FFS for tree crops

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Since 1997, Farmer Field Schools (FFS) have been developed in Indonesia for Integrated Pest Management (IPM) in five tree crops - cashew, cocoa, coffee, pepper and tea. Applying the FFS approach to IPM for perennial tree crops has required several adaptations, including changes in content and duration of the FFS, and in the methods employed in Agro-Ecosystem Analysis (AESA). This article is based on our experiences with the IPM Smallholder Estate Crop project (IPM-SEC project) and the SUCCESS Project to control Cocoa Podborer (CPB).

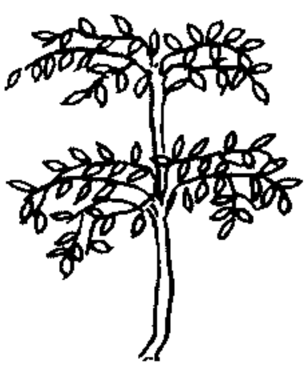
Adapting to perennial ecosystems

The five tree crops mentioned above are perennials. Tree age before complete renewal varies from crop to crop and even from farmer to farmer, but averages around 20 years. The rice ecosystem, where the FFS approach was developed, undergoes destruction and hence catastrophic change during harvest. But the perennial ecosystem remains fundamentally unaltered, particularly in the case of continuously harvested crops like cocoa, which produces fruit throughout the year and cashew, which has three flushes per year. Tea also grows leaves continuously throughout the year. Of these five perennial tree crops, only one - coffee - can be said to have a significant period during which no flowering and fruiting takes place. This means that any pests are presented with two conditions not present in an annual crop like rice or cotton: a continuous food supply and a dependable habitat.

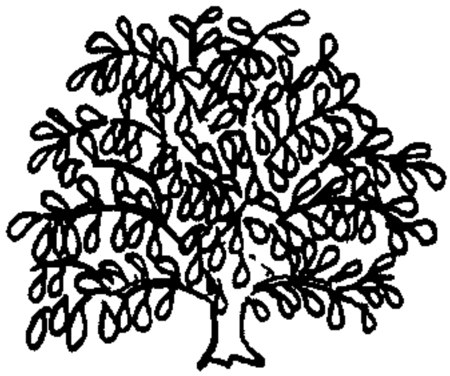
As a consequence, certain mechanical practices are not possible with perennials. One example is the practice of “ploughing down” after a clear harvest, which results in the drastic

Some IPM constraints and opportunities for various tree crops

IPM method	Conservation of predators and parasitoids	Augmentation of natural populations of predators and parasitoids	“Classical” Biocontrol (introduction of exotic predators and parasitoids to control introduced pests)	Mechanical/ Cultural methods for pest control	Use of pathogens for biological control
CASHEW	Excellent control of Lawana sp., Machaerota rostrata (both Flatid Homopterans) and Cricula trifenestrata by natural enemies; good control of Helopeltis by weaver ants and spiders and other natural enemies	Augmentation of Aphanomerus sp., an egg parasitoid of Machaerota rostrata, may be possible		Pruning and cutting back canopy so trees do not touch each other prevents expansion of Helopeltis	Trichoderma can control root rot; Synnematium can control Flatid pests; Beauvaria attacks Helopeltis.
COCOA	CPB has too few natural enemies; good potential for control of Helopeltis and Apogonia with weaver ants; encouraging black ants (Dolichoderus spp.) may reduce Helopeltis and CPB	Some possibility of control of CPB by release of Trichogramma spp., and Goryphus mesoxanthus, but no functioning insectaries		Continuous flowering and fruiting means there is no seasonal die-off of CPB. Pruning, sanitation, bagging pods, frequent harvesting and fertiliser diminish CPB	Trichoderma can control Phytophthora; Beauveria bassiana 725 can be effective against CPB; Beauvaria attacks Helopeltis.
COFFEE	Coffee Berry Borer (CBB) has few natural enemies. Zeuzera coffea, a branch borer, has parasitoids and some predators. Weaver ants may provide some protection against CBB, but there are as yet no experimental results on this.		Complete seasonal harvest prevents establishment of CBB parasitoid Cephalonomia stephanoderis, first introduced in 1989. Ample populations of Coccinelid Curinus, introduced in 1986 to control jumping lice in the lamtoro bean now limits green and white scale in coffee.	Simultaneous flowering and fruiting has not resulted in a CBB die-off; little is known about alternative hosts during the fallow period.	Beauvaria bassiana 615 can be effective against CBB
PEPPER	Lots of jumping spiders and robber flies; a parasitoid Spathius piperis can control the branch boring weevil Lophobaris; as aresult disease, not pests, is the main problem.	Use of green cover crop, Arachis pintoi, to provide refuge for beneficials	Within Indonesia, the parasitoid Spathius piperis may need to be introduced to certain islands like Bangka, where it has not been observed to occur.	Pruning of affected branches can help control the branch borer, Lophobaris piperis	Trichoderma can control Phytophthora
TEA	Loopers are parasitised by Tachinid and Ichneumonoid parasitoids, but there is not a very rich range of spiders feeding on Helopeltis.			Cutting out bushes infected by Ganoderma pseudoferreum, trenching around infected area and applying sulphur	Ganoderma can be controlled by Trichoderma; Beauveria attacks Helopeltis.



Coffee (two level)



Cashew (older tree)

Cacao (pruned to reduce CPB)

reduction of a pest, for example rice yellow stemborer in China or cotton pink bollworm, through destruction of its food supply and habitat.

Pest difficulty

The "natural" condition for perennial ecosystems is one in which the pest is always present in the cropping system. Some tree crop pests are difficult, others less serious. Each crop requires its own observation techniques, its own cultural/ mechanical practices, and has its own particular pests and diseases. The most difficult pests, such as Cocoa Podborer, spend all of their larval life inside the fruit to be harvested, invulnerable to natural enemies and pesticides while they are inside. Leaf eaters are a less serious problem (except on tea). There are two reasons to reassess the seriousness of tree crop pests. First, we need to know the true pest impact if we are to figure out mechanical or biological controls. Second, we need to overcome the tendency of pest protection bureaus to exaggerate the danger of minor pests, as this can distort the decisions resulting from weekly AESA.

Ecological IPM began with rice, whose pests all have a rich array of natural enemies, both aquatic and terrestrial. By the start of the FAO IPM Programme, a substantial body of research already existed on the role of natural enemies in the control of the chief rice pest, Brown Planthopper. Compared with rice, very little research on the ecosystems of perennial crops has been done in Indonesia. Tree crops also lack the aquatic element of the rice ecosystem, which provides many beneficial insects and spiders. More research is needed on the habits and biology of the most important pests and beneficials - but lack of research cannot prevent us from proceeding with IPM control methods that work.

AESA in high trees and vines

AESA includes observation of pests, natural enemies, neutrals such as detritivores, disease, and plant nutrition, which should all be taken into account when making a decision on pest management. In rice, this observation is carried out weekly in ten randomly selected spots (hills) throughout the field. It involves the entire rice plant from roots to the tip of the flag leaf. Each tree crop, however, requires its own approach to AESA and its own frequency of observation. Pepper and coffee usually undergo AESA once in two weeks, whereas cashew, cocoa, and tea require weekly observation.

Tree canopies are also much more difficult to observe than rice plants. Some cashew trees grow to more than ten meters high. Some coffee canopies are two-tiered. Ladders are required for AESA on cashew, high coffee, and pepper vines. This also entails some risk - during training, one facilitator trainee fell from a tree.

More complete canopy observation using a ladder should be carried out on one tree in every three, but this is just a rule of thumb. Budding branches in cashew, fruits in coffee and cocoa, and leaf condition must be observed, especially for disease. Roots require inspection for fungus or nematodes. In this way, AESA delivers more information about the ecosystem than any scouting method for simply counting pests.

Adjusting the FFS training season

In the SUCCESS Cocoa Podborer (CPB) project, the content of the FFS was changed radically in order to deal with a single pest. The FFS format was changed to emphasise knowledge of one major pest and the cultural methods that will best control it, instead of knowledge of the entire crop ecosystem through AESA. This adaptation involved shortening the FFS to just seven meetings, five of which were field-learning meetings. In terms of content, four cultural methods for control of CPB were emphasised: frequent harvesting; pruning to open the canopy; adequate use of fertiliser; and crop sanitation. These changes were in large part driven by donor desires to reach all Sulawesi Cocoa farmers with the new technologies.

In perennial agro-ecosystems, there are solid reasons for doing full season training for IPM: ecosystem changes can be followed throughout the crop season, including the outcomes of pest simulation experiments. However, a full season for coffee, including all cultural practices, would be a whole year long if all methods were done in season. This is far too long and costly to be practical. Other crops do not need such a long season. In the IPM-SEC project, a standard FFS length of six months was decided upon for bureaucratic and budgetary reasons, and this is adequate for all crops. Duration was set at 20 sessions for all FFS, regardless of the duration from flowering to harvest.

Assessing the trade-offs

Each crop has its own particular pests and diseases, and requires its own observation techniques and cultural/mechanical practices. Adjustments and changes in the FFS approach had to be made accordingly.

The FFS approach of involving farmers in participatory field learning activities remains a powerful one. In adapting the approach, however, a number of trade-offs are involved. In the case of the SUCCESS project, the adaptations meant exchanging open-ended field experimentation – the classic FFS approach – with teaching a few specific mechanical methods for pest control. The impact of training is still positive and effective, but other consequences of these tradeoffs need to be evaluated.

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A full version of this paper is available at www.eseap.cipotato.org/upward.