

Thames Valley Cocoa Club

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**Population responses
of insects on cocoa
under no shade**

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- My talk will be restricted to a discussion of the influence of overhead shade removal on insects after the cocoa canopy has closed.
- Although dense shade limits cocoa yield, the greater biodiversity it provides helps control some insect pests and it secures a more stable microclimate (Johnson, 1962).
- Biodiversity and microclimate interact, but I chose the specific examples I use because they fit more strongly in one than the other of these factors.

Microclimate

- Beer *et al.* (1997) found that shade trees ameliorate adverse climatic conditions and nutritional imbalances in cocoa. Shade buffered high and low temperature extremes by as much as 5 °C and contributed up to 14 t/ha of litterfall annually.
- Examples of the effect of changes to microclimate:
 1. Mirids, which have been the most devastating insect pests of cocoa in West Africa for almost 100 years.
 2. Cocoa thrips (*Selenothrips rubrocinctus*), a sometimes serious pest of insolated cocoa in the West Indies and now found in most growing regions.

‘Mirid damage’ and dieback

- Cankers and various manifestations of dieback in cocoa result from pathogenic fungi, eg *Calonectria rigidiuscula*, invading mirid feeding lesions. Both partners are necessary for damage.
- Although total damage due to mirids is higher on unshaded than on shaded plots (Posnette, 1943) it occurs in a more diffuse form (Squire, 1947; Youdeowei, 1971), is less severe (Williams, 1953), and recovery is more likely.

‘Mirid damage’ and dieback

- Williams (1953) surveyed more than 1000 sites in Ghana and concluded that shade influenced both the incidence of attack and the severity of damage. ‘Stag-head’ is more prevalent in unshaded cacao, while ‘capsid pockets’ are typical of very dense shade.

Johnson (1962) observed that it was chemical control of mirids that made reduction in shade possible.



Microclimate effects on mirids

- Mirid numbers fall at the end of the dry season because the insects become unable to feed once trees suffer severe water stress so nymphal mortality increases (Cross, 1971).
- Conversely, when trees are weakened through drought, the fungal pathogen may escape from isolation and spread back from the site of invasion, with the subsequent death of the branch (Taylor, 1954).
- Any breaks in the canopy so produced are a focus for colonisation by immigrant adult mirids.

Microclimate and cocoa thrips

- Adult and immature thrips pierce leaves with their mandibles and suck up sap from the wounds. Drops of excrement also produce necrotic spots on leaves.
- Thrips feeding causes premature senescence and abscission of leaves. Attack on consecutive flushes can seriously weaken trees.
- Thrips populations peak in the dry season. In Ghana, Cotterell (1928) found that attacks were exacerbated by a combination of low humidity due to deforestation, absence of overhead shade, and water stress.

Loss of biodiversity

- This aspect of shade removal has attracted most comment, particularly predictions that pest outbreaks will occur more frequently as shade trees are thought to be reservoirs of generalist predators.
- In Brazil, many cocoa farmers accepted that argument and have resisted government policy by choosing to keep their heavy shade and forego the higher yields and profits on offer (Johns, 1999).
- Studies of shade removal on biodiversity demand large plots: 0.25 ha is probably the minimum plot size (Somarriba *et al.*, 2001). Few studies comply!

Loss of biodiversity: the ant mosaic

- Ants are the most numerous predators in tropical agroforestry systems (Philpott & Armbrecht, 2006).
- A dominant ant species is numerically superior where it occurs and excludes all other dominants.
- As well as being predators, all dominant ants protect homopteran insects from which they solicit sugar-rich honeydew.
- Because dominants exclude all other dominants including non-related conspecifics their territories form an uneasy three-dimensional mosaic.
- Some dominants need forest trees for nest sites so are excluded from unshaded cocoa with consequences for pests particularly Homopterans.

Loss of biodiversity: the ant mosaic

- Many of the dominants are carton-nesting *Crematogaster* spp. (eg *africana*, *clariventris*, *depressa*, *stadelmanni*) all of which prefer tending scale-insects other than the mealybug vectors of Cocoa Swollen Shoot Virus.
- On unshaded cocoa they are often displaced by twig and pod-nesting *Crematogaster* spp. (eg *striatula* and *castanea*) which prefer mealybugs the vectors of CSSV.
- Bigger (1981) found fewer ant species in unshaded mature Amelonado plots than in shaded ones, but more caterpillars, grasshoppers and mirids.
- Similarly, Campbell (1984) found higher numbers of 5 mealybug species vectors of CSSV and other homopteran pests in unshaded than in shaded Upper-Amazon plots.

Conclusions

- None of the examples I have presented are sufficient reason to inhibit moves toward growing cocoa unshaded.
- However, farmers should be aware that occasionally severe outbreaks of pests will occur and have a strategy at hand to deal with them.

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