The Behaviour and Population Dynamics of Pantorhytes Weevil

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How far can a Pantorhytes *weevil walk? Does it have any sense of direction? Does it prefer sun or shade? Dr Errol Hassan is studying the population dynamics of the* Pantorhytes *weevil in the Northern District. In other words, he is examining the factors which cause an increase or decrease in the cacao weevil population in a cocoa block. One question he doesn't have to answer is "How far can a weevil fly?" Fortunately it can't fly, so its rate of migration is fairly slow, when compared with flying insects.*

These studies are not just of theoretical interest. They have a definite practical value. Finding out what conditions cause a reduction in Pantorhytes *population is surely the first step to the desired target of reducing the population below an economic level.*

THE population dynamics work is mainly centred in 9 blocks of cocoa—2 under rubber, 2 under Leucaena, 1 under coconuts, 2 under primary bush and 2 without shade.

1. POPULATION MOVEMENT

In the block of 300 trees under coconuts (approximately one acre) a detailed study is being made of the population increase and movement. Each month the entomology assistants hand-pick every adult weevil they can find on the 300 trees. This has been going on for 31 months, and each month all the new adults found have been marked with a different coloured paint. In subsequent collections therefore, they can be recognized. All the unpainted ones are examined to see if they are male or female, so that statistics on the proportion of males to females can be determined. The weevils are not then killed; they are returned to the trees (not necessarily the same tree, but any one in the "test area").

The paint mark is only a pin point of a certain colour in a certain position on the body of the weevil.

Thirty trees of the 300 are also studied for larval channels. These also are marked with paint of a distinctive colour (the bark of the tree is painted, not the actual larvae). So the active larval channels are known and new ones noted when they appear.

An examination is also made of one line of cocoa trees outside the test area, each tree in the line being progressively further and further away from the test area. A careful note is made of every marked weevil that is found on these trees, and afterwards it is replaced on the same tree so that its progress away from the test area can be traced. This study has shown that, for their size, the weevils can move fairly fast. Of the 290 weevils collected outside the sampling site, 87 had moved a distance of over 100 yards in 9 months, while a few weevils had moved over 300 yards. The factors which control movement are still not understood, although it is clear that a continuous cocoa canopy aids the movement of weevils, because they can walk from one tree to the next without coming down to the ground.

In the previous issue of *Harvest* (Second Quarter, 1971) it was recommended that a vegetative barrier of *Pueraria* should be grown around each cocoa block. This will not completely keep out the weevils, of course, because they can still walk along a path through the *Pueraria,* or be carried in on the back of a plantation worker. But it does materially reduce the migration into a cocoa area.

2. POPULATION AND SHADE

The course of an infestation varies with differing conditions of shade. Some blocks have no shade, some have light or heavy shade from primary bush, Leucaena, coconuts and rubber.

The heaviest infestations of *Pantorhytes* occur where there is no shade; conversely, the weevil population builds up only slowly where

Plate I.—The entomology team working on the population movements study. On the right Dr Hassan examines a new adult to determine and record its sex. The weevil is then passed to the assistant on the left for its distinguishing paint mark. The paint tins in the foreground indicate that it is sometimes necessary to touch-up an old paint mark. The weevils are then placed in the wire cage and later returned to the trees in the test area

the shade is heavy. For cocoa growing under rubber and coconuts, it appears that the population will stabilize at a level that does not result in economic damage to the trees.

3. MICROCLIMATE STUDIES

"Microclimate" means "climate on a very small scale". As you walk through a cocoa block the temperature will vary as you move from sun to shade or to a hollow with no breeze. For a weevil the changes are on a smaller scale still. It is hotter on a leaf exposed to the sun than in the shade. The humidity can vary with sun and wind over a distance of a few inches. So the weevil prefers some places to others on the tree for living and for laying eggs, and a study of their preferences will assist in making control measures more effective.

In collaboration with the Physics Department of the University of Papua and New Guinea, entomologists have set up instruments for a detailed study of the microclimate in a cocoa block. Electronic instruments record the temperature and humidity in the jorquette (main fork of the trunk), the temperature of the leaf surface and of the bark surface, the temperature under the surface of the bark and actually inside the larval channel. In addition, there are instruments to measure wind velocity and energy from the sun.

For 2 months all these instruments were on an unshaded block. Now they have been moved to a block with primary bush shade.

From the microclimate study will come the data needed to establish what are the optimal conditions for the growth of the weevil. These

Plate II.—Fine wire probes are inserted under the bark and into a larval channel to measure the temperature and humidity

conditions will then be reproduced in the laboratory for further study of the behaviour of the weevil.

4. STUDIES WITH RADIOACTIVE ISOTOPES

Radioactive isotopes provide a very useful tool for tracing the movement of weevils. The electrons emitted by the isotope can be detected by a Geiger-Muller counter. The weevil can be made "detectable" by painting a radioactive varnish on its back, or by giving it food containing a radioactive ingredient.

This technique can assist with all three studies mentioned so far—population movement, shade and microclimate effects. Last year the entomologists, again in collaboration with the University of Papua and New Guinea, painted radioactive varnish on the backs of weevils then released them and traced their movement.

It is now planned to extend the work further by feeding the adult weevils with food containing the radioactive isotope Phosphorus 32. The "labelled" phosphorus will become part of the body of the weevil and some of it will be carried over into the eggs. Some experimental work will be needed first to establish the dosage of the isotope to be used in the work. With too little, the isotope will not be passed on into the eggs to enable them to be picked up with a Geiger-Muller counter; with too much isotope, of course, the weevils will die.

It is known that, in the field, only a fraction of the eggs and larvae grow into adult weevils; a high proportion of them die before reaching sexual maturity. It is hoped that the use of Phosphorus 32 will show just how high the death rate is, and will give more evidence on the factors that are causing the death of the weevils at all stages of development.

This method also has great possibilities in showing movements of the weevils on a small scale (from one position to another on the same tree). In conjunction with the microclimate study, it should reveal a great deal of useful information on the conditions for growth or death of the *Pantorhytes* weevil.