THE ROLE OF MODERN INSECTICIDES IN THE CONTROL OF TSETSE FLIES

It seemed that with the discovery of D.D.T. and B.H.C. a solution was near at hand to that major insect problem which affects vast areas of Africa, namely the Tsetse fly. The difficulties arising though from the magnitude of the problem were not at first appreciated, for unless insecticide operations could be carried out over hundreds of square miles of remote and often worthless country with absolute success then their use would be bound to end in failure. The use of modern insecticides for this problem presents quite a different picture to that where these are used on economic farm crops growing on a few hundred acres.

Insecticides might be used successfully where small isolated areas of fly occur, e.g. the islands of L. Victoria, small savannah fly belts or where concentrations of fly occur in otherwise vast belts, but to suggest that these might be used against the ~~vast~~ continuous G. morsitans belt is nonsense. It might be argued that in Zululand insecticides have been used successfully and a large area (7,000 sq. miles) has been almost cleared of fly (G. pallidipes and G. brevipalpis), but here was an instance where concentrations occurred and it was only necessary to treat 200 sq. miles of country (concentration areas) the remainder being dispersal area.

A number of methods of application of modern insecticides have been experimented with against various species of Tsetse fly and in several cases where a method has been unsuccessful against one species, usually * G. palpalis, it has been discarded, whereas it may have proved successful against another. There are twenty species of Tsetse fly distributed throughout Africa, each one different in requirements and habits. This all goes to show that a great deal more work is necessary before insecticides become a practical and economical method of combating Tsetses and then it can only be against the small isolated belts or the concentration areas.

Modern insecticides can be made to act in two distinct ways against the Tsetse fly:-

(1) A residual killing effect where a residual lethal deposit is built up by sprays or dusts.

(2) Immediate killing effect by aerosol smokes and fogs or fine sprays.

If these two could be combined the chances of success might be enhanced, i.e. if one could get an immediate killing effect together with a residual killing effect. So far it has only been possible to get one or the other and this is seen especially in aerial application where it was found that the large droplets of residual sprays would not penetrate the vegetation canopy to the same extent as those of smokes and fogs or fine sprays, so that now in aerial operations immediate kill is relied on. The following methods of application have been tried:-

(1) Residual.....

* The islands of L. Victoria are infested with G.

(1) Residual killing effect.

(a) Selective application to vegetation from the ground with sprays.

(b) Non-selective application to vegetation from the air with sprays.

(c) Impregnated screens.

(d) Dusts.

(e) Bait animals sprayed with insecticides.

(2) Immediate killing effect.

(a) Smokes from generators.

(b) Aerosol fog from the Todd Insecticidal fog-producing apparatus (T.I.F.A.)

(c) Aerosols and finely atomised sprays from aeroplanes.

(1) Residual killing effect.

(a) Selective application of insecticide to vegetation using Four Oak sprayers has been tried on the islands of L. Victoria against G. palpalis. Oil solutions of D.D.T. and B.H.C. were at first used but it was found that all residual effect was soon lost owing to absorption by the leaves. Later D.D.T. and B.H.C. emulsions were used with great success and a 98% kill achieved on two islands. A series of applications to all likely fly haunts were made to cover the maximum, probable pupal period. The populations took a long time to recover and it is thought that the experiments were entirely successful but that reinfestation took place by canoe carried flies. This method is suitable for G. palpalis as this fly is normally restricted to a narrow belt along the water's edge, but for savannah species it is quite out of the question. In a small fly belt it might be possible to treat in this manner a large majority of fly resting places, breeding places and movement routes after careful study and so possibly eliminate the fly, but the cost would be tremendous.

(b) Non-selective application of insecticide to vegetation from the air was tried on four islands of L. Victoria but the heavy, evergreen canopy and unpredictable meteorological conditions made the difficulties of achieving anything approximating a complete kill as difficult as they could be. Eight applications of B.H.C. and D.D.T. emulsions in the form of liquid spray were made in an attempt to build up a heavy residual deposit. The insecticide was emitted from two pipes under the aircraft and passed from the tanks under gravity to these so that the emission rate was not constant and this was another limiting factor. There was only a small temporary drop in the fly population. The spray did not penetrate the vegetation canopy owing to the large droplet size. It might be possible to use this method in not too extensive areas of savannah fly bush, but it would have to be at the time of maximum leaf fall which is often rather short and it would be especially difficult on the drainage lines where the foliage persists quite late into the dry season.

(c) Impregnated screens were experimented with on

the islands of L. Victoria. The application of insecticidal solution to vegetation by hand spraying is laborious so that insecticide impregnated screens were tried. These were put up at likely places on the islands and were sprayed weekly with insecticide solution (D.D.T. and B.H.C. oil solutions). In both cases a 50% reduction was obtained. Impregnated screens would be almost useless against G. morsitans as this fly is little attracted to stationary screens or traps but might prove useful in the control of the thicket loving G. pallidipes which comes more readily to them.

(d) Dusts, both D.D.T. and B.H.C., in conjunction with the smoke generators, have been used in Zululand in the mountainous, broken areas of country where fixed wing aircraft were unable to operate. These were applied by hand and mechanically operated dusters. D.D.T. dust was used almost exclusively as the B.H.C. dust proved irritating to the operators. The results were gratifying but now this method has been superseded by the application of aerosols from Helicopters.

(e) Experiments with bait oxen dipped or sprayed with insecticide have been carried out at Shinyanga, Tanganyika and in Zululand. At Shinyanga 300 cattle were sprayed with a preparation of D.D.T. and driven each day into a small isolated block of bush infested with G. pallidipes. The results were disappointing and the failure of the experiment can be attributed to the fact that the cattle were not in the block when this particular fly feeds most readily, namely early morning and evening. This was because they had to be kraaled each night someway away owing to lions. This experiment would have probably been successful against the savannah tsetse, G. morsitans and swynnertoni, both of which feed by day.

Bait cattle sprayed or dipped with an emulsion of D.D.T. have been used in Zululand against G. pallidipes quite successfully. The residual films persist for a period of 5-6 days. Other noxious Diptera e.g. Stomoxys, Tabanidæ etc. were also profoundly affected.

In Uganda cattle have been fed with B.H.C. and have remained toxic to tsetse for 42 days. This method, though, may not prove so useful as might be thought, as it seems likely that the dose needed to produce toxicity in the blood to the tsetse is too near that point harmful to the animal.

(2) Immediate killing effect.

(a) Smoke generators have been used against G. palpalis on the Lake islands, against G. swynnertoni in the Attta block near Kikore, Tanganyika, and in Zululand against G. pallidipes. On the islands B.H.C. generators were used and an 80-90% kill was achieved with each smoking. The thick vegetation and variable winds were the main difficulties. At Attta block B.H.C. was also used and the majority of the fly were killed with each smoking and a large reduction achieved, but not 100%. The experiment proved to be extremely expensive. In Zululand D.D.T. generators were used in the valleys together with dusts as mentioned before and the conclusion reached was that, though serving as a useful supplement to aircraft application, these could not be relied on to bring about extermination unless, perhaps, they were applied over a number of years.

(b) The Todd Insecticidal Fog Producing apparatus (T.I.F.A.) is a machine which produces an aerosol fog of very fine particles, the principle being the same as that for aircraft exhaust aerosols, the solution, emulsion or suspension being introduced into a blast of hot air. This machine has been used by the Colonial Insecticide Unit in two ways. (1) On a raft towed along the lake shore against G. palpalis and (2) On a truck driven through open thorn scrub country infested with G. swynnertoni. It has also been used in Kenya for deflying trains. The G. palpalis experiment was unsuccessful as the fog did not penetrate the thick peripheral vegetation of the island and meteorological conditions were unfavourable. The open thorn scrub experiment was promising though, and it was found that the fog would kill caged flies up to a distance of a quarter of a mile. It is felt that more work could be done with this machine and that mounted on a Landrover or Jeep it could be driven through flat savannah country or even over moderately rough terrain, and, making every use of the wind to carry the fog, the chances of success would be hopeful. It would be ideal for small isolated areas of fly or concentration areas. The great advantage of the T.I.F.A. is that it can be used all night while the inversion conditions are suitable (i.e. the ground is as cool or cooler than the air so that there are no thermal up-currents and the aerosol therefore does not rise), whereas aircraft can only operate for a short time in the late evening and early morning.

(c) Finely atomised sprays and aerosol smokes applied from fixed wing aircraft have been used in East Africa and Zululand; in the latter country Helicopter aircraft have also been used. These are of course the methods par excellence excepting that the costs are so tremendously great.

Finely atomised sprays were first tried in Zululand but were abandoned because it was found that there was insufficient penetration through dense bush owing to the spray droplets being caught on the overhead canopy, and that spraying had to be restricted to the period of maximum leaf fall which was comparatively short. The apparatus too was not particularly perfect. Since then the Colonial Insecticide Unit have developed a boom apparatus for the application of a very finely atomised spray. Here the boom is fitted beneath the wings of the aircraft and a small pump beneath the fuselage feeds insecticide to it from the tanks at a constant rate; the insecticide is emitted through numerous but equally spaced jets giving a finely atomised spray. It is believed from recent experiments that this method of application is superior to the exhaust aerosols because the mass median drop diameter is more constant.

Exhaust aerosols were first used in Zululand against G. pallidipes and were found to be superior to the spray method which they had been using previously because a better penetration of thick vegetation was achieved. The insecticide is fed under gravity into the exhaust manifold of each engine and the hot exhaust gases give an almost perfect sublimation of insecticide in the form of white smoke. D.D.T. and B.H.C. oil solutions were used.

The Colonial Insecticide Unit first tried exhaust aerosols on the islands of L. Victoria using an apparatus similar to that fitted to the Zululand aircraft. They were not very successful owing to the thickness of the canopy

conditions, but the aerosols were better than the residual sprays (para. 1(b)). Later they treated small blocks of vegetation infested with G. morsitans, G. swynnertoni and G. pallidipes at Kikore, Tanganyika. Here they were quite successful and the experiments would probably have been 100% had the blocks been properly isolated to prevent immigration of flies from the surrounding fly bush. The apparatus though was not as yet perfect for the emission rate of insecticide varied and this was because the insecticide was flowing under gravity from the tanks to the exhausts. Recently the apparatus has been improved and the insecticide now passes through a pump under the fuselage, as in the boom apparatus, before entering the exhausts. D.D.T. and B.H.C. oil solutions have been used in these experiments.

In Zululand helicopters are now being used to cover the mountainous broken country over which fixed winged aircraft cannot operate. Aerosol smoke apparatus is fitted to them and apparently they are proving most successful.

Weather conditions are a limiting factor and operations can only be carried out in the early morning and evening when the inversion phenomena exists, so that the aerosol settles downwards instead of rising.

Aerial application is limited to isolated areas of fly bush, both artificial and natural, to breeding concentrations of fly as in Zululand and to hold up a fly advance by barrier spraying while more permanent measures can be taken.

A great deal of organisation is required for aerial control of tsetse as operations must be on a large scale to ensure success. Thus money must be no object and therefore it can only really be used where a problem is extremely urgent.

Recent developments in Arboricides are of interest and it is felt that the possibilities of the use of these in tsetse control should be mentioned. The Colonial Insecticide Unit sprayed the vegetation of one of the islands of L. Victoria with two defoliant compounds so that the penetration of insecticides to be applied at a later date, when leaf fall was complete, would be more certain. The experiment was not successful, but then this was due to a lack of knowledge of the vegetation. Work is continuing and there are possibilities that Arboricides may be used successfully in discriminative clearing against the savannah tsetses. Discriminative clearing promises to be the most successful of the savannah tsetse controls and if one could simply spray from the ground or air the trees and shrubs to be cleared in order to kill them, the labour and time saved would be tremendous.

In Southern Rhodesia the fly areas (mainly G. morsitans) are vast and continuous and unless concentrations can be found then the possibilities of modern insecticides in the control of these are slight. Even ~~then~~ if these do occur then all that could be hoped for from modern insecticides would be a reduction in population but never a complete control. The isolated fly belts, if any, might prove vulnerable to insecticides. It is felt though that before any insecticide work is carried out a careful study should be made of the fly and its requirements in the particular area which is to be considered for the experiment.

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