ASSESSMENT OF DAMAGE AND CONTROL OF *HELOPELTIS CLAVIFER* (HETEROPTERA: MIRIDAE) ON TEA IN PAPUA NEW GUINEA

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ABSTRACT

The mirid Helopeltis clavifer *(Walker) (Heteroptera: Miridae) caused severe damage to tea in plucking at the Garaina Experimental Tea Plantation during 1977-78. The damage caused and probable reasons for the outbreak are discussed. Spraying with endosulfan gave good control.*

A simple, rapid method of estimation of damage levels was developed and is outlined. The results of regular surveys using this method can be used to monitor damage levels, detect areas requiring spray applications and determine the efficacy of the control measures used. The method could possibly be adapted for use on other pests in Papua New Guinea.

INTRODUCTION

Planting of tea at the Garaina Experimental Tea Plantation in the Morobe Province commenced in 1949 with the intention of assessing the problems and the economics of production of tea growing in Papua New Guinea. During the 1950's and early 1960's the plantation's main function was to produce seed from tea seed bearers for the establishment of the highlands tea industry. The background and progress of the plantation is described in detail in various DASF Annual Reports (e.g. DASF 1961, 1965) and by Graham *et al.* (1963). During the two years until March 1976 the tea factory was undergoing repairs, and field-work on the plantation was reduced to maintenance only. In this period most of the tea bushes were neglected and from March to July 1976 the overgrown tea bushes were pruned back and all *Albizia* sp. shade trees lopped and poisoned. After a second pruning the tea was tipped in to form the plucking table. Regular fertiliser applications were begun and from 1976-1978 the plantation was used to demonstrate the viability of the tea estate and factory at Garaina.

Helopeltis clavifer (Walker) (Heteropera: Miridae) was first reported damaging tea in the Garaina nursery during 1964 and was controlled with insecticides (DASF 1966). By 1967 the insect was attacking seed bearing tea bushes and the problem intensified. Heavy feeding damage caused dieback of shoots and the proliferation of secondary laterals which were also attacked and often killed. The fruit and the enclosed cotyledons of the developing seed were sometimes distorted after being attacked (DASF 1969).

In 1977, *H. clavifer* caused significant damage to tea in plucking at Garaina and this paper describes the damage and methods used to control the pest and outlines a simple method by which *H. clavifer* damage in tea blocks can be regularly

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monitored. The method can be used to indicate if and when insecticidal control measures against the pest should be implemented and the efficacy of these chemical treatments.

METHODS

During a visit in April 1977 to investigate the pest outbreak at the plantation, the damage caused to tea in plucking was examined, and it was suggested that several cultural methods be used in an attempt to contain the infestation without the use of chemicals. It was recommended that the stands of tea seed bearers remaining on the plantation be removed since it appeared that these had provided a permanent, sheltered environment for small *H. clavifer* populations for many years and their removal would prevent pockets of infestation remaining adjacent to the tea fields. The plucking round of thirteen days was to be maintained in order to remove eggs, which are laid in the soft flush and other tissue susceptible to the insects. Pickers were instructed to remove damaged flush tissue and to kill insects sighted during the plucking rounds. Additionally the fertilizing schedule was to be adhered to as far as possible since some researchers had claimed that *Helopeltis* attack was correlated with plant nutrition (Pearson 1958).

A second visit to the plantation was made three months later. It was apparent that the infestation was spreading and that chemical control measures were necessary. Previously, when *H. clavifer* damage was confined to nursery plants and seed bearers, sprays of dieldrin or gamma-HCH (lindane) had been applied (A.F. Hutton, pers. comm.). At that time the major objection to the use of chemicals was the possibility of interference with the insects pollinating the seed bearers.

However in the control programme reported here the main consideration was the possible disruption of other potential pests of tea. For instance both mite and tea tortrix populations have shown upsurges after application of chemicals (usually organo-chlorine insecticides) to control other pests of tea in Sri Lanka (Ceylon) (Baptist 1956; Cranham 1961, 1966). Several species of mites and tortricids have been recorded on tea in Papua New Guinea, and certainly the tortricids are under good control by a range of parasites in the Waghi Valley. Tortricid species occur in low numbers at Garaina and it was assumed that here too they were under good biological control.

After considering several available insecticides, it was decided to assess endosulfan since it is recommended on tea elsewhere, is less likely to kill parasites of other pests, has a relatively short waiting period and imparts no tainting (Fisher and Pierza 1966; Laycock and Templer 1973; Mulder 1971; Sana *et al.* 1975).

Endosulfan at the rate of 440 g a.i. in 60 L water/ha was applied to about 2.5 ha of tea in plucking during July 1977 using a Stihl misting machine, with a diffuser baffle on the nozzle. The spray operator walked down every second inter-row space, spraying two rows at a time and directed the spray at right angles to the line of walk and with the wind. A four hectare block could easily be sprayed by two men in one day.

It was intended that, where necessary, insecticide application was to be made immediately after plucking and that a second spray would be applied directly after the next plucking round. The second spray would kill any nymphs which had hatched from eggs present at the first spray before they became adult. This schedule would also allow the usual 13-14 day plucking interval and a 12-13 day waiting period.

Since it was difficult to gather data on the optimal timing for, and the effectiveness of, the insecticide applications using

visual counts of *H. clavifer*, a damage assessment survey system was developed. This method was used to determine a damage score for each of several transects which covered a representative proportion of each tea block. In the four hectare Garaina blocks, four transects each of 200 m were taken so that the block was uniformly inspected. The recorders walked along the inter-row space recording a positive score each time fresh *H. clavifer* damage was noted on either side of the transect walk. After scoring, one pace was taken before a further score could be made. This pace represented the planting distance of one metre, and if each tea bush were infested a score of about 200 would have been made along the 200 m transect mentioned above. It was necessary to differentiate between damage up to a few days old on flush leaves, which represented fresh *H. clavifer* feeding, and older damage to fully expanded leaves. Only the former was counted as a positive score.

Table 1 shows the levels of infestation and damage counts which were considered applicable over a 200 m transect after preliminary sampling at Garaina. Any block which had a transect score of between 15 and 25 had attained a "warning level" and careful surveys at weekly intervals were necessary. Scores which exceeded 25 (i.e 12.5% of the total possible score) represented a high level of infestation (spray level) in that transect. Any block which had one transect score of 25 or more was to be investigated more thoroughly and, if necessary, all or part of the block sprayed with endosulfan at the earliest opportunity after plucking had finished in that block. Areas adjacent to blocks attaining a "heavily infested" score of 25 were to be carefully surveyed at weekly intervals to monitor *H. clavifer* damage levels.

For practical purposes regularly spaced and permanently marked transects were used in each tea block. The recorders were therefore able to become familiar with their route and could carry out their work without supervision. These fixed sample sites also allowed trends in damage levels to be assessed for far less effort than would have been required using random samples.

Both the damage scoring method and spray application technique were taught to general labourers at Garaina. They were capable of handling these activities with reasonable accuracy. Supervisors checked on damage levels and made the decision whether or not to monitor damage levels more frequently or to implement chemical control measures. During August and September 1977 about 66 ha of tea at Garaina was sprayed with endosulfan and from February to March 1978 a further 32 ha received insecticide applications in response to the monitoring system.

RESULTS

Damage symptoms on tea in plucking

Both the adults and nymphs of *H. clavifer* attack recently expanded flush leaves and the unfurled buds. In the immediate feeding area a series of light green "water soaked" feeding spots are formed. These are generally circular but on recently expanded leaves they sometimes have an angular appearance. The feeding lesions gradually change colour to a light, then dark, brown as all the cells within the lesion die. Frequently areas of necrotic tissue coalesce. Later the lesions become black and occasionally the whole leaf shrivels and dries out from the tip or edges. Attacked leaves curl and are usually grossly distorted. At Garaina it was noted that feeding was concentrated on leaves and that flush stems were rarely attacked. Thus there was less proliferation of side shoots than would normally occur when shoots or growing points are damaged.

The greatest amount of damage observed at Garaina occurred in the first

Table 1. — **Levels of infestation and damage counts considered applicable over a 200 m transect**

Damage count	Infestation level	Percentage of total possible count	Action needed
0	Nil	0	Nil
1-5	Very light	0.5-2.5	Nil
6-10	Light	3.0-5.0	Nil
11-15	Light-medium	5.5-7.5	Nil
16-25	Medium-heavy	8.0-12.5	Close monitoring
>25	Heavy	>12.5	Possible spraying

block to be pruned. The new shoots were so badly damaged that this block was more than a month late in coming into production. This outbreak was almost certainly initiated from a persistant but low intensity *H. clavifer* infestation on the tea seed bearers nearby. In this block 70-80% of the plucking tips were damaged but over the "in plucking" area of the whole plantation the loss of green leaf was small. However, fears that populations of this pest might increase and cause greater production loss necessitated a close examination of the problem.

At the first inspection nymphs were found on 15-20% of all freshly damaged tips examined but these proved to be first and second instar stages only. Further investigation showed that few adults were found during the day and that older nymphs (third, fourth and fifth instars) were generally located on larger twigs or towards the centre of the tea bush. Adults were found much more frequently during the early morning, during cloudy periods or in the late afternoon and it was suspected that the adults and larger, more robust nymphs retired to the more sheltered, humid centres of the bushes during the day to escape desiccation by the wind and sun.

The outbreak and its possible causes

A light infestation of *H. clavifer* had been present on tea seed bearers at Garaina for many years but damage to recently pruned tea was first noted during early December 1976 in areas adjacent to unpruned blocks by J.R. Pippet. The infestation had moved to a contiguous block of tea "in plucking" by February 1977 and then rapidly expanded over much of the area "in plucking" on the plantation. At Garaina the six months of October to March are normally very wet (average of 283 mm of rain per month) and the latter three months receive an average of only 4.0 hours of sunshine per day compared with 5.2 hours in the October to December period (McAlpine *et al.* 1975).

The rapid expansion of the *H. clavifer* outbreak occurred during February 1977 when 400 mm of rain (41% more than usual) fell. In addition this period almost certainly received less sunshine than usual. An abundance of flush tissue for food was available to the expanding pest population since a large area of tea in plucking condition had recently been prepared and shade tree removal, fertilising and weed control had created conditions ideal for flush growth in the plucking table.

Control measures and assessment technique

The cultural methods recommended did not contain the infestation and insecticide applications were commenced in July 1977. Investigations in August/

September 1977 indicated that excellent control was achieved since damage levels in sprayed areas were substantially reduced, while in unsprayed areas *H. clavifer* damage either remained at a stable level or increased. Similarly, satisfactory levels of control were achieved after subsequent sprays in 1978, by which time the monitoring system was in progress (see *Figure 1*).

The survey method as outlined was simple, rapid, and appeared to give a reliable estimate of *H. clavifer* damage levels in the tea blocks. At Garaina one labourer trained in the method could survey more than 34 ha of tea in plucking in one morning (five hours). This involved about 6.5 km of transects through the tea blocks.

In some transects the surveys detected localised areas of heavy pest infestation which otherwise were unlikely to have been noticed. Although the overall transect score or the total block score was below the spray level, the recorder noted that most of the counts were in a short portion of the transect. These small pockets of heavier damage were then delimitated and spot sprayed where necessary.

As an example of the counting system a summary of *H. clavifer* damage counts made at Garaina during the eleven month period February to December 1978 is shown in *Table 2*. In addition three individual cases showing reductions in damage levels subsequent to chemical control are presented in *Figure 1*. The plots in *Figure 1*A represent damage scores in one transect line while that in *Figure 1*B are average counts for four transects in one four hectare block. Notes made on block 8D which was brought into plucking after pruning and tipping-in during 1978 recorded that a high level of damage was observed on 19 September 1978. This block was then plucked for the first time over the following three days (19-21 September) and two endosulfan sprays applied on 22 September and 4 October 1978. By 23 October the block was back into regular plucking and on 11 December the tea bushes were flushing well and had a good colour. The spray treatment in this block had been very effective.

DISCUSSION

Damage at Garaina to tea in plucking was very similar to that described for other *Helopeltis* species in tea growing countries of Asia and Africa (Lever 1949; Benjamin 1968) and the level was high compared to the number of insects involved — a usual feature of *Helopeltis* attack (Carter 1962). It is likely that the damage is caused by the insect injecting a toxic saliva into the plant before sucking the cell contents from the young tissue. This occurs when the insect feeds on other host plants (Smith 1978).

Although the factors responsible for the outbreak of *H. clavifer* in Garaina tea blocks were not clearly identified, it was probable that a combination of meteorological and biotic factors were involved.

The fertilizing regime apparently had no effect on the pest incidence and the association discussed by some authors may merely reflect the inability of the plant to put on new growth faster than it is damaged, rather than a greater susceptibility to pest attack (Carter 1962).

Most investigators of infestations on tea considered that humidity was a major determinant influencing *Helopeltis* distribution in the field (Lever 1949; Carter 1962). Conditions of dull, overcast and damp weather appeared to be conducive to *Helopeltis* outbreaks while infestations declined during windy weather, bright sunshine, drier periods or continual heavy rain. The initial outbreak of *H. clavifer* at Garaina was probably influenced by suitable weather conditions combined with removal of shade trees (less than twelve months previously) and the huge increase in available food supply when the blocks

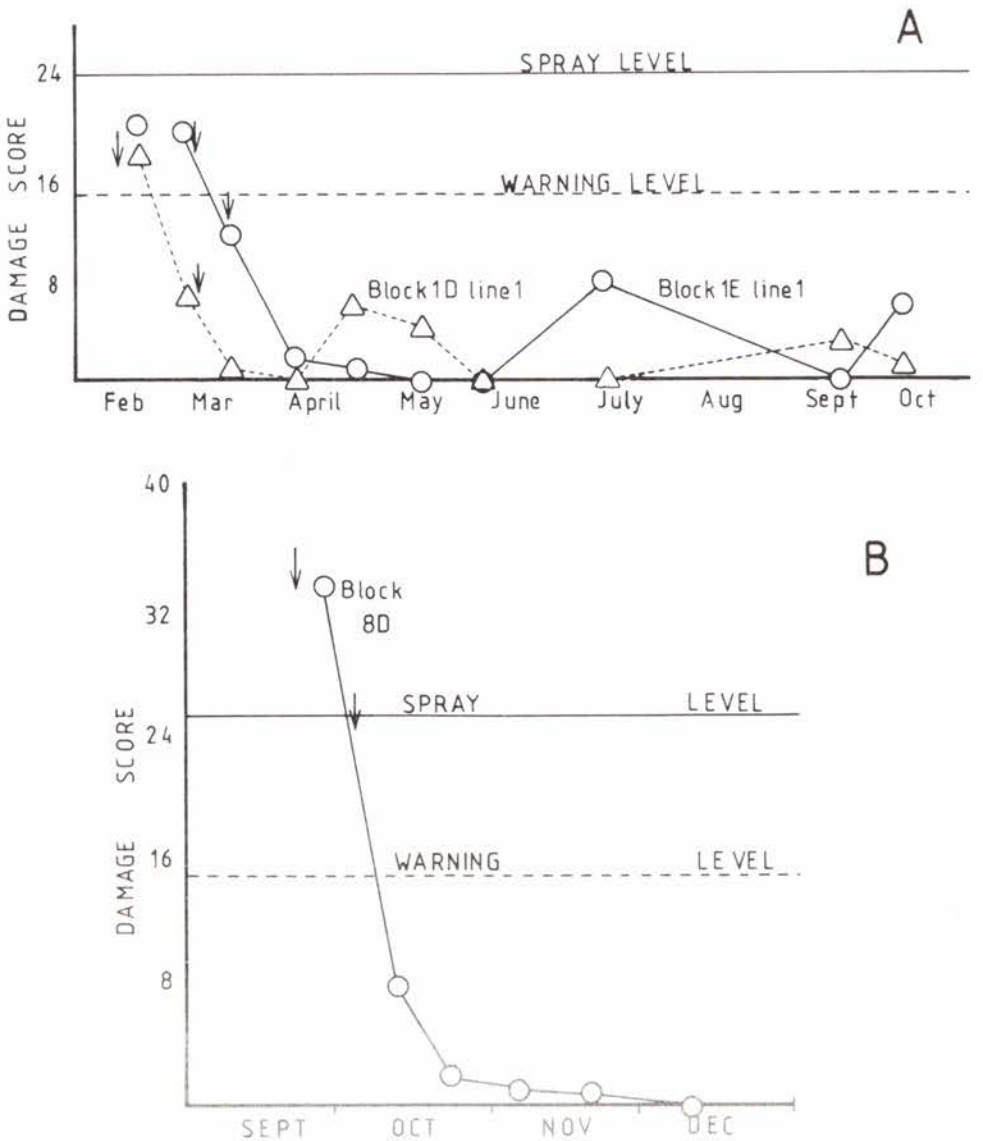

Figure 1.—Assessment counts of recent *H. clavifer* damage in tea blocks at Garaina (1978). Arrows represent an endosulfan spray application.
A. Scores recorded in one transect of Blocks 1D and 1E over a 9 month period.
B. Average scores over four transects in Block 8D

Table 2.—**Summary of *H. clavifer* damage counts made at Garaina from February to December 1978**

Sub-block	No. of rows counted	Total Length of row counted (m)	Approx. area covered (ha)	warning level*	spary level	Damage counts per sub-block on each date										
						22/2	8/3	23/3	10/4	28/4	18/5	5/6	21/6 22	12/7 13	21/9	10/10
7	5	1684	7	127-211	211	9	—	8	5	16	17	13	1	2	4	0
6	6	975	5	73-122	122	14	—	13	8	19	33	22	22	25	14	4
1F	4	800	4	60-100	100	13	19	5	6	5	4	1	1	6	9	7
1C	4	800	4	60-100	100	1	9	3	6	6	2	11	2	0	2	3
1E	4	800	4	60-100	100	27	28	17	8	1	1	8	1	11	30	18
1D	1	200	2	15-25	25	18	7	1	0	6	4	0	0	0	3	1
2H	1	200	2	15-25	25	0	1	0	0	0	2	0	0	1	6	2
1B	4	800	4	60-100	100	0	1	3	5	4	3	4	2	0	3	3
1A	2	275	2	21-35	35	13	10	1	0	1	0	0	2	0	2	1

						28/9	13/10	23/10	6/11	21/11	11/12
8C	4	800	4	60-100	100	—	—	—	46	156	50
8D	4	800	4	60-100	100	135	32	9	5	4	0

* In the text the warning level and spray level were specified for a row length of 200 m. In this table they have been adjusted for different total lengths of row counted.

were converted to plucking condition.

Good control of damaging *H. clavifer* populations was achieved using endosulfan applied through a motorised knapsack mistblower and the timing of sprays could be accurately determined through regular damage surveys. These surveys could also be used to determine the efficacy of chemical control methods. If conducted on a regular (e.g. weekly) basis, pest populations could be monitored and accurate forecasting of damage to tea and planning of control methods to reduce the damage level could be made.

By a slight modification of the recording technique reported here a direct calculation of the percentage infestation of tea bushes could be made. At Garaina this would involve recording one positive score for fresh damage noticed on one side of the transect walk and a score of two if damage occurred on both sides. Then, as before, one pace should be taken before further scoring could take place. Using this method 400 tea bushes would be inspected along the 200 m transect and a score of about 400 would result if all the tea bushes were infested. In this case the damage score divided by four would indicate the approximate percentage infestation of bushes along that transect.

It is felt that this method, with suitable modifications, could be used as a rapid survey technique for monitoring insect damage in tea blocks and, perhaps, in other crops in this or other countries.*

* The authors have recently noted a paper by Rattan working in Malawi who also deals with the possibility of using scouting methods for *Helopeltis:* Rattan, P.S. (1982). A preliminary report on experiments for the control of *Helopeltis shoutedeni* (Mosquito bug). *Quarterly Newsletter of the Tea Research Foundation of Central Africa* No. 65: 15-21.

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