FINAL REPORT
OF
RESEARCH PROJECT

No. Ent. II (443)

P1-86/6-ICI-H10/0311, 1220

ELECTRONIC DEVICES FOR DETECTION AND CONTROL OF INSECT TISSUE BORERS OF PLANTATION CROPS

JANUARY, 1986 TO MARCH, 1989

ICAR

Centranl Plantation Crops Research Institute

REGIONAL STATION, KAYANGULAM

KRISHNAPURAM - 690 533

KERALA, INDIA

DECEMBER, 1989.

FINAL REPORT

1. Institute Code No. : Ent.II (443)
2. I.C.A.R. Code No. : P1-86/6-ICI-HIO/0311, 1220.
3. Name and Address of Research Institute/Centre : Central Plantation Crops Research Institute, Regional Station, Kayamgulam, Krishnapuram -690 533 Kerala State.
4. Project Title : Electronic devices for detection and control of insect tissue borers of Plantation Crops.
5. Name and Designation of Project Leader : C.P.Ramachandran Sr.Research Assistant.
6. Name (s) and designation (s) of Project Associates/Collaborators including Project Leader and work done.

Sl.No.	Name	Designation	Period		Project Leader/ Associate/ Collaborator
1.	C.P.Ramachandran	SRA	1986-1988		Project Leader
2.	B.Somanathan Nair	Asst.Prof.	"	"	Collaborator
3.	N.Kumudini		"	"	"
4.					

7. Location of Research Project with complete Address. : C.P.C.R.I.,Regional Station, Kayamgulam, Krishnapuram -690 533 Kerala State.
8. Date of start : January, 1986.
9. Date of termination : March, 1989.

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a.

a). Objectives :

To design and fabricate a less costly electronic device to detect Red Palm Weevil infestation at an early stage itself based on amplification and isolation of feeding sound of grubs within the tissues of the coconut palm.

2. Developing of equipments to detect other tissue borers of Plantation Crops.

B). Practical utility:

Red Palm Weevil Rhynchophorus ferrugineus F. is the most dangerous pest of the coconut palm. Cashew stem and root borer Placaederus ferrugineus is another serious pest of cashew. Being internal tissue feeders the presence of the pests is detected only at a very late stage, when the plant has succumbed to pest infestation. At present contact insecticides are used to treat the infested palms by administering the insecticide suspension through a funnel inserted in to the topmost exit hole of the weevil, after sealing of other holes. There is no method available to check the effectiveness of the treatment. In this context developing an electronic equipment to detect the activity of the pest based on the feeding sound is highly helpful in detecting the pest infestation before the external symptoms are visible and also to evaluate the efficacy of the treatment. The equipment can also be used for studying the feeding behaviour of the pest.

Technical Programme

a) 1. Developing various electronic circuits for amplification and isolation of feeding sounds of Red Palm Weevil grubs;

2. Testing and modification of circuits to suit various types of microphones and choosing the least expensive microphones

3. Testing the efficacy of the circuit in detecting feeding sound in laboratory and field and working out modifications of circuit.

b). Observations taken

Various types of circuits having different capabilities using various types preamplifiers, Amplifiers, isolators etc.

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were tested to avoid feed back disturbances. Filters of various band widths ranging from 50 cycles to 300 cycles at the lower band and 400 to 700 cycles at the upper band were tested. Different types of microphones were tested and performance evaluated . Various circuits were also tested in the laboratory under simulated conditions and in the field for evaluating their performance and modifications carried out based on the tests.

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Summary of results:

Various preamplifiers using transistors and IC's and amplifier circuits were developed. Since amplification beyond certain levels caused feed back disturbance opteisolators were used to separate power amplifier unit from preamplifier filter circuit. A single filter was used to cut off signals having frequencies below 0.1 hz and above 0.7 hz. Use of ordinary dynamic microphone causes some amount of disturbance. Vibration pick up supplied by M/S Philips was found to be quite suitable. A final prototype was fabricated having the circuits in three modules the preamplifier, Filter optoisolator and Power amplifier. Since the vibration pick up is costly a double filter was designed to suit the use of ordinary dynamic microphones.

Progress of work in relation to the time targeted for completion of work and reasons for non-achievement of targets, if any.

The work was started in 1986 with the intention of producing a less costly equipment using indegenous products. Earlier studies had indicated that the feeding sound of the weevil grubs has a peck frequency of 0.3 hz. Based on the above factors the work was taken up in separate aspects like microphone, preamplifier, Filter, isolation of power amplifier, power amplifier and speaker. In designing the equipment feed back disturbance matching of the circuit to microphone and power supply were other limiting factors which required particular attention.

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Preamplifier:

Various types of preamplifiers using transistors and IC's were designed. Also preamplifier circuits available in the market were also tested. It was observed that the feeble feeding sound of the grubs had to be amplified to a certain level after the filter and the energy level had to be brought to 1.4 volts. Further, the amplitude of the feeding sound generated by the grubs varies depending on the height of the palm and closeness of the grubs to the microphone. Therefore, arbitrarily the amplification of the preamplifier could not be fixed at a certain level. A much larger amplification was designed and appropriate gain control was provided to adjust the energy level after the filter depending on the amplitude of the feeding sound.

Filter

Initially various types of filtering techniques were tried with Ic 747 single, double and quadruple filters were tried. As the stages of filters increased it was found that the amplitude of the signal is reduced. Therefore, single filter was used for the development of the circuit. But on completion of the entire circuit it was found that use of single filter resulted in a much wider band width than anticipated. This caused interference of extraneous sounds when ordinary dynamic pick up was used. With vibration pick up the performance was found to be quite adequate. To use dynamic pick up a double filter was designed.

Isolation of power amplifier from filter and preamplifier:

The preamplifier andfilter with high amplification when connected to power amplifier gave a lot of feed back disturbance and the feeding sound signal was completely marked. To avoid feed back disturbance both the units were given separate power source. The preamplifier and filter operate on two 9 volts cells, while the power amplifier operates on 6 volts with normal 4 nos of 1.5 volts cells. Further, to achieve maximum isolation optical isolation was incorporated various optoisolators like 2TE, 2N28, 2N30, 2N33, photo darlington MOC 3020 etc were tested. 2N33 and MOC gave the best performance and were selected for the equipment. Optoisolation helped in preventing the direct passage of electrical energy

from the preamplifier/filter to power amplifier and thus the two sets were completely isolated and no direct electrical energy contact was possible.

Power amplifier :

Various power amplifiers using transistors, TBA810 and other IC's were tested. Initially the performance of TBA810 in the circuit was not satisfactory. Hence, ordinary and power tiansistors were tried. But the performance was not satisfactory and hence again TBA 810 was tried with appropriate matching resistors, which gave reasonably good performance and was selected as the power amplifier for the equipment.

Microphones

The work was started with throat microphone which is a vibration pick up. An electronic weevil sensor circuit was developed for this and was found to give good performance. On enquiry, it was found that the throat microphones are not indegenously produced. This has to be imported at a high cost and therefore another circuit was developed. In this circuit speakers with low impedence were tested and was found to be sensitive, provided the paper diapham touched the stem. But on using for a shorter period in field the paper diaphram got damaged. Modification of the speaker using films and fine quality leather to cover the speaker to protect the paper diaphram did not yield desired results. The contact of the diaphram with the surface of the coconut stem was important for its proper functioning.

Under the circumstances, efforts were made to procure vibration pick up. Vibration pick up available was found to be quite costly. The cheapest vibration pick up a sample of which was supplied by M/S Philips India costs about Rs.5,600/- Therefore, condensor and dynamic microphones were tried. Condensor microphones of various qualities were found to give a lot of disturbances. Dynamic microphone of low impedence was found to give less disturbance but was not matching to the circuit developed. So, modifications were tested on the circuit and provision of a (gating) gated switch was found to be an adequate measure for matching the dynamic microphone with the circuit developed.

Prototype:

Based on the above data two prototype models were prepared as per the block design given below.

Microphone preamplifier gated switch single filter optocoupler poweramplifier speaker.

This circuit was found to be quite adequate for a vibration pick up. In this model, the inteference due to other sounds is minimum with vibration pick up. But with ordinary dynamic mycrophone extraneous noises were also picked up.

In the second model the filter designed was a double filter effecting sharp cutting of the sound frequency at the lower and upper bands, so that other extraneous sounds were delineated to a maximum extent.

The equipments were tested in the laboratory and to a limited extent in the field. Field testing indicated that the equipment could detect feeding sound of grubs even if they are present in fewer numbers and 3 to 5 m away from the microphone. The feeding of Rhinoceros beetle, another pest of coconut, was also detected as the feeding frequency of the beetle falls within the band width of the equipment and similar to thefeedung sound of red palm.weevil grub.

Large scale field evaluation on the efficacy of the equipment to detect the weevil infestation at an early stage and to evaluate its efficacy in field operation has to be taken up. In this connection, the Department of Agriculture, Kerala State was contacted and after giving adequate training to the Departmental Staff the prototypes will be given to them for field testing, modification, if any, based on the feed back information from field testing can be carried out and then only the model can be released for use by public.

Some preliminary studies on the feeding sound of cashew stem bores was carried out. The feeding sound was found to be inaudiable, but the snapping of filare during feeding was audiable. But the sound of feeding was of low amplitude as compared to the feeding sound of Red Palm weevil grubs. Moreover, fibrous tissues of both the plants are different.

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Further work could not be carried out as research on cashew was shifted to NRCC and the project was closed.

From observations made on feeding sound of cashew stem borer and monitoring the sound through weevil sensor it is suggested that the following lines of work may yield results to develop cashew stem borer sensor.

1. The sensitivity of the equipment should be much more (nearly double) than that of the weevil sensor.

2. A vibration pick up may be more suitable than the dynamic microphone.

3. The band width of the filter should be sharp and narrow to pass the "tick" sound due to the breaking of fibre.

4. A different type of equipment to monitor reflected light from a sensitive vibrating diaphram perceiving the feeding sound. The modulations of reflected light and standerdisation of the modulations due to feeding sound may be more sensitive. This involves fiber optic techniques.

Papers Published:

Paper being prepared.

Literature cited:

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15. Details(nos. etc.) of Field/Laboratory Note Book and their final location.

Primary Project file	One
Sub-project file	Nil
Experimental log book	One
Laboratory note book	Nil
Field note book	Nil

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