Bibliografía

1. ABDEL–RAHMAN, M. Responses of field corn and sweet corn to treatments with several growth biostimulants. Proceed. Pl. Growth Reg. Work Group 5th. Annual Meet. (1978). Longmont, Colorado. **In**: Plant Growth Regulator Abstracts 5:(1 744). 1979.

2. BOON, W. R. Los aspectos químicos y modo de acción de los herbicidas dipiridilos diquat y paraquat: Servicio de Información "Plant Protection" ICI. México. 1971.

3. LANGHAM, D. G. Genetics of sesame "Open Sesame" and mottled leaf Instituto Experimental Agrícola Zootécnica Caracas, Venezuela. 1943.

4. MORGAN, P. W. Ethylene as a plant hormone. Conferencia 2a. Reunión sobre Reguladores del Desarrollo de Plantas e Insectos (mimeo. no publ.) mayo 29-30 (1980). Monterrey, México. 1980.

5. MORGAN, P. W. y H. W. GAUMAN. Effects of ethylene on auxin transport. Plant Physiology 41:45-52. 1966.

6. MONTEDISON. S. Ergostim, bioestimulante para cultivos agrícolas (Trad. italiano). Informazione Tecniche Montedison. Sin fecha.

7. MUTTON, L. L. Environment effects on the ripening response of tomatoes to ethephon. Abst. 1738 Agricultural Research Centre. Yanco (Australia). **In**: Plant Growth Regulator Abstracts 6:(241). 1980.

8. ONKAR, S. y O. S. SINGH. Response of cotton varieties to exogenous applications of etherel. Cotton Development 7:15-17 (India). **In**: Plant Growth Regulator Abstracts 5:(1 155). 1977.

9. OPLINGER, E. S., ANDERSON, I. R. y JOHNSON, R. R. Effect of seed on foliar applications of Ergostim on soybean and corn. Proceeding Plant Growth Regional Work Group. 5th. Annual Meet. (1978) Longmont, Colorado. 1979.

10. ROBLES, S. R. Producción de Oleaginosas y Textiles. Limusa. México. 1980.

11. SANDERSON, J. F. Preharvest desication of oilseed crops. Outlook Agriculture 9:121-125. 1976.

Investigations into the control of the Kola stem borer *Phosphorus virescens* Oliver (Cerambycidae: coleoptera) in Western Nigeria.

Sumario. Los estudios de campo y laboratorio con inyectores hechos con latas de aceite como aplicadores de insecticida. mostraron que el barrenador del tallo de la Kola (*Phosphorus* sp.) puede ser controlado con éxito mediante la aplicación de Gammalin 20 E.C. (20% BHC Gamma), 0.25% i.a., a los hoyos barrenados por los insectos.

Theobroma cacao, L. *Cola acuminata* Vent. Scotch & Endl. and *C. nitida* Vent, Scotch & Endl., all Sterculiaceae, are cash crops that have branches big enough to harbour stem borers of one of the major pests of tree crops. The borers so far identified include *Tragocephala nobilis, Tragocephala castnia* mainly on cocoa, *Phosphorus virescens, Phosphorus gabanator* and *Phosphorus virescens* var, *jansoni* mainly on kola. *Phosphorus* sp. which is the main species discussed in this work occurs throughout the kola producing regions of Nigeria. The insect attacks all ages of kola trees. The effect on young trees is particularly devastating, resulting in severe stunting, malformation and often death of the plants. This makes the establishment of new kola groves very difficult (4).

Cultural control methods such as poking of the insects in the tunnel with long wires, cutting off and either removal or burning of the cut stems as well as squashing and killing adult insects have been advocated (3). Insecticidal control has also been tried. Squire and Iwenjora (3) sprayed whole plants with Rogor 40 and obtained about 54% mortality of the larvae when infected branches were later dissected. In another laboratory trial at Umudike, they found that 113.40 gm of Sevin in 27.30 litres of water applied as a drenching spray seemed promising in controlling the pest. They suggested that this insecticide was worth further field trials. Ojo (1) reported less than 50% larval mortality due to the application of each of the insecticides: Lannate 20 E. C., Gammalin 20 E. C. and Nuvacron 50 E. C. when sprayed to drench infected trees at Kate in Oyo State, using pneumatic knapsack sprayers.

In this experiment, control measures using special insecticide applicators were investigated on newly and long established kola trees threatened by the pests.

Materials and Methods

An insecticide Gammalin 20 E. C. (20% Gamma BHC) which had long been in use by farmers, mostly on cocoa, was used in the test, compared with Sevin

(Sevin 85) W. P., and suggested for further trials by Squire and Iwenjora (3). Disposable syringe and needles as well as oil can injectors (Plate 1) were used as spray applicators for laboratory and field experiments carried out from 1979 to 1980.

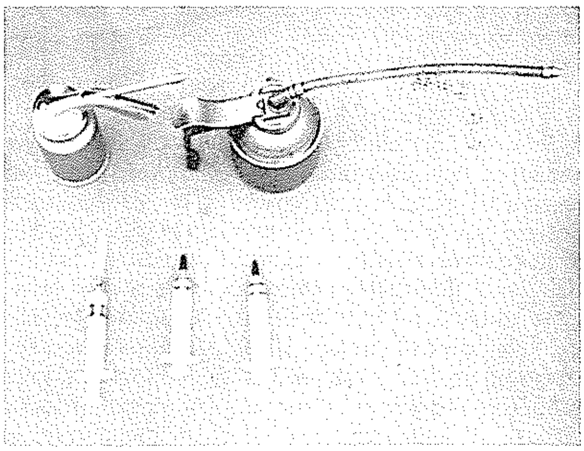

Fig. 1. Oil can injector and syringe and needle.

Larvae extracted from kola branches were placed in petri-dishes containing filter papers impregnated with 0.25% a.i. of the insecticides. Mortality was recorded after 24 hours. The persistence of the insecticide was tested by observing larval mortality on filter papers which had been impregnated with the insecticide and used immediately or dried for 5 days before use. Kola branches with larval infestation were cut from the field, brought to the laboratory and insecticide applied into the uppermost hole on the branch until there was a run off in the basal holes. The branches were sliced open after 5 days to record larval mortality as it occured in treated and untreated branches.

Field Test

A kola plot at Ifo Pilot Project and another at Sagamu, both in Ogun State were used during the two years experimentation. With the aid of oil can injectors, syringe and needles (Figures 2 and 3) insecticide formulations were injected into the infested branches. Aluminium ladders were used to gain access to infested branches on tall trees. Larval mortality was assessed by cutting and opening kola branches at 5 days after application of the insecticides.

Results

Table 1 shows that Gammalin 20 caused more mortality of the larvae placed on petridishes

Fig. 2. Applying insecticide to kola stem using an oil can injector.

Fig. 3. Applying insecticide to a kola stem using syringe and needle.

Table 1. Larval mortality on insecticide impregnated filter paper.

Insecticide	No. treated	No. dead after 24 hrs	% Mortality
Gammalin 20 E.C. (0.25%)	8	8	100
Sevin 85 W.P. (0.25%)	8	5	63.5
Control	8	0	0 %

Table 2. Insect mortality in kola branches treated under laboratory condition.

Insecticide	No. treated	No. dead after 5 days	% Mortality
Gammalin 20 E.C (0.25%)	20	20	100
Sevin 85 W.P. (0.25%)	21	16	76.6
Control	18	1	8.

Total of three occassions.

impregnated with insecticide at various occasions. The fumigant action of Gammalin 20 seemed to be very efficient as larvae writhed vigorously before dying. Larvae were observed to die within 24 hours when placed on filter papers even after 5 days of impregnation with Gammalin 20 whereas those larvae placed on petridishes treated with Sevin writhed and many of them did not finally die after 24 hours. Those on control (untreated) filter papers did not die at all. On every occassion, Gammalin 20 recorded a mean of 100% insect mortality while Sevin 85 recorded 45.5%.

When the insecticides were applied into the branches, under laboratory conditions, the efficiency was more in favour of Gammalin 20 than of Sevin W. P. (Table 2). The mean percent mortality due to Gammalin 20 in this experiment was also 100%while Sevin W. P. recorded a mean mortality of 76%.

Field application using oil can injector on younger trees showed that Gammalin 20 was more effective than Sevin W. P. in insect mortality. There was no mortality of insects on control unsprayed branches (Table 3). The foliage on plants treated with insecticides at both Sagamu and Ifo were observed to rejuvenate later.

Discussion

When branches were cut, only one insect per branch always existed and it bored the holes down the branch before pupating and later emerging. It was observed that insects died as soon as they probably came in contact with Gammalin 20. Treatment with the same concentrations of Sevin 85 W. P. did not cause as much death of the insects as Gammalin 20.

There were more chances of blocking the syringe and oil can injector with Sevin W. P. than with Gammalin 20 E. C.

Farmers have been used to spraying Gammalin 20 on cocoa against attendant pests for the past 20 years and residual tests on cocoa have shown that it is relatively safe to handle. Farmers would therefore need no further training in the preparation and handling of Gammalin 20 E. C. The contact, fumigant and stomach activities of Gammalin 20 E. C. probably increased its activity over Sevin W. P. most especially with the method of application, i.e. using oil can injector.

The applicator used in the field could be obtained locally and at various low prices. Squire and Iwenjora (3) had commented that folial spray application is difficult during the rainy seasons. If control is directed against the larval stages using the oil can injector, damage would be stopped as opposed to being minimised by applying folial sprays against the adult beetles (2; 4). The oil can injector method is precise

Table 3. Larval insect mortality in kola branches treated in the field using oil can injector.

Insecticide	No. treated	No. dead after 5 days	% Mortality
Gammalin 20 E.C. (0.25%)	10	9	100
Sevin 85 W.P. (0.25%)	10	6	80
Control	8	0	0

Total of two occassions.

and would reduce the amount of insecticide used when compared with other methods of application including folial spray, dusting and painting. The method is also one that can be applied in any season (rainy or dry) to obtain maximum efficiency as the insecticide goes directly into the tunnel. It is however limited to heights within reach but can be aided by the use of ladders. Since the devastating effect of the borer is more on younger plants than the very old ones, control at the stage of establishment is needed and can be carried out effectively using the methods described above.

Summary

Laboratory and field studies with oil can injectors as insecticide applicator have shown that kola stem borers *Phosphorus* sp. can be successfully controlled by the application of 0.25% a.i. Gammalin 20 E.C. (20% Gamma BHC) to the holes bored by the insects.

Acknowledgements

I am grateful to the Director for permission to publish this paper and the staff of Entomology Division for assistance in carrying out the operations.

July 14, 1981.

AKINWALE A. OJO*

* Cocoa Research Institute P. M. B. 5244 Ibadan, Nigeria.

References

1. OJO, AKINWALE A. Insecticide control of kola stem borers *Phosphorus verescens* Olivier. Ceranbycidae Crin Annual Report 1977/78.

2. PUJOL, R. Characoma nuisibles aux noixde kola. *Cafe cacao The* (VI) 2:105-114. 1962.

3. SQUIRE, F. A. and IWENJORA, F. O. On the kola tree borer in Nigeria *Phosphorus virescens* (Olivier) Lamidae. Federal Department Agricultural Research Ib. Memo 49:17 p. 1963.

4. GERARD, B. M. Stem borers *Phosphorus virescens* Crin Annuary Report 1967 – 68, 28. 1968

Nitrate reduction in some tropical grasses in their natural environment.

Sumario. Diecisiete especies de pastos y otras nueve monocotiledóneas que crecían en su medio ambiente natural fueron sometidas a ensayo respecto a la actividad de nitrato-reductasa utilizando dos métodos en vivo. El método de infiltración al vacío dio valores más elevados en 19 especies que el método Jaworski. El significado y posibles aplicaciones de las técnicas de la prueba nitrato-reductasa para trabajos en pastizales son presentados en la presente comunicación.

Reduction of nitrate to nitrite by nitrate reductase is the rate limiting step in the overall reduction of nitrate to ammonia in plants (3). Some workers have made correlations between nitrate reductase activity and grain yield potential of a grass crop (1) and total dry weight accumulation in ryegrass. Hageman *et al* (6) suggested that estimation of nitrate reductase in seedlings was a useful approach in the screening of species in breeding programmes where protein yield was the objective. A similar approach (using a biochemical tool) in the assessment of nitrogen requirements is just as valid in the management of other ecological systems especially in grassland ecosystems. The object of this study was to develop a method for assessing the plant nitrate status by NRA assay. The NRA obtained in two *in vivo* assay methods were compared in seventeen grass species and nine other monocotyledons growing in their natural environments. The methods were chosen for their simplicity, relative inexpensiveness and suitability for assaying numerous samples.

Materials and Methods

Seventeen grass species and nine non-grass monocotyledons growing in their natural environment on the University of Ife Campus, Ile-Ife, Nigeria were used in this study. Leaves were harvested and chopped into large pieces about 1.5 cm squared and 0.5 g of tissue was used for each assay. NRA was determined by methods based on the *in vivo* assays of Jaworski (8) using propanol and Klepper *et al.* (10) using vacuum infiltration. Modifications were made to standardize some of the common basis of both methods e. g. weight of tissue 0.5 g; incubating medium 5.0 ml in 25 ml screw cap bottles; concentration of reagents (0.1 m phosphate buffer pH 7.5, 0.05 M KNO_3). For the vacuum infiltration technique, propanol (5 %) was excluded. Samples were vacuum infiltrated twice for 5-10 minutes each time by placing the bottles in a vacuum dessiccator and connecting it to a vacuum line. Samples were incubated

Abbreviation: NRA Nitrate reductase activity