# PROGRESS IN THE BIOLOGICAL CONTROL OF LANTANA CAMARA IN EAST AFRICA AND DISCUSSION OF PROBLEMS RAISED BY THE UNEXPECTED REACTION OF SOME OF THE MORE PROMISING INSECTS TO SESAMUM INDICUM 1/

D.J.Greathead
Commonwealth Institute of Biological Control

In East Africa, as in many other parts of the tropics, various forms of *Lantana camara* L. were widely planted as ornamentals. In a number of areas it soon spread into waste land and pastures forming dense thickets. Not only is the plant unpleasant to move in but it is toxic to stock, competes with young trees in plantations, in some areas in Africa it provides an ideal habitat for tsetse flies, and on the Kenya coast it also threatens to destroy the habitat of the sable antelope. Biological control was considered at the beginning of the 1950s and the Hawaiian authorities were asked for material of the species which had been successfully established in Hawaii.

*Teleonemia scrupulosa* (Stål) was received in Kenya in 1952 and colonised successfully in most infested areas by 1963 and *Ophiomyia lantanae* (Frogg) was received in 1958 and released in Kenya before it was realised that it was already present. After the setting up of the East African Station of the CIBC in 1962 cultures of *Diastema tigris* Guenée and *Syngamia haemorrhoidalis* (Guérin) were received from the West Indian Station, CIBC, and until 1967 releases were made at a number of sites. *D. tigris* has not been recovered and recoveries of *S. haemorrhoidalis* have only been made near Kampala. *Uroplata girardi* Pic was received in 1967 and released at two sites. Near Kampala it became established but remains at low density. These developments have been reviewed in more detail by Greathead (1968,1971).

Only *T. scrupulosa* has been of any value, however in most areas although it causes extensive defoliation during dry weather the plants are not sufficiently weakened to prevent recovery during the wet season or to suppress flowering and fruiting, which is the pattern of events in other countries. At one place, Serere in central Uganda, the population exploded during the first dry season after its release to the extent that defoliation was complete and tender shoots were killed. Die-back followed and large areas were burnt, but during the subsequent wet season there was limited regrowth. In each succeeding year the same pattern was repeated so that now the extent of the infested area has been greatly reduced and those thickets that remain are shrinking year by year. Recolonisation is prevented by the ploughing of cleared land, competition with other plants and the continued pressure from *T. scrupulosa*.

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Unfortunately following the first "explosion" when there were bugs everywhere there was severe damage to sesame growing on the research station. Feeding and oviposition caused abnormal growth in addition to direct damage. The eggs hatched and nymphs developed but showed poor survival and the few adults which were obtained in the laboratory failed to reproduce (Davies & Greathead 1967). These attacks on sesame have been repeated each season. Fortunately as sesame is an annual grown only during the rains there is no question of the development of a sesame adapted strain.

These events have made further biological weed control extremely difficult in East Africa as the quarantine authorities have become very sensitive. It is also of scientific interest as Harley (1969a, 1969b, 1970) has shown that another lantana Tingid Leptobyrsa decora Drake reacts in the same way, but not a third, Teleonemia elata Drake, and that the adults of two lantana Hispids Uroplata girardi and Octotoma scabripennis (Guérin) are also attracted to sesame.

T. scrupulosa was never adequately screened but since its first introduction, to Hawaii in 1902 without feeding tests, it has been widely used without untoward results even in places where sesame is grown - its home Mexico, where the original stocks were collected, is the largest sesame producer in the New World ! The risk to sesame could have been discovered in screening tests but would it ? Zwolfer & Harris (1971) recommend consideration of the following insects for weed control :

1. Biological adaptations. There are no obvious behavioural morphological, or ecological adaptations but this is true of many insects.

2. Host Range. Tingidae are usually regarded as having very restricted host ranges and T. scrupulosa is no exception ; apart from L. camara it has been found breeding on the closely related Lantana spp. and Lippia spp. and there are a few records from unrelated plants listed by Drake & Ruhoff 1965.

3. Feeding and oviposition tests. Had they been carried out they would obviously have included major crop plants and economically important Verbenaceae. In fact some tests were made in India against teak, Tectona grandis L. and it was not deliberately released there as it fed and reproduced on this plant in the insectary, but it escaped into the field and did not become a pest of teak (Roonwal 1952).

It would have been pure chance if sesame had been tested in feeding tests as it was not at the time an important crop in East Africa and was in fact not encouraged as it was considered unrewarding in terms of yield for the effort employed.

4. Investigations of the basis for host recognition. As Zwolfer & Harris (1971) note this is an involved and difficult process and therefore does not usually form part of the screening process.

In order to ascertain the reasons for the unexpected damage to sesame this topic is now being investigated. Preliminary experiments showed that there is strong positive phototaxis which, even in the presence of the lantana plant, causes most adult insects to congregate on the light side of the cage. In the dark the insects are quiescent. However by enclosing test groups of insects under a half petri dish, which was turned through 180° every two minutes, in front of a window it has been possible to establish that they react to colour, and rest on yellow cards in preference to any others, and that they react to the proximity of plants which they cannot touch by stopping and probing the substrate. In a series of tests only one of the test plants, Lantana camara, produced a stronger reaction than a control - moist blotting paper. The other plants included Sesamum indicum L., Lippia grandifolia Hochst. ex A.Rich, on which T. scrupulosa feeds and breeds in the field, and Lantana trifolia L. which is not a host plant, as well as other non-host plants. The results of preliminary tests on feeding through a parafilm membrane on water, sucrose solution and crude extracts expressed from chopped test plants were disappointing as although the insects fed (checked by the inclusion of methylene blue in the test solution) survival time was more than twice as long on sucrose than on water which was as effective in sustaining life as Lantana camara, L. trifolia, Lippia grandifolia and Sesamum indicum however T. scrupulosa fed on extracts of other plants fared no better than the unfed controls.

These preliminary experiments will be followed up with tests using purified extracts as it would appear that the crude plant extracts are toxic, containing substances released from cell walls during preparation.

If any conclusion can be drawn at this stage it is that Lantana camara is the only positively attractive plant but that in order to explain the occurrence of the insect on sesame and Lippia spp. one must postulate that T. scrupulosa will probe any plant on which it comes to rest and that host plant selection is ultimately determined by the palatability of the sap extracted. If this suggestion can be substantiated, and it may be beyond our resources of technical expertise and equipment to do so in Uganda, it will call in question the advisability of extrapolating from the results of feeding tests and be of some comfort to entomologists, but not the Uganda farmer, to know that sesame is not a true host plant in the sense that it attracts T. scrupulosa so that ultimately when finally Lantana camara becomes an insignificant part of the flora around Serere damage to sesame will also cease to be significant.

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DISCUSSION

WATERHOUSE One of the things that Dr. Harley did when he heard of attack on Sesamum was to examine whether or not this plant had been included amongst those he tested in Hawaii. Feeding would have been observed. He reported that those subsequent tests clearly revealed attack on Sesamum.

He didn't go as far as Dr. Greathead, but in a large cage in the open and also in field exposures of Sesamum to Teleonemia, the insects remained on the sesame plants and fed. The relevance of this, of course, is that the East African results with sesame don't undermine the validity of the tests that Harley was doing to examine the safety of the organisms attacking Lantana.

BUCKINGHAM Where did the insects for your first introduction originate? Was it Hawaii or Australia or did they come from Mexico?

BENNETT They came from Hawaii. They were from the original introductions from Mexico into Hawaii, Fiji and Australia. Dr. Waterhouse pointed out yesterday that a very narrow genetic strain was introduced originally into Hawaii, and I'm not certain how much additional material had been released in Hawaii before the shipments were made to East Africa.

BUCKINGHAM Are you contemplating getting specimens from Central America and Mexico and testing them simultaneously to see if there is a change from the original stock.

BENNETT I don't know whether Dr. Greathead has considered this or not. Certainly as Dr. Waterhouse has pointed out, they have introduced other strains into Australia and I'll ask him to comment on what differences have occurred, apart from the possible defoliation of additional clones of Lantana.

WATERHOUSE Well, first of all, the gene-pool in Hawaii is not nearly as small as the gene-pool that was introduced into Fiji. It appears, although I don't know the details, that Mr. Krauss and perhaps others, from time to time, sent Teleonemia scrupulosa to Hawaii subsequent to the transfer of Teleonemia to Fiji. So there was, in fact, a much greater set of collections in the Hawaiian gene-pool. The Fijian material came from Hawaii before these subsequent introductions. In our recent work, Dr. Harley obtained 28 viable colonies from a variety of places, some with the help of Dr. Bennett. These were bulked, after examination under quarantine conditions, and the mixed culture is the one that was liberated. Unfortunately, we have no means of distinguishing between the new material and the first strain. However, if observations show in the next year or two that Teleonemia is more widespread and survives in areas in which it was unable to do so before and creates additional damage (and there is early indication of this) then we may assume that the additional gene-pool has indeed been of great value.

I think this underlines the necessity for examining the particular strains of Lantana or, indeed, of any other weed under investigation. We will hear later on today from Dr. Wapshere, the problems that have arisen in trying to get organisms that will attack the particular Australian taxa of skeleton weed. We now know that there are many many taxa of Chondrilla juncea (skeleton weed) in Europe. This means that care must be taken to introduce strains of natural enemies that are adapted to attacking the particular taxa that are weeds in Australia.

LITTLE There has been research in Kenya and East Africa on charcoaling useless scrub and Lantana makes very good charcoal. It represents quite a resource if it can be properly exploited.

<u>HARRIS</u> One of the lessons to be learned from this example is that insects that can lengthen their life significantly on a number of other plants may be dangerous. There is a tendency to say if an insect doesn't breed on the test plants, it's safe; but I favor greater caution. This doesn't mean to say we shouldn't use these insects, but they wouldn't be my first choice. Hemiptera in general can lengthen their life on many many non-host plants, and if the weed population that they are introduced against does not collapse, but is merely defoliated annually, I think we may expect trouble.

<u>ZWOLFER</u> I think even if <u>Sesamum</u> would not have been included in pre-introduction screening tests, such a behavior might have been predicted. When making screening tests with <u>Microlarinus</u> spp. Andres and Angalet found that adults can survive on a broad range of plant species, whilst reproduction is restricted to a few species forming a definite pattern. It was predicted that, when introduced to North America, there might occur some adult feeding on various plant species. Actually, this has happened but was not considered as a serious phenomenon. Perhaps Dr. Bennett could comment on the question whether the benefit derived from <u>Teleonemia</u> in Africa by defoliation of <u>Lantana</u> is outweighed by occasional damages to <u>Sesamum</u>?

<u>BENNETT</u> As I understand it, the damage to <u>Sesamum</u> has been in rather small experimental plots rather than on large scale plantings. I am not certain how far the <u>Teleonemia</u> adults have migrated from the <u>Lantana</u>, but apparently less than a kilometer.

END OF DISCUSSION

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