

USE OF WEED-KILLERS IN THE CONTROL OF NATURAL COVERS

BY

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Weed-killers have been used for a considerable number of years in agricultural practice; in Europe and America quite extensive use of them is made nowadays, particularly for improving cereal crops. Spraying is the usual means of applying the weed-icide and the substances used include iron sulphate, copper sulphate, sodium chlorate, sulphuric acid, nitric acid and calcium cyanamide. The improvement of lawns and areas of grass by this means has received considerable attention and satisfactory results have been obtained.

The development of natural covers on rubber estates in Malaya has created an interest in the use of chemicals as a means of controlling and eradicating certain types of covers, particularly where, through inadequate attention and control, bracken (*Gleichenia linearis*) and stagmoss (*Lycopodium cernuum*) have developed in dense masses.

Ordinary slashing of these thick growths is expensive, and does not completely eradicate them, further treatment being necessary after a few months. Obviously, a chemical which, when sprayed on the plants, will completely kill them is highly desirable from several points of view. Cost of eradication will be reduced, damage to rubber roots by "changkols", etc., will be eliminated and, as no soil disturbance will take place, the risk of erosion will be greatly reduced.

Only two types of weed-killers have been tried to any extent on rubber estates, one being a compound in which sodium chlorate is the effective agent and the other a liquid containing arsenic (sodium arsenite) as the destructive substance.

The sodium chlorate is marketed in the solid form and is applied in the form of a 2.5 per cent solution in water. About 25 gallons of the solution are required per acre. Spraying is carried out in some suitable form of sprayer such as the "Four-Oaks" knapsack sprayer; one labourer can effectively treat one acre per day.

The arsenical weed-killer is sold in a concentrated liquid form, the solution being alkaline and containing in addition tarry matter. For use, this liquid is diluted 20 times, and is applied at a similar rate as for sodium chlorate.

About thirty estates, to our knowledge, have made use of weed-killers within the last two years and detailed reports have been received from about one-third.

Records of Results

ESTATE A

Thick growths of grass, (*Axonopus compressus*) were treated respectively with sodium chlorate and with ordinary anti-malarial oil. A 2 per cent solution of the sodium chlorate was sprayed at the rate of 100 gallons per acre, the material alone costing \$4.00 per acre and labour an additional 50 cents. Weather conditions were not particularly dry and the result was a scorching of the tops, with no permanent effect on the grass.

With anti-malarial oil, 40 gallons per acre were used, costing with labour \$9.00 per acre, and the above-ground shoots were all killed, but the grass was not destroyed.

ESTATE B

Lalang grass, carpet grass (*Axonopus compressus*) and cattle grass or "sani pillu" (*Paspalum conjugatum*), were all treated with arsenic weed-killer under good weather conditions. A dilution of one part in 20 parts of water was applied at the rate of between 80 and 100 gallons per acre. The lalang grass was effectively killed above ground, but within three weeks was shooting again vigorously. The other two types of grasses were burned off, but were sending up new shoots after ten days, and after three weeks were as thick as before.

The cost of this treatment was about \$9.00 per acre.

ESTATE C

Areas of cattle grass ("sani pillu"), about one foot high, were treated with different concentrations of arsenic weed-killer. The normal strength solution (1 in 20), and solutions of twice and thrice this strength were used, at the rate of 20 gallons per acre. Where the "1 in 20" strength was used, second and third applications were made as soon as new grass shoots began to appear. In each instance a successful burning of the grass tops was obtained but no complete killing of the roots occurred. With twice the normal strength of spray, regeneration of the grasses was complete in two months. The costs were \$4.50, \$6.50 and \$7.00 per acre, respectively.

A little stagmoss which was growing amongst the grasses was completely killed in every case, and some wild "coffee" plants

(*Fagraea racemosa*) were only slightly affected, their leaves being scorched.

A modification of this experiment is in progress, where, after killing the grass tops with one spraying of normal strength, the roots will be exposed by a light "changkolling" and will be sprayed once.

ESTATE D

A small area of lalang grass was treated with sodium chlorate (2 per cent solution) three sprayings being given at 10-day intervals. Following this, the very much weaker shoots were hand-pulled and then, at 4-monthly intervals, spraying and hand-pulling were repeated. This resulted in the disappearance of the lalang after 18 months.

Heavy lalang grass was also killed in three to four months by successive sprayings with large volumes of 2 per cent chlorate solution, but the cost of eradication amounted to about \$300 per acre.

ESTATE E

Areas of dense lalang grass were sprayed with sodium chlorate solutions, at strengths varying from normal to four times the normal strength, two or three sprayings being made in each case. The total amounts of sodium chlorate used per acre ranged from 6 lb. up to 20 lb. Again, complete destruction above ground was achieved, but new shoots soon appeared from the uninjured root systems.

Costs varied from \$1.40 to \$4.30 per acre.

ESTATE F

On this estate a variety of chemicals in solid and liquid form were applied to areas on which stagmoss was the principal natural cover, other growths including Straits rhododendron, lalang, other grasses, rubber seedlings, and desirable types of natural covers.

The chemicals applied included iron sulphate, double kainit (potassium, magnesium sulphate and magnesium chloride), ordinary salt, copper sulphate, lime, Adco, and sodium chlorate.

Most of the compounds had very little effect, and those that did kill the stagmoss were too expensive, *e.g.* copper sulphate killed stagmoss at a cost of \$5.00 per acre. The only exception was sodium chlorate which destroyed the above-ground portions of the stagmoss at a cost of about \$1.00 per acre.

ESTATE G

Areas of bracken (*Gleichenia linearis*) and carpet grass (*Axonopus compressus*) were treated with arsenic weed-killer at three dilutions, viz., normal, $\frac{2}{3}$ normal and $\frac{1}{2}$ normal strength. In the first series of tests rain followed the spraying within two hours, and no results were obtained. In dry weather, a repetition of the experiment produced a satisfactory killing of bracken with all three dilutions, while several desirable types of natural covers remained alive and had only their leaves damaged. The treatment of the grass caused the usual scorching of the grass blades, but within three weeks new and vigorous shoots were appearing.

ESTATE H

Moderately dense growths of stagmoss were sprayed with arsenic weed-killer under ideal weather conditions. One round of spraying, using 20 gallons of a 1 in 20 solution per acre, was carried out, and this was followed by a second spraying, using 15 gallons of a 1 in 30 dilution. Effective killing of the tops resulted, but the root systems were only partially killed.

The cost of this spraying was \$5.00 per acre.

ESTATE K

Areas of stagmoss and bracken were sprayed with arsenic weed-killer, using 20 to 25 gallons of a 1 in 20 dilution per acre. The treatment, which was carried out in dry weather, resulted in the killing of both bracken and stagmoss; a small amount of hand-pulling was needed some two or three months later in order to complete the eradication.

ESTATE L

On this estate heavy bracken areas were sprayed with normal dilutions of arsenic weed-killer, using 20 to 25 gallons per acre, the spray being applied in the middle of the day. The bracken was completely killed, and only one or two fronds shot up again, these being removed by hand-pulling.

The cost of treatment was \$3.00 per acre.

Experiments with Weed-killers on Rubber Estates

| Estate | Type of cover treated | Type of spray used | Rate of spraying gallons per acre | Strength of spray | Costs per acre | Weather conditions | Result of treatment |
|--------|--|-----------------------|-----------------------------------|---|----------------|--------------------|---|
| A | Thick Grass (<i>Axonopus compressus</i>) | (a) Sodium chlorate | 100 | 2 per cent | \$4.50 | Showery | Scorched tops; no permanent damage |
| | | (b) Anti-malarial oil | 40 | Undiluted | \$9.00 | Showery | All above-ground shoots killed; no permanent damage |
| B | Lalang Grass Carpet grass (<i>Axonopus compressus</i>) "Sani pillu" (<i>Paspalum conjugatum</i>) | Arsenic | 80 to 100 | 5 per cent (normal) | \$9.00 | Fairly dry | Growth above ground killed; new shoots appearing after 3 weeks |
| C | "Sani pillu" (<i>Paspalum conjugatum</i>) | Arsenic | 20 | (i) 5 per cent (three successive applications) | \$6.50 | Dry | Tops only were killed; Regeneration in two months. Stagmoss killed, but wild "coffee" only scorched |
| | | | 20 | (ii) 10 per cent | \$4.50 | | |
| | | | 20 | (iii) 15 per cent | \$7.00 | | |

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| D | Lalang Grass | Sodium chlorate | (a) 25 (Hand-pulling was done after spraying) | 2 per cent (three successive sprayings at 10 days interval) | High | Fairly dry | (a) lalang grass disappeared in 18 months |
| | | | (b) Large volumes | 2 per cent (successive sprayings) | \$300.00 | | (b) lalang grass killed and other plants established |
| E | Lalang Grass | Sodium chlorate | 25 | 2½ to 10 per cent (two or three successive sprayings) | \$1.40 to \$4.80 | Fairly dry | Tops only killed; regeneration occurred in a short time |
| F | Stagmoss (<i>Lycopodium cernuum</i>) | (a) Sodium chlorate | 20 to 25 | 2½ per cent | About \$1.00 | Fairly dry | (a) Stagmoss killed, and better bush types of covers only scorched. |
| | | (b) Copper sulphate | 20 to 25 | 5 per cent | \$5.00 | Fairly dry | (b) Stagmoss killed; other plants scorched. |

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| G | Bracken (<i>Gleichenia linearis</i>) | Arsenic | (a) 20 to 25 | (a) (i) 5 per cent (ii) $3\frac{1}{2}$ per cent (iii) $2\frac{1}{2}$ per cent | | (a) Rain within two hours | (a) No effect |
| | Carpet Grass (<i>Axonopus compressus</i>) | | (b) ditto | (b) ditto | | (b) Dry | (b) Stagmoss only killed at each strength. Grass scorched, re-generated in 3 weeks |
| H | Thick stagmoss | Arsenic | 20 | 5 per cent followed by $3\frac{1}{2}$ per cent | \$5.00 | Dry | Tops completely killed, but roots only partially dead |
| K | Stagmoss and Bracken | Arsenic | 20 to 25 | 5 per cent | \$2.50 | Dry | Both plants killed; a little hand-pulling required for final eradication some two months later |
| L | Heavy Bracken | Arsenic | 20 to 25 | 5 per cent | \$3.00 | Dry (mid-day) | Bracken completely killed; a little hand-pulling required later |

Conclusions

Successful eradication of areas of bracken and stagmoss can be achieved by spraying methods if care is taken; the cost of killing these plants in this way compares very favourably with other methods like hand-pulling or "changkolling." Lalang and other grasses, and bush types of covers, when sprayed, are only checked in their growth and are not permanently injured, since their root systems are able to produce fresh shoots very quickly after treatment, and there is also a considerable amount of new growth arising from the germination of seeds.

Solutions of sodium chlorate and arsenic weed-killer are effective on stagmoss, whilst the killing of bracken is accomplished best by means of the arsenic compound. The optimum concentrations appear to be a 2.5 per cent solution of sodium chlorate, and a "1 in 20" dilution of the arsenic compound. The mechanism of the action of arsenic compounds on some plants is, very simply, as follows. The arsenic is dissolved in a strongly alkaline or acid medium and this medium kills the living cells of the leaves and stems, rendering them permeable to the arsenic solution. In this way the arsenic enters the plant and is carried down to the roots, until the whole plant is killed. Spraying must be done in dry weather, since rain, even on the same day as the spray is applied, is liable to neutralise the effect. In this connection the best time of spraying would seem to be the middle-day hours, between 10 a.m. and 2 p.m.

In view of modifying conditions, it is apparent that the use of sprays for control of weeds has a definitely limited application in Malaya. The rainfall is high and during the major part of the year daily rain is a common occurrence. Heavy morning dew is another restricting factor, and bearing these facts in mind, it would only appear satisfactory to use liquid sprays during the two dry spells which occur, from January to March and from August to September, though the application of this restriction will vary according to local conditions.

The cost of successful spraying lies between \$2.00 and \$3.00 per acre, as against a figure of \$5.00 to \$10.00 per acre for other methods of eradication of noxious growths. Neither the arsenic nor the sodium chlorate are applied in sufficient strength to harm the soil or the rubber trees (roots or tapping panels). The arsenic spray (diluted) may tend to irritate the skin of human beings, and in the undiluted form is a strong irritant and poisonous. All chlorates are highly inflammable and it may be counted as a disadvantage of using chlorates that, when the dead plant material dries the dried chlorate solution will increase the inflammability of material which already catches fire

very easily. During the actual spraying, practically none of the spray reaches the ground, most of it being caught by the aerial parts of the bracken and stagmoss and in this way young plants of better types of covers are uninjured and can grow through the killed material which was originally growing above them.

Killing the weeds by spraying obviates the disturbance of soil, such as occurs when a "changkol" is used, and this is of great advantage where the plants have to be killed in bunds or pits or on steep hillsides, in that the risk of soil erosion is minimised. Further, no damage to the rubber tree roots can take place.

It may be an advantage to use sprays on heavy lalang and other grass patches as a preliminary measure to make easier the subsequent digging required for their eradication.

Some attention should be devoted to the use of dilute sulphuric acid sprays and also to treatment with other types of weedicides, such as sodium sulphocyanide, though with the use of sulphuric acid there is the need for considerable care in the handling of the undiluted reagent.

Summary

1. Details of experiments with weed-killers on various types of natural covers are presented.
2. Sodium chlorate and arsenical weed-killers appear to be most effective on bracken and stagmoss.
3. Lalang and other grasses, and bush types of covers, are not seriously damaged by the weedicides under consideration.

Acknowledgement

Acknowledgement is made to the various estate managers who have reported their experiences in the use of the sprays.

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Addendum

The above article was prepared by the writer before going on leave in December 1934, and during 1935 one or two developments have appeared which are recorded below.

1. Sodium arsenite is now obtainable in Malaya and can be used very effectively for controlling grasses and covers, with the advantage that it is also cheap. Solutions of strength from 0.25 to 1 per cent have been used effectively in controlling grasses and lalang (scorching and killing back the tops, without doing

any permanent damage to the roots) and the chemical costs about 20 cents per lb.

2. Sulphuric acid has been tried, but is not likely to be used to any extent because of its cost and the danger in handling it (risk of burns).

3. Calcium cyanamide has proved effective in controlling areas of stagmoss and further experiments are in progress. This chemical has a fertilising value in addition to its value as a weedicide, and thus, although very expensive merely as a weed-killer, the extra gain to the rubber trees (nitrogen, and possible calcium) must be considered in its use.

4. Control of thick covers of leguminous creepers, in order to reduce competition with the rubber trees, may be achieved by spraying methods, and experiments are in hand dealing with this point. A light spraying with chlorate or arsenite will kill the plant leaves, and perhaps some roots, but will leave sufficient plants alive which can regenerate.

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