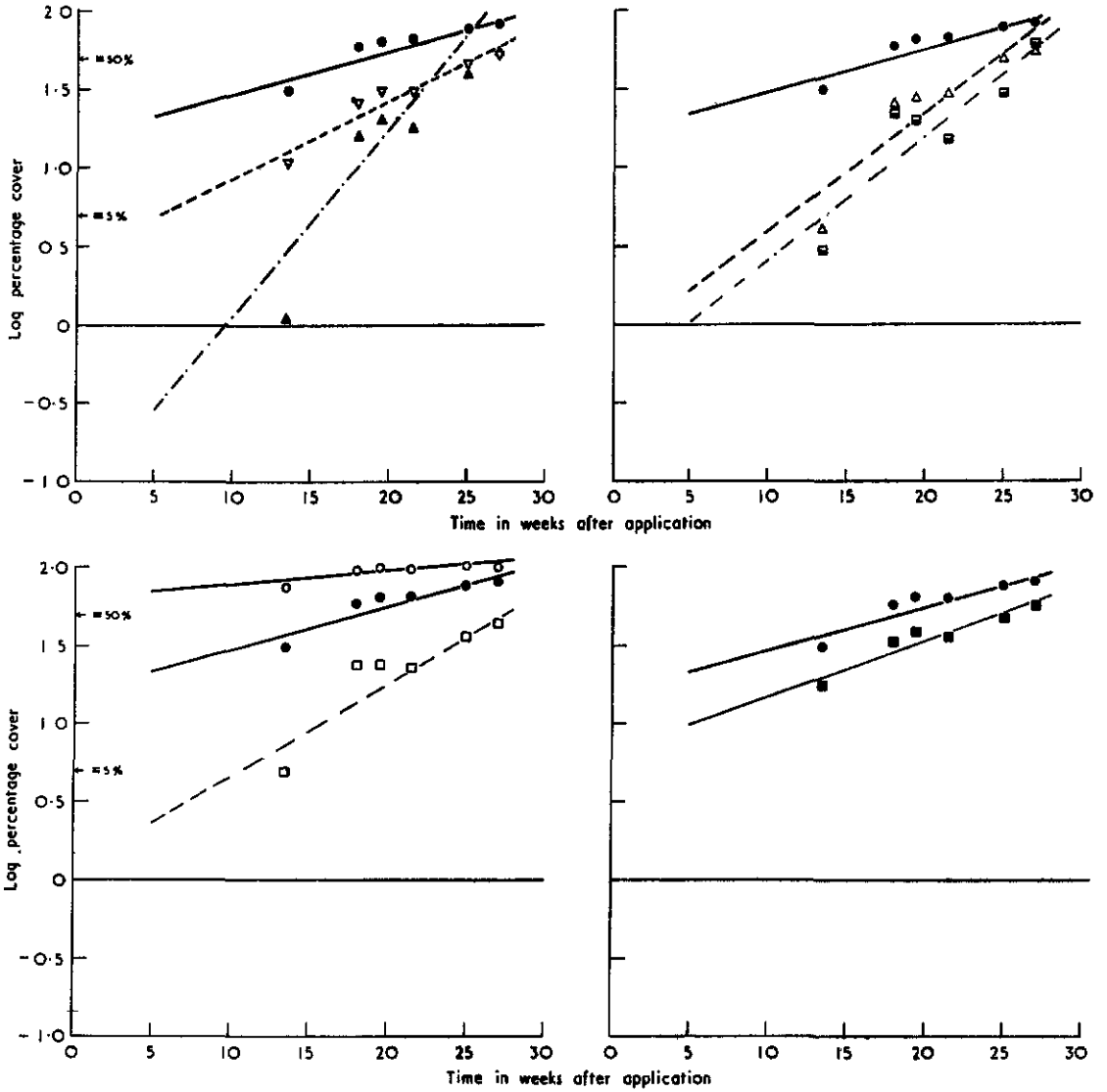
| | *In a given experiment* | *Averaged over 5 experiments* |
|---|---|---|
| At 5 per cent cover | 5.8 | 2.6 |
| At 50 per cent cover | 3.9 | 1.7 |

These estimates are derived from the data on the control and the two Simazine treatments tested in the 5 experiments; they serve as a rough guide to the reliability of the other treatment values.

TABLE 4. THE EFFECT OF VARIOUS CHEMICALS ON PERCENTAGE OF SOIL COVERED BY PASPALUM CONJUGATUM MEASURED AT THE END OF EACH EXPERIMENT

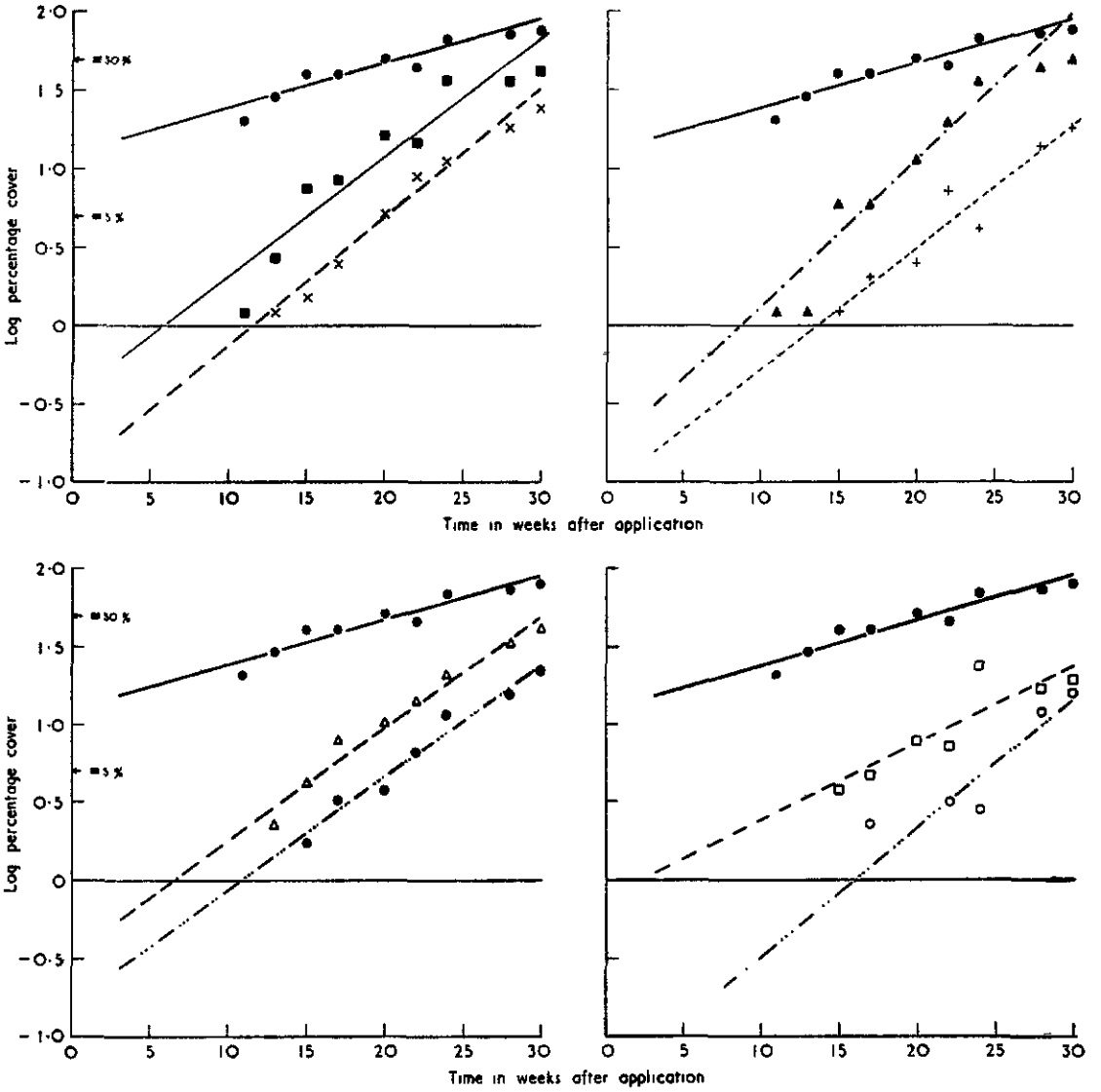
| Experiment No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Time after spraying in weeks / Treatment (quantities per acre) | 22 | 30 | 25 | 25 | 26 |
| Control | 49.2 | 52.8 | 61.3 | 52.2 | 59.3 |
| Simazine 5 lb | 30.4 | 31.7 | 48.2 | 26.1 | 37.5 |
| Simazine 10 lb | 22 2 | 36.8 | 31.5* | 15.8* | 40.0 |
| Simazine 15 lb | 31.0 | — | — | — | — |
| Atrazine 5 lb | 29.6 | 28.2* | — | — | — |
| Atrazine 10 lb | 11.8 | 17.2* | — | — | — |
| Atrazine 15 lb | 11.8 | — | — | — | — |
| Prometone 5 lb | — | 24.7* | — | 35.4 | — |
| Prometone 10 lb | — | 20.4* | — | — | — |
| Atratone 5 lb | — | 18.8* | — | — | — |
| Atratone 10 lb | — | 20.3* | — | — | — |
| Simazine 5 lb + amitrole 5 lb | — | — | 22.5* | 17.9 | — |
| Simazine 5 lb + dalapon 5 lb | — | — | 43.6 | — | — |
| Amitrole 5 lb | — | — | 14.8* | — | — |
| Dalapon 5 lb | — | — | 70.1 | — | — |
| Alipur 0.5 gal | — | — | — | 29.7 | — |
| Alipur 1.0 gal | — | — | — | 35.3 | — |
| Shell WL 3379 12 lb | — | — | — | 56.4 | — |
| Neburon 4.5 lb | — | — | — | 15.8* | — |
| Prometryne 5 lb | — | — | — | 18.9 | — |
| Prometryne 10 lb | — | — | — | 11.8* | — |
| Banvel D 0.5 gal | — | — | — | — | 24.9* |
| Banvel D 1.0 gal | — | — | — | — | 26.1* |
| Banvel T 0.5 gal | — | — | — | — | 37.3 |
| Banvel T 1.0 gal | — | — | — | — | 49.0 |
| Minimum s.e. of difference between means | 20.50 | 11.24 | 12.13 | 17.45 | 12.15 |

* Significantly different from the control at 5% level



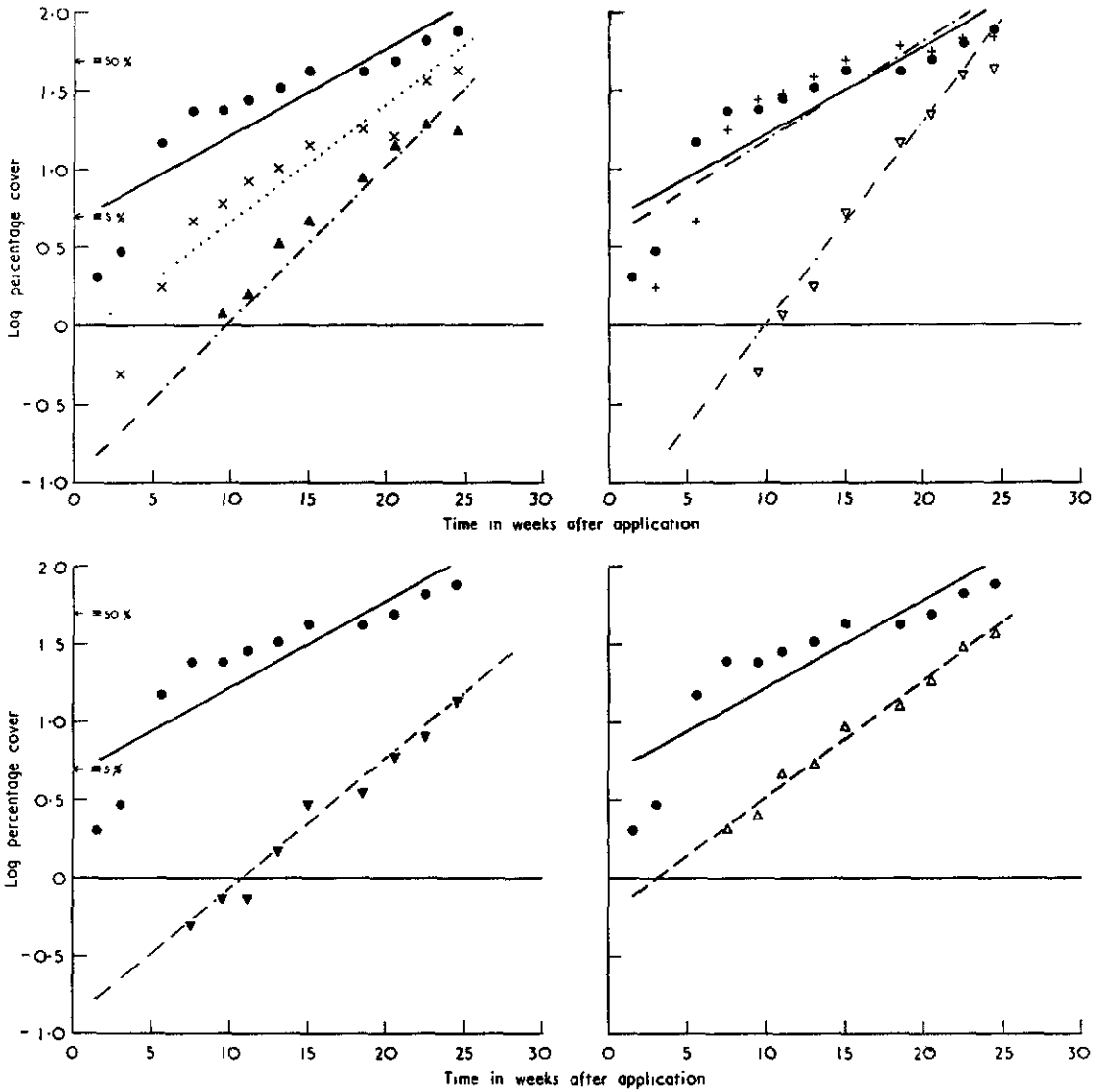

| | | |
|---|---|---|
| ●——● | Control | Y = (0·0285 ± 0·0060)t + 1·189 ± 0·127 |
| △— — —△ | Simazine 5 lb/ac | Y = (0·0754 ± 0·0177)t − 0·177 ± 0·376 |
| ▲—·—·—▲ | Simazine 10 lb/ac | Y = (0·1138 ± 0·0247)t − 1·171 ± 0·526 |
| ▽- - - - - -▽ | Simazine 15 lb/ac | Y = (0·0499 ± 0·0068)t + 0·438 ± 0·144 |
| ■——■ | Atrazine 5 lb/ac | Y = (0·0355 ± 0·0061)t + 0·817 ± 0·131 |
| □— — — -□ | Atrazine 10 lb/ac | Y = (0·0615 ± 0·0127)t + 0·053 ± 0·315 |
| ▣— — —▣ | Atrazine 15 lb/ac | Y = (0·0794 ± 0·0198)t − 0·395 ± 0·420 |
| ○——○ | *Control with fertilisers* | Y = (0·0084 ± 0·0031)t + 1·794 ± 0·065 |

*Figure 1. Data for Experiment 1.*



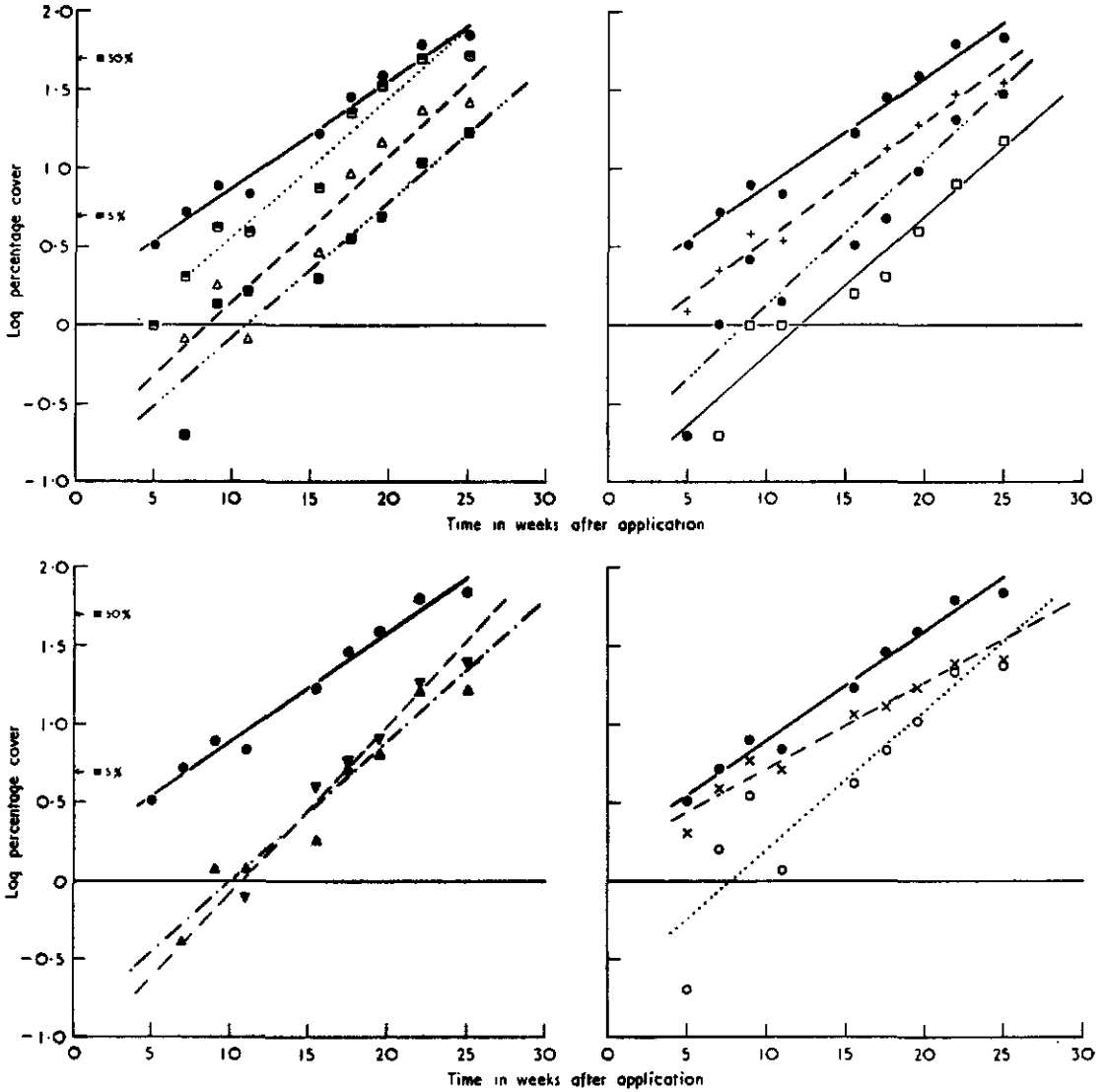

| | | |
|---|---|---|
| ●——● | Control | Y = (0·0275 ± 0·0039) t + 1·098 ± 0·064 |
| △— — —△ | Simazine 5 lb/ac | Y = (0·0708 ± 0·0047) t − 0·445 ± 0·103 |
| ▲—·—·—▲ | Simazine 10 lb/ac | Y = (0·0899 ± 0·0087) t − 0·814 ± 0·181 |
| ■——■ | Atrazine 5 lb/ | Y = (0·0754 ± 0·0092) t − 0·459 ± 0·192 |
| □— — —□ | Atrazine 10 lb/ac | Y = (0·0496 ± 0·0101) t − 0·139 ± 0·231 |
| ●—···—···—● | Prometone 5 lb/ac | Y = (0·0712 ± 0·0043) t − 0·777 ± 0·097 |
| ○—···—···—○ | Prometone 10 lb/ac | Y = (0·0815 ± 0·0088) t − 1·333 ± 0·211 |
| ×- - - - - - - - × | Atratone 5 lb/ac | Y = (0·0803 ± 0·0045) t − 0·945 ± 0·098 |
| +- - - - - - - - + | Atratone 10 lb/ac | Y = (0·0768 ± 0·0085) t − 1·052 ± 0·193 |

*Figure 2. Data for Experiment 2.*



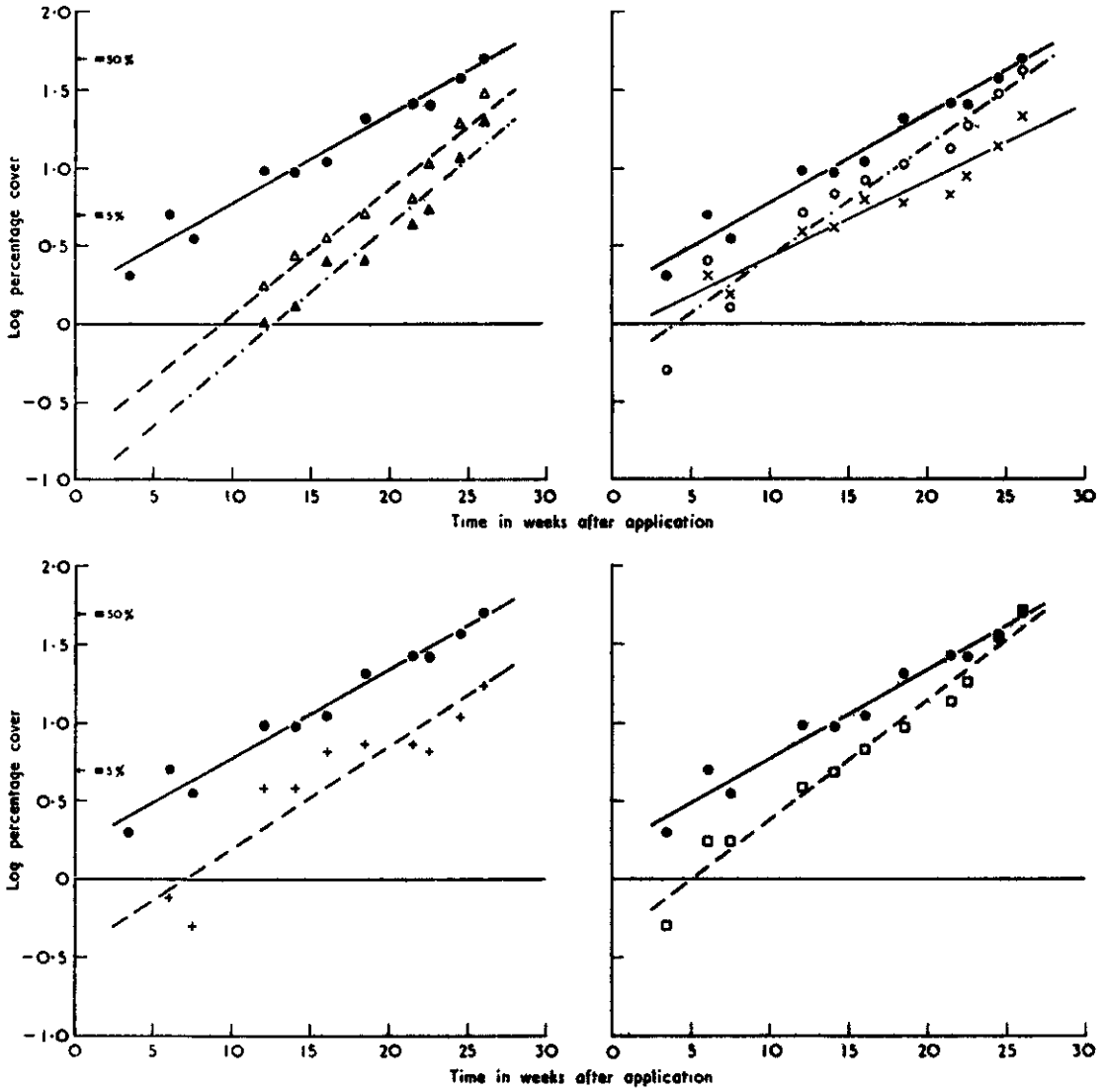

| | | |
|---|---|---|
| ●——● | Control | Y = (0·0567 ± 0·0088)t + 0·639 ± 0·128 |
| △— — — —△ | Simazine 5 lb/ac | Y = (0·0746 ± 0·0046)t − 0·240 ± 0·079 |
| ▲—·—·—▲ | Simazine 10 lb/ac | Y = (0·1001 ± 0·0054)t − 0·983 ± 0·092 |
| ▼— — — —▼ | Simazine 5 lb/ac + Amitrole 5 lb/ac | Y = (0·0850 ± 0·0042)t − 0·929 ± 0·069 |
| ▽—·—·—▽ | Simazine 5 lb/ac + Dalapon 5 lb/ac | Y = (0·1321 ± 0·0075)t − 1·301 ± 0·133 |
| ×·····× | Aminotriazole 5 lb/ac | Y = (0·0743 ± 0·0084)t − 0·098 ± 0·127 |
| +— — — —+ | Dalapon 5 lb/ac | Y = (0·0627 ± 0·0091)t + 0·548 ± 0·139 |

*Figure 3. Data for Experiment 3.*




| | | |
|---|---|---|
| ●——● | Control | Y = (0·0692 ± 0·0041 )t + 0·192 ± 0·067 |
| △— — —△ | Simazine 5 lb/ac | Y = (0·0939 ± 0·0119 )t − 0·802 ± 0·205 |
| ▲—·—·—▲ | Simazine 10 lb/ac | Y = (0·0879 ± 0·0087 )t − 0·895 ± 0·150 |
| ×— — —× | Alipur 0·5 gal/ac | Y = (0·0537 ± 0·0043 )t + 0·169 ± 0·071 |
| +— — —+ | Alipur 1·0 gal/ac | Y = (0·0741 ± 0·0043 )t − 0·197 ± 0·070 |
| ⊟·····⊟ | Shell WL 3379 12 lb/ac | Y = (0·0888 ± 0·0081 )t − 0·325 ± 0·133 |
| ○ ·····○ | Neburon 4·5 lb/ac | Y = (0·0873 ± 0·0142 )t − 0·682 ± 0·232 |
| ●—··—··—● | Promerone 5 lb/ac | Y = (0·0926 ± 0·0114 )t − 0·816 ± 0·183 |
| ▼— — —▼ | Simazine 5 lb/ac + Amitrole 5 lb/ac | Y = (0·1064 ± 0·0095 )t − 1·154 ± 0·379 |
| ■—··—··—■ | Prometryne 5 lb/ac | Y = (0·0882 ± 0·0128 )t − 0·961 ± 0·222 |
| □——□ | Prometryne 10 lb/ac | Y = (0·0884 ± 0·0104 )t − 1·085 ± 0·179 |

*Figure 4. Data for Experiment 4.*




| | | |
|---|---|---|
| ●——● | Control | Y = (0·0561 ± 0·0037)t + 0·210 ± 0·063 |
| △— — — —△ | Simazine 5 lb/ac | Y = (0·0813 ± 0·0082)t − 0·761 ± 0·163 |
| ▲—·—·—▲ | Simazine 10 lb/ac | Y = (0·0854 ± 0·0091)t − 1·079 ± 0·181 |
| ×——× | Banvel D 0·5 gal/ac | Y = (0·0483 ± 0·0049)t − 0·068 ± 0·088 |
| +— — — —+ | Banvel D 1·0 gal/ac | Y = (0·0647 ± 0·0096)t − 0·457 ± 0·174 |
| O—·—·—O | Banvel T 0·5 gal/ac | Y = (0·0725 ± 0·0064)t − 0·303 ± 0·110 |
| □— — — —□ | Banvel T 1·0 gal/ac | Y = (0·0766 ± 0·0043)t − 0·393 ± 0·076 |

*Figure 5. Data for Experiment 5.*