investigation to suggest that appreciable amounts of a wet or dry organomercury seed dressing would normally be removed by washing dressed grain.

A subsidiary investigation showed that variances between 160 g samples from a seed treatment are significantly greater, but of the same order, as variances between 20-g sub-samples from the same 160-g sample. The standard errors of the means for eight 20-g sub-samples, quoted in Table 1 as an indication of the order of accuracy attained, are therefore slight under-estimations of the true errors for testing significance.

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ENTOMOLOGY

Insecticide Resistance in the Cocoa Capsid, *Distantiella theobroma* (Dist.)

THE first large-scale trials with γ-BHC against the cocoa capsids *Sahlbergella singularis* Hagl. and *Distantiella theobroma* (Dist.) in Ghana were made in 1954[1]. The level of capsid control achieved, and the resultant crop yields of cocoa, were so outstanding that the use of this insecticide in recent years has been country-wide. Aldrin and endrin have also been used successfully and the control reported by Armstrong[2] as having been obtained with amounts of insecticide as low as ½ oz. active ingredient (a.i.) per acre is ample evidence that capsid strains, tolerant or resistant to chlorinated hydrocarbon insecticides, were unknown in Ghana in 1961. Now, however, capsids resistant to γ-BHC have been found on a plot of Amelonado cocoa at Pankese Cocoa Station, near Nkawkaw.

The plot was planted in 1956 and has since received four spray applications of γ-BHC each year, the initial spray of 4 oz. a.i. and all subsequent sprays of 1–2 oz. a.i. per acre applied in 5 gallons of water by portable, motorized mistblowers. In August 1961 it became apparent that the capsid population was building up on this plot and that the cocoa was being seriously damaged. Spraying frequency was therefore increased to once every two weeks and during December the trees were being treated individually at a rate equivalent to more than 4 oz. actual γ-BHC per acre per fortnight. However, the capsids were still not being controlled and the situation was therefore brought to the notice of the West African Cocoa Research Institute.

Using the laboratory bioassay method outlined by Armstrong[2], collections of capsids from Pankese have been compared with capsids from the Tafo area. These tests have established that the LD_{50} of γ-BHC is about 40 times higher for capsids from Pankese than it is for Tafo capsids, the decreased slope of the log. dose-probit line to 1·3 (Pankese) from 2·6 (Tafo) clearly indicating that the former have developed resistance, and not just tolerance, to γ-BHC.

A further test using aldrin, but limited in replication by the number of available capsids, has strongly indicated that the Pankese capsids are also resistant to this insecticide.

The distribution of γ-BHC-resistant capsids is thought not to be very widespread in Ghana at present, for while some cocoa at Pankese has been sprayed four times a year with γ-BHC since 1954, one of the plots in the original large-scale spraying trial being situated at this cocoa station, the other 25 sites, which also featured in the spraying trials of 1954, and which are scattered throughout the country, have similar histories of regular γ-BHC spray applications and, as yet, show no evidence of resistant strains.

The capsids at Pankese and those from Tafo, with which they were compared, were all *D. theobroma*, and it is noteworthy that this species is now the predominant cocoa capsid in Ghana, *S. singularis* being very uncommon. By contrast, in 1926, Cotterell stated that *S. singularis* was the most important cocoa pest and the population figures, given in the *Annual Reports of the West African Cocoa Research Institute*[3] and by Nicol[4], clearly show that it was once more numerous than *D. theobroma*.

S. singularis is considerably more active than *D. theobroma*, both as nymphs and adults, moving and feeding over a much larger area of the food plant[5]. The greater activity could lead to a relatively bigger pick-up of insecticide by *S. singularis* and render it more vulnerable than *D. theobroma* to toxic residues on sprayed trees. This could explain why Donald[6], using DDT, obtained 100 per cent control of *S. singularis* but not of *D. theobroma* in a trial in 1948 at Akwadum and also the recent, almost total disappearance of *S. singularis* from Ghana following the wide use of anti-capsid sprays. Thus, the sequence from about 1956 appears to be the replacement of *S. singularis* by a species less susceptible to insecticides followed by the development of insecticide resistance within that less susceptible species.

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CYTOLOGY

Karotype and Revised Chromosome Number of *Amphiuma*

A REVISED chromosome number of 28 has been established for the amphibian *Amphiuma means tridactylum* Cuvier, the congo eel, from studies of both somatic and

Fig. 1. Late prophase of mitosis in *Amphiuma* testis