Health Hazards in the Spraying of Cocoa with Trichlorphon

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Spraying with trichlorphon (trade names: Dipterex, Lepidux) is one of the measures recommended for the control of the Pantorhytes *weevil in cocoa trees. It involves spraying of foliage, branches and trunks of cocoa trees by motorized portable misting machines every 6 weeks. Because of the danger of poisoning from over exposure to this insecticide, tests have been carried out at Popondetta to determine maximum safe exposure periods for spraymen.*

TRICHLORPHON is an organo-phosphorus insecticide which is considered relatively safe to use provided certain commonsense safety precautions are observed. If these safety precautions are not followed, then symptoms of poisoning and even death of spraymen can be expected.

Organo-phosphorus compounds came into being in 1940 as a result of research to find an efficient "nerve gas" for use in warfare. If swallowed, these compounds are rapidly absorbed from the stomach into the bloodstream. Poisoning may also occur through the lungs and spraymen should avoid walking through their own spray mist. In practice, however, the greatest danger is from absorption through the skin.

As well as from spraying operations, there is a risk in handling the concentrate, for a relatively small amount of the more toxic concentrates on the skin can cause rapid poisoning.

Plate I.—A sprayer at work without protective clothing. One difficulty with low volume spraying is that the spray coming from the nozzle is almost invisible.

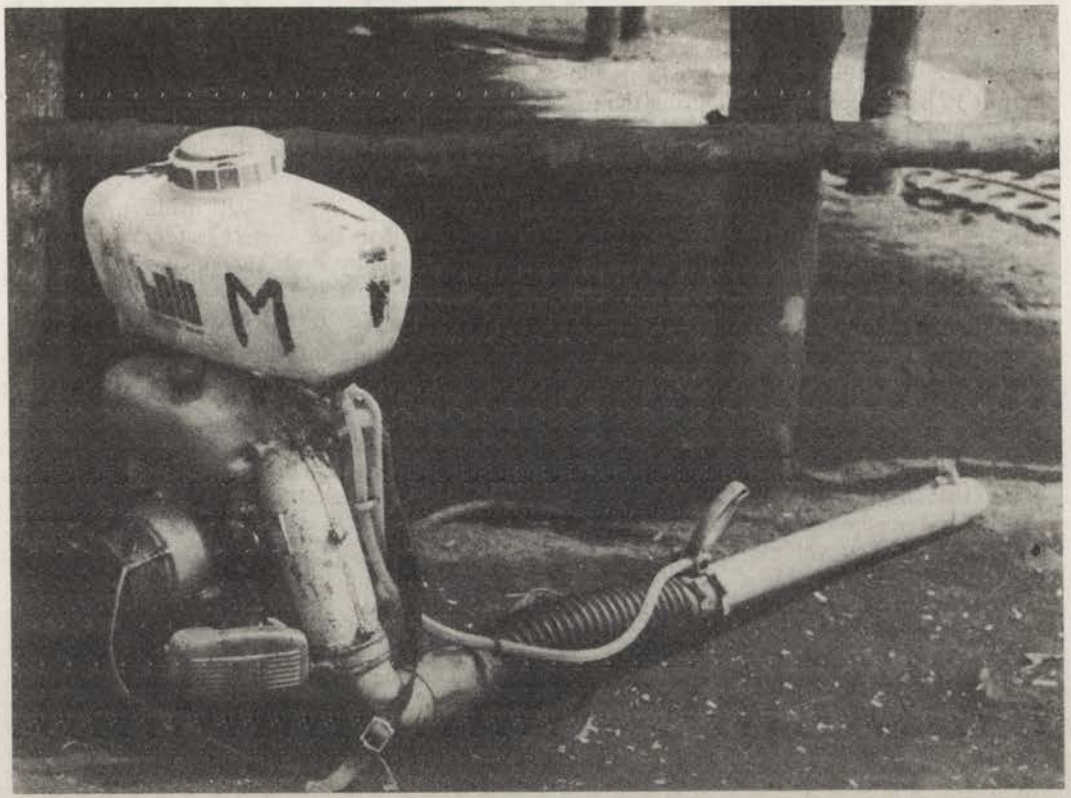

Plate II.—Spraying equipment.

Organo-phosphorus insecticides used in agriculture affect insects, animals and man by destroying the substance known as cholinesterase. Without this substance, a muscle can contract, but it cannot relax. The first muscles affected in poisoning are those which work automatically and are not under the control of the will, such as the muscles of the stomach, intestine and lungs. For these organs a regular pattern of contracting and relaxing is vital and any interruption to this pattern of action would be fatal.

The first symptoms of organo-phosphorus poisoning include muscular trembling, weakness, cold sweats, nausea, vomiting, abdominal discomfort, irritability and restlessness. Pinpoint pupils of the eye and some tightness of the chest occur in some cases.

Fortunately it is possible to measure the amount of cholinesterase in the blood (and other organs) and the normal content of persons not exposed to organo-phosphorus insecticides usually falls within the range of 90 to 150 units. Symptoms of poisoning do not usually appear until the blood cholinesterase level drops to 25 to 30 units.

Cocoa trees form a dense interlocking canopy 6 to 7 ft above the ground level, 5 to 6 years after planting. The spraymen would thus be working in an insecticide-saturated atmosphere for 6 to 8 hours per day, 5 or 6 days per week.

As broadly outlined above, trichlorphon can be taken into the body through the lungs, the stomach or the skin. When used as a spray in cocoa, the greatest danger from the insecticide would be through skin absorption.

Because no information on the effects of continued spraying with trichlorphon under Papua New Guinea conditions was available, it was decided to conduct some trials at Popondetta. Six spraymen were chosen for the trial. Initial blood tests showed that their blood cholinesterase levels ranged from 125 to 150 units, slightly higher than average. It was agreed that a man would be taken off spraying when his blood cholinesterase level reached 50 units. This allowed a safety margin of 20 units,

since symptoms of poisoning do not usually appear until the level drops to 30 units.

The spray used initially was 1.5 lb trichlorphon in 30 gal. water per acre. During the trial, blood samples were taken three times weekly (Monday, Wednesday, Friday) from the spraymen and sent to Port Moresby for analysis.

As spraying continued, the cholinesterase level dropped by approximately 12 per cent between readings for the first 2 weeks, then the readings levelled off, and fluctuated between 70 and 90 units for a period of 6 weeks. Levels then dropped sharply to the predetermined "minimum safety" level of 40 to 50 units, at which point all spraymen were taken off the job. This level was reached some 9½ weeks after spraying commenced.

This first trial was carried out using the high volume method of spraying. With the introduction of low volume spraying, a new trial was run in conjunction with a trial to test the effectiveness of protective clothing. This clothing consisted of long-sleeved overalls buttoned at the neck and wrist, elbow-length heavy duty polythene gloves, plastic-brimmed hats and agricultural type respirators with replaceable canisters. The unprotected spraymen wore short-sleeved shirts and shorts.

With the change to low volume concentrate spraying, 2 lb trichlorphon in 2 gal water were sprayed on an acre of trees. The spray itself was therefore 20 times more concentrated although the total amount of trichlorphon per acre only increased from 1.5 lb to 2 lb.

Again, blood samples were taken three times per week and forwarded to Port Moresby. Results showed that there was a steady reduction in blood cholinesterase level of approximately 16 per cent per week over the first 2 weeks. There was no difference between the protected spraymen and the unprotected spraymen during the first 3 weeks, but for the remaining 7 weeks there was a difference of from 12 to 23 per cent in blood cholinesterase levels, the protected spraymen remaining at an average of 20 to 33 per cent below normal, while the unprotected spraymen had levels of 32 to 48 per cent below normal. The lowest reading obtained was a reduction of 53.1 per cent for an unprotected sprayman, still well above the safety level.

Blood samples taken from workers on other plantations showed a more rapid drop of blood cholinesterase than this. It was obvious that gross contamination of spraymen was occurring and investigation showed that this was mainly from leaking spray machines. However, with the introduction of the more concentrated spray (10 per cent as against 0.5 per cent for the wettable powder formulation) contamination of skin and clothing could also have been important.

Accordingly, a plea was made to planters to ensure that the correct safety precautions were adopted by both spraymen and planters. This led to a marked improvement in the field position.

The foregoing information may be summarized in the following precautions:

1. The 70 per cent w/v concentrate is poisonous. Avoid contact with the skin and avoid breathing in the vapour. If concentrate is spilled on the skin, wash thoroughly with soap and water.

2. Spillage of the concentrate or mixed spray should be avoided.

3. At no time should hands be used to mix spray, nor should they, for any reason, be immersed in the spray solution.

4. Sprayers must not eat or smoke while spraying or before they have washed after spraying.

5. At the end of the day's spraying, spraymen should wash thoroughly, using plenty of soap and water. All clothes worn during spraying should be washed the same day. A sprayman should never sleep in the unwashed clothes he has worn while spraying.

6. Spraymen should spray for no more than a 2-week period, and then be put on other work for 4 weeks.

7. Care should be taken to apply the insecticide at the correct concentration rate per acre. If either the rate or concentration is increased, the spraymen will be exposed to higher rates of insecticide and will therefore run a higher risk of being poisoned.

8. Spray machines should be checked regularly to ensure that there is no leakage from the tap, the nozzle or the tank. Serious contamination can result from a leaking machine.

Further Reading

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Book Review

THE VANISHING PEASANT

Innovation and Change in French Agriculture by Henri Mendras. Translated by Jean Lemer. M.I.T. Press, Cambridge, 1970.

Most countries in the world find that their agricultural sector lags behind other areas in developing into a modern economy. In Papua New Guinea the recent rapid development of our economy has largely been the result of new business enterprises owned by expatriates. Many village people have entered the cash economy by growing small areas of new crops or rearing livestock, but most of these people have continued to regard themselves as subsistence gardeners. They have remained on the edge of the cash economy and have not adopted new practices which would increase their productivity. This is causing concern to planners who want to see Papua New Guinea develop her economy rapidly.

Planners who are concerned with the failure of Papua New Guinea villagers to adopt more productive innovations should read "The Vanishing Peasant". Although it deals with the French peasant, many of the findings of Henri Mendras in his extensive study of rural communities in France are applicable to other countries including Papua New Guinea. The study is one of the most extensive ever carried out on the various aspects of change in rural communities. In particular his study of basic attitudes to work, the land, the family, the farm and to time contribute to our understanding of traditional societies. To the peasant, says Mendras, the fundamental professional qualities are a "feeling for the land" and "courage". The universal values of science, the economic rationality and the imposed direction of work and time, familiar to the town-based extension worker, are foreign values which are not relevant to their life. To the peasant the extension worker recommending changes is often seen as a threat. He is usually made more so by the methods he uses if he seeks to deal with individual farmers and have them adopt new innovations. The following passage would seem to have particular relevance to Papua New Guinea.

"The mechanism of change is essentially collective and social in nature: innovation must be integrated into the common routine of the entire village in order to be accepted. Hence the peasant is never inclined to be the only one to do something unaccustomed; on the contrary, he is carried along by his group. Extension work that is based on the assumption that it can be more effective when directed toward individuals is misguided. A single individual has great difficulty in making decisions, as psychologists have shown and recent experience has confirmed. Agricultural progress has been much more rapid when it was the act of groups and institutions" (p. 40).

Mendras concludes with a view of possible future developments in French agriculture. To revitalize rural life, he proposes a national system of agricultural "workshops" organized around towns of 4,000 to 6,000 people. His proposals verge on an ideal model for society that would in all probability prove impracticable, but they are based on a belief in the ability of peasant communities to adapt rapidly to change if they are given the right conditions; a vital condition is that a new, visible and easily understood system is rapidly established. A study of "The Vanishing Peasant" by planners in Papua New Guinea should assist them to ensure that the "right conditions" are developed here. This should enable a rapid change by village communities which will keep them in balance with the developments in urban centres.

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