

EVALUATION OF HERBICIDES FOR WEED CONTROL IN MATURE TEA

I—EFFECTS ON THE WEED SPECIES

D. T. Wettasinghe & N. S. Rajendram

The importance of weed successions leading to the dominance of resistant species and, in this connection, the danger of depending on a single herbicide for weed control are emphasized.

Initial screening of herbicides in observation plots indicated that 12 materials were of relatively low activity and were therefore eliminated from further testing. Simazine, diuron, amitrole, pentachlorophenol and 2, 4—D were outstanding and selected for testing for crop tolerance.

Eleven other herbicides (with diuron as a standard) were further evaluated for herbicidal activity in a field experiment. Lenacil, linuron and diuron displayed extreme herbicidal activity over a wide range of species including the paraquat-resistant *Paspalum conjugatum* and *Borreria* spp. CP 44939, fluometuron, atrazine, desmetryne and neburon were effective against *Borreria* spp., but not against *Paspalum conjugatum*. Atrazine, chloroxuron and prometryne gave good control of *Paspalum conjugatum*, but did not control *Borreria* spp. effectively. Propachlor was ineffective against both *Paspalum conjugatum* and *Borreria* spp., but gave good control of *Cyperus tenuiculmis*. All chemicals tested effectively controlled *Cleome burmanni*, *Ageratum conyzoides* and *Bulbostylis puberula*.

The development of chemicals capable of effecting selective weed control in crops has brought on a major revolution in agriculture. One of the undesirable consequences of the regular use of herbicides is their impact on the composition of the weed flora. Numerous examples of successions leading to the dominance of resistant species have been recorded in various parts of the world. This potential danger is probably at its greatest in monocultural farming systems based on a single herbicide. The answer to this problem no doubt lies in the more efficient usage of the herbicides presently in use, and the continuous development of other selective herbicides which would then be available for an integrated programme of weed control. The awareness to, and the importance of this problem of "changing weed flora" are such that Pfeiffer (1966), referring to the introduction of the remarkably successful sugar beet herbicide, pyrazon, suggested that the search for other selective herbicides for sugar beet be intensified rather than slowed down.

The object of the present programme of evaluation is to provide a selection of herbicides with varied spectra of activity. It is hoped that these chemicals could be then integrated into a scheme of weed control that would prevent the build-up of resistant species.

Scheme for evaluation of herbicides

1. Testing for herbicidal activity

During this stage of evaluation the primary interest is in the degree of activity of the candidate herbicides against weeds. The herbicides are tested at two or three rates, one of which is the anticipated rate of commercial use. Whenever the retail prices are available the cost of the treatment is also taken into consideration in determining the levels at which the herbicides would be tested.

2. Testing for crop tolerance

The second stage of evaluation is mainly concerned with crop tolerance. As this involves the conducting of yield trials which are both expensive and time-consuming, only materials which consistently display a very high degree of activity and persistence over a wide range of species are considered for inclusion in this stage of evaluation. In these yield trials the herbicides are tested at rates and frequencies much higher than would be necessary for weed control.

3. Further testing and development

Herbicides proving to be safe for use in tea would have to be further tested to determine the optimum dosage, method, time of application, *etc.*, and also the influence of climatic and edaphic factors on their performance. It is also essential to undertake large-scale trials (1- or 2-acre plots), preferably on commercial estates, to study their performance and any problems that may arise when they are used on a field-scale.

Materials and methods

Screening for herbicidal activity

Initially experiments were of an exploratory nature with the main aim of obtaining a 'yes' or 'no' decision with regard to herbicidal activity. Therefore, they were not laid out in experimental designs which could be statistically analysed, but took the form of observation plots. An untreated area immediately adjacent to each treated plot was used as 'control'. The assessments were essentially subjective estimates using an arbitrary scale. On the basis of these initial tests the following herbicides, which were of relatively low activity were eliminated from further testing :- Glenbar, Alicep, prefix, benzthiazuron, DCPA, methachlorphenprop, metabromuron, chlorbromuron, C 243, NPH 1221, NPH 1231 and trifluralin.

Simazine, diuron, amitrole, pentachlorophenol and 2,4-D were outstanding and, therefore, selected for testing for crop tolerance, without further evaluation of their herbicidal activity. Results of these experiments will be presented in a later publication.

Eleven herbicides were selected for further evaluation for herbicidal activity. These eleven herbicides and diuron, which was included as a standard, were each tested at two rates, viz 0.6 and 1.2 lb per acre of lenacil, diuron, linuron, fluometuron, chloroxuron, neburon and propachlor ; 0.5 and 1.0 lb per acre of atrazine, atratone, prometryne and desmetryne ; and, 1.0 and 2.0 lb per acre of CP 44939. In all cases the rates quoted are of the active ingredient. These rates are rather low and in some cases appreciably lower than the manufacturer's recommendation. We considered it important to test herbicides at levels which would make their use economically feasible in comparison to manual methods of control.

The experimental site was a seedling tea field in the first year of the pruning cycle, at the Low-Country Station. The cover of tea was poor. Plots, 286 sq. ft in area, were demarcated in the tea, and arranged in three randomized blocks.

The most prominent weed species on the site were *Borreria hispida* (formerly *Spermacoce latifolia*), *Borreria* spp., *Cleome burmanni*, *Ageratum conyzoides*, *Cyperus tenuiculmis*, *Bulbostylis puberula*, *Paspalum conjugatum* and *Digitaria adscendens*. The soil was a gravelly loam.

All herbicides were applied at a volume rate of 50 gallons per acre using a Hortensia sprayer fitted with a cone nozzle and operating at a pressure between 20-30 psi. The herbicides were applied on to a clean-weeded soil surface, and, therefore, only their residual action was compared. The soil was moist at the time of application and 3.50 inches of rain were recorded during the four days following application.

Fifteen weeks after the application of treatments, the weeds in the plots were harvested, separated into species, and their dry weights determined. In addition, during the course of the experiment regular observations were made on the treated plots and the immediately adjacent unsprayed border area to obtain confirmatory evidence of species sensitivity.

Results and discussion

The results are detailed in Table 1. As there was no appreciable difference in activity between the two levels tested, only the mean weights of weeds are presented in the Table.

Lenacil, the only substituted uracil tested, gave extremely good control of all the species. There is little doubt that this chemical is highly active, but would require prolonged evaluation for crop tolerance as related compounds are known to be toxic to tea.

The substituted ureas, diuron and linuron, showed certain similarities. Both gave good control of *Borreria* spp., *C. burmanni* and satisfactory control of *C. tenuiculmis*. Diuron was more active against the grasses than linuron. Fluometuron and neburon, two other ureas, gave good control of *Borreria* spp., *C. burmanni* and *D. adscendens*, but was ineffective against *P. conjugatum*. Neburon had hardly any effect on *C. tenuiculmis*, while fluometuron gave partial control of *C. tenuiculmis*. The fifth urea tested, chloroxuron, gave good control of *C. burmanni* and *P. conjugatum*, moderate control of *D. adscendens* and *C. tenuiculmis*, and poor control of *Borreria* spp. Thus on the basis of herbicidal activity, the other ureas tested do not appear to have any advantage over diuron and linuron.

The anilide, propachlor, displayed an interesting activity in that it was very effective against *C. tenuiculmis*, but was ineffective against *Borreria* spp. and *P. conjugatum*, which are predominant weeds in low-country tea. The chemically related product CP 44939 gave good control of *Borreria* spp. but was not effective against *P. conjugatum* and only partially effective against *C. tenuiculmis*. Both propachlor and CP 44939 are herbicides which for optimum results should be incorporated into the top 1-2 inches of the soil within a few days after application. In the present experiment, however, these chemicals were not incorporated, yet they were quite effective. This was probably due to the heavy rain (3.13 inches) that fell on the fourth day after the herbicides were applied.

C. tenuiculmis was markedly resistant and *C. burmanni* susceptible to all four substituted triazines tested. None of the triazines gave good control of *D. adscendens*; desmetryne was the least effective. *Borreria* spp. were adequately controlled by atrazine and desmetryne, but not by prometryne and atratone. *P. conjugatum* was controlled by prometryne and atratone but not by atrazine and desmetryne. Atratone displays the useful property of being very effective against *P. conjugatum*.

A. conyzoides and *B. puberula* were very effectively controlled by all herbicides tested.

Reference

PFEIFFER, R. K. (1966). Present trends in the use and development of chemicals in relation to agriculture. *PANS (C)* 12, 94-98.

TABLE 1 — *Assessment of weed growth 15 weeks after application of 12 herbicides*

Herbicide	Rate (lb/acre ai)	Mean dry weight (g) per plot of the total weed growth and some of the more important species					Others	Total
		<i>Borreria</i> spp.	<i>Cleome</i> <i>burmanni</i>	<i>Paspalum</i> <i>conjugatum</i>	<i>Digitaria</i> <i>adscendens</i>	<i>Cyperus</i> <i>tenuiculmis</i>		
Lenacil	0.6 & 1.2	68	57	58	35	139	15	372
Diuron	0.6 & 1.2	82	56	48	31	316	14	547
Linuron	0.6 & 1.2	118	20	125	153	380	21	817
Propachlor	0.6 & 1.2	292	15	286	65	184	9	851
CP 44939	1.0 & 2.0	76	42	273	38	516	4	949
Fluometuron	0.6 & 1.2	100	40	269	87	528	53	1077
Chloroxuron	0.6 & 1.2	373	40	53	142	657	51	1316
Prometryne	0.5 & 1.0	227	66	99	128	797	81	1398
Atratone	0.5 & 1.0	302	36	10	103	1085	22	1558
Atrazine	0.5 & 1.0	104	35	229	108	1210	39	1725
Desmetryne	0.5 & 1.0	76	66	311	228	981	240	1902
Neburon	0.6 & 1.2	131	35	220	85	1853	14	2338