

13 Management of CWD

13.1 Main Points

- Regular monitoring of coffee fields is needed to detect infections early, before they become generalized.
- Where only a very few trees seem to be infected, they should be immediately uprooted and burned on the spot, together with their neighbouring trees, which may already have become infected but yet to show symptoms.
- Where infection is widely spread throughout the field, all the trees should be uprooted and burned.
- A minimum fallow period of 12 months is recommended to stand a chance of reducing residual soil infectivity before replanting coffee; in the meantime other crops can be grown instead of coffee.
- Wherever possible replanting should take place with resistant material. If this is not available, susceptible seedlings from a reputable source only should be used.
- For routine coffee plot management, weeding with sharp tools, such as machetes and slashers, should be avoided to reduce damage to coffee stems which increases the chance of infection entering the tree.
- Where sharp instruments have to be used, e.g. during stumping and pruning, frequent cleansing of the cutting blade should be carried out.
- Chemical control is difficult, but painting cut stem and branch ends with a copper oxychloride solution may help to reduce infection.
- Quarantine procedures in all countries need to be revised, and training should be given to try to stop coffee wood crossing national boundaries.

Based on the studies and experiences of this project, this chapter reviews currently available management methods that can be used to control the spread of this disease. It should be pointed out, however, that much more experimentation is required to further evaluate some of these methods; hence, they do not represent a technology package, but a collection of techniques that field practitioners are encouraged to try out and experiment with.

13.2 Cultural Practices Used in Managing CWD

When we use the term 'management' here, we really mean prevention, because there is no cure for coffee wilt disease (CWD); once symptoms are apparent on the tree, it will die and even if this takes a long time, it must be removed as soon as possible because it represents a continuing source of infection.

Phiri N. and Baker, P.S. (2009) *Coffee Wilt in Africa Final Technical Report*. CAB International.

13.2.1 Monitoring

Regular monitoring is required to detect any coffee bush showing even partial dieback symptoms on the aerial parts of the plant (Figures 13.1 and 13.2); all doubtful plants should be clearly marked.

The disease can be confirmed if the superficial bark is removed from parts of the stem and blue-black bands are found below the bark, which is a diagnostic of CWD (Figure 13.3).

Any knife used to examine the bark should immediately be sterilized; the infected plants should then be uprooted, cut into sections and burnt *in situ*. If the wood is dry, this can be done immediately; but if the wood is still green, then a few days may be needed to allow the wood to dry to facilitate burning.

Figure 13.1: Typical early symptoms of coffee wilt disease (CWD) - chlorotic, leaf curling and dieback on one side of a branch (arrows).



Figure 13.2: Typical coffee wilt disease (CWD) symptoms - dieback on one side of a branch (arrow).



Figure 13.3: Coffee wilt disease (CWD) - a characteristic brown or blue-black coloration is seen under the bark.



13.2.2 Uprooting and burning

Uprooting and burning was successfully used as part of the control campaign against CWD in the historical outbreaks dating back to the 1930s. It involves frequent inspection of the coffee farm in order to identify infected coffee bushes. Once identified, the infected coffee bushes are uprooted by digging out as much of the root system as possible and then burning them on the spot at the earliest opportunity – in the hole where the coffee bush was uprooted. However, immediate burning is often difficult because the wood is not dry enough and so does not burn easily. The best way to solve this problem is to cut the coffee materials into smaller pieces which promotes drying, and these pieces can then be heaped in the hole from where the infected coffee tree was uprooted. Dry firewood could also be used to facilitate the burning.

Despite clear guidance about burning *in situ*, there is a common practice by farmers to transport infected coffee stems to their homesteads for use as firewood, staking material for climbing beans or even as fencing material around coffee gardens. These practices help spread CWD further in the area. This poses a huge threat to the spread of CWD; therefore, limiting these practices will improve the management of CWD. If for any reason burning *in situ* is not possible, then the wood should be placed into sacks or thick plastic bags to limit any disease transmission.

In order to reduce further risk of inoculum in adjacent coffee trees, those coffee trees surrounding the infected coffee trees also need to be uprooted and burned. The research carried out suggests that trees up to 10m away should be uprooted (Chapter 11), but this could be too much for many farmers to accept, and it is possible that less draconian measures might suffice in some cases. However, if infection is at an early stage, perhaps only one or two trees infected on a farm, then it would be advisable to eradicate all trees in a 10m radius.

When CWD infection levels are high, i.e. when a majority of coffee trees are being infected in a coffee garden, it is advisable to uproot and burn all coffee trees in the farm, and replant with resistant or tolerant coffee germplasm if available. This may pose problems due to the loss of the little remaining source of income for the farmer. Educating the farmers about the advantages and disadvantages of uprooting and burning all coffee trees in heavily infected farms should help in this case.

13.2.3 Replanting

Despite uprooting and burning, remnants of the tree will remain in the ground and these will remain infective. It is not clear to what extent it is these remnants alone that retain the infection or whether it is the soil itself – if it is the latter, this implies the presence of chlamydospores (spores specifically adapted to survive away from the host), but their existence has not been verified for CWD. For practical purposes, it is assumed that inoculum can be eliminated by observing a fallow period of at least 6 months (Hakiza, personal communication) to 2 years (Wrigley, 1988) before replanting with a susceptible coffee seedling. At this stage, a more precise interval cannot be given, which in any case will depend on soil type and other environmental conditions. Further experimentation with a range of experimental conditions could substantially improve advice to farmers.

13.2.4 Use of disease-free planting materials

CWD is spread through planting materials, i.e. plants and seedlings, but there is no evidence that it is spread through seeds as well (Girma and Hindorf, 2001).

Seedlings, however, can easily transmit *Gibberella xylarioides*, especially through soil adhering to their roots and spores carried on their stems and branches. Seedlings from reliable sources, such as registered clonal propagators, may limit this risk. However, in many areas the reliable sources may be difficult to find, hence extreme caution is advisable.

Farmers and seedling producers should be trained in using potting soil from an area free of *G. xylarioides*, such as virgin land or an area without a history of coffee. Soil sterilization is another option for eliminating soil-borne inoculum, but this may be expensive and time consuming. Nevertheless, whatever the cost, soil solarization for commercial nurseries should be a standard practice, not only for CWD, but because of other soil-borne pests such as root-knot nematodes.

Resistant coffee-planting materials will in most places not be available, though they are likely to be available in Uganda from 2010 onwards.

13.2.5 Prevention of coffee tree wounding

CWD penetrates through wounds, so any agency causing wounds will aid the spread of the fungus. Kranz and Mogk (1973) noted that in Ethiopia most dying and dead trees had been wounded by a slasher (weeding implement, machete), and the surveys and observations carried out in the present project support this (Figure 13.4).

Therefore, a major way to limit infestation is to encourage the alternative ways to suppress weeds. The use of mulch, hand weeding near the main stem(s) and the use of herbicides are all possibilities, as is the development of cover crops. This is a major

Figure 13.4: Wounds (arrows), originating from slashing during weed control, at the base of a coffee stem.



area for future research, especially participatory research, to find acceptable and cost-effective ways to suppress weeds without the use of sharp blades. A weed-wiping technique, using a wick impregnated with a systemic herbicide, such as that developed by Cenicafé in Colombia, could be a good alternative to try as well.

Hence, even pruning and stumping, which involves deliberate cutting of the branches or trunk (Figure 13.5), needs careful hygiene. Frequent disinfection of cutting blades should reduce the chance of transmission of infection, but it is very unlikely that

Figure 13.5: Rejuvenated (stumped) coffee with grown suckers (arrows) forming the next cycle.



smallholders or even hired labourers on plantations will carry this out assiduously. Pruning saws, which retain small fragments of sappy wood between the teeth, may be a particularly effective way to transmit the infection to a new tree.

Additionally, the cut surface of the coffee stump provides a very large surface area exposed to ambient CWD spores. This can be seen when new suckers which were sprouting from the cut stumps were all infected with CWD, and hence die before they even grow to a height of 1 m from the growing point (Figure 13.6). Such activities can lead to the death of a whole field of coffee.

In order to prevent this catastrophe, the implements should be flamed over fire before cutting each stem or after cutting a few stems so that they are sterilized, particularly in farms with the history of CWD. If a farmer can afford it, it is advisable for the stumps to be painted with a fungicide paste. An ordinary copper-based fungicide can be used for this purpose. The copper-based fungicide should be mixed with water at the rate of 300 g copper-based fungicide to 1 l of water. The paste can be applied with a paint brush on the cut surface of the stump.

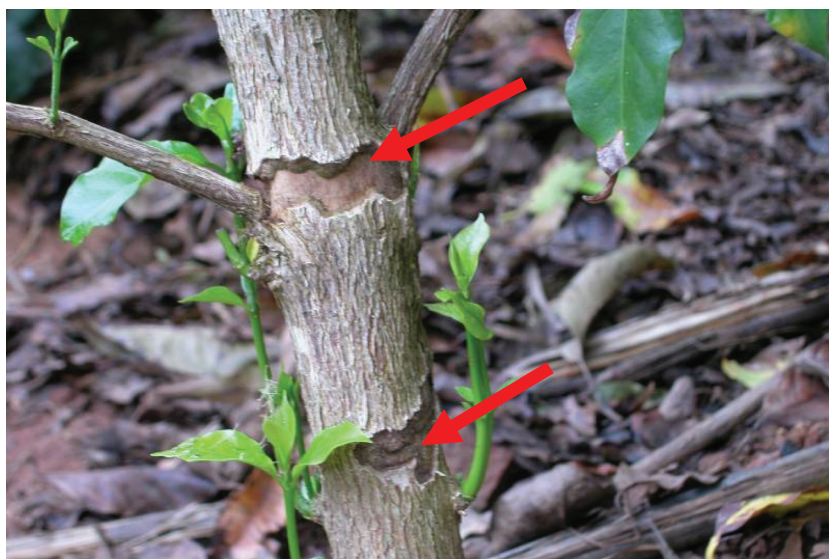
Some wounding may also occur naturally at the collar area of the coffee stem, i.e. the area of the coffee stem at the soil level. These microscopic wounds develop mostly when the trees sway due to heavy winds. However, it is not clear if this represents an important route of infection. It does, however, represent an important route of infection in a similar disease, *Fusarium* bark disease (*Fusarium stilboides*).

Another cause of stem wounding is wood-boring insect pests, such as the white stem borer (*Monochamus leuconotus* or *Bixadus sierricola*), which create breaches (Figure 13.7) in the protective bark, and thereby exposing the unprotected tissue to infection through aerial and rain transmission. However, to date there is no evidence that insects transmit infection, and indeed there is information that they do not, as we have seen in Chapter 10.

Figure 13.6: A coffee wilt disease (CWD)-infected stump with suckers which succumbed to CWD (arrows).



Figure 13.7: A coffee stem wounded (ring barked) by white stem borer (arrows).



It is possible that insects are to some extent responsible for the occasionally initial infection of plots, where a single tree suddenly becomes infected (Chapter 11), but even if this is true, it is doubtful that controlling this route of infection by chemical control would be cost-effective, even if farmers had the funds to pay for it.

Livestock, in particular goats and cattle, also wound coffee stems. Goats chew coffee bark in Uganda when left to graze in the coffee gardens. In addition, cattle were found tethered to the coffee stems resulting in the rope causing a wound to the coffee stem as the tethered animal moved around the coffee tree while grazing. It is, therefore, imperative that goats be prevented from grazing in coffee gardens, and cattle should not be tethered to coffee stems to prevent wounding.

13.2.6 Weed management practices for preventing coffee stem wounding

The results of preliminary tests (Chapter 12) suggest that mulch suppresses weeds and lowers the onset of CWD, probably because it reduces the use of implements that can damage the stem or the roots. This possibility is strengthened by another experiment that showed that the use of herbicides, combined with hand-picking weeds around the coffee stems instead of slashing, also reduced the incidence of CWD.

This resulted in farmers adopting these methods for controlling weeds. In addition, the cover crop, *Desmodium intotum*, which suppresses weeds during its growing condition, was also adopted as an alternative to weed control, after substantial studies by weed scientists at Jima Agricultural Research Centre (JARC) in Ethiopia.

13.2.7 Chemical control

CWD is a systemic disease, which infects vascular bundles; therefore, controlling it with chemicals is a very difficult option. The only feasible cost-effective way to use chemicals to help control CWD for farmers is by preventing infection from occurring

through stem applications of a copper-based product. The results in Chapter 12 showed some promise, but the subject needs further study. In addition, for many smallholder farmers this prophylactic measure will risk too much investment for too little visible reward – after all, the farmer has to apply the chemicals before any symptoms, so he or she may never know whether the application had an effect, unless neighbouring plots succumb without treatment.

The most useful way to use stem painting may be during an eradication programme, to accompany tree destruction with a sanitary cordon plus stem painting of remaining trees.

Even though systemic fungicides are almost certainly uneconomic to use for controlling CWD, their use should be seriously considered to protect valuable coffee germplasm in collections. Many CWD-affected countries are losing their valuable germplasm. Uganda, for instance, has lost coffee germplasm due to CWD (Hakiza, personal communication); in addition, Uganda has lost *Coffea kapakata* at the Entebbe Botanical Gardens due to this disease. Preliminary studies with benomyl under greenhouse conditions in Uganda demonstrated that the fungicide may control CWD, but frequent drenching every month was required (Hakiza, personal communication).

13.3 Integrated Crop and Pest Management (ICPM)

ICPM is an integrated approach to crop health management. The methods include cultural, mechanical, physical, environmental, chemical and biological control. The components of ICPM must be used in a systematic way. It must include a proper monitoring programme for CWD, for insect pests, and a proper identification of CWD so that ideal components are chosen and combined to manage the disease effectively. Use of information systems, in particular training of extensionists and farmers, and dissemination of information are crucial for the ICPM approach to manage CWD.

The main objectives of an ICPM programme are to eliminate or reduce the initial inoculum for the disease, to reduce the effectiveness of initial inoculum, to increase the resistance of the crop, to delay the onset of the disease and to slow down the secondary cycles. ICPM of CWD can, therefore, include a combination of some of the following methods:

1. Using resistant or tolerant varieties.
2. Provision of balanced crop nutrition.
3. Using healthy (clean) planting material.
4. Effective quarantine.
5. Management of infected coffee-plant materials.
6. Control of insects which pre-dispose the coffee tree to infection.
7. Using cultural practices, for example preventing tree wounding during the weed management.
8. Choosing a clean field to establish coffee planting.
9. Suppressing the pathogen in infected fields.
10. Prevention of the spread of disease in the field.
11. Using pesticides.

It is this approach that was advocated during the Regional Coffee Wilt Programme (RCWP). However, there are critical issues still to resolve, for example:

- The true cost–benefit balance of each element is still unknown, let alone the cost–benefit of combining two or more components.
- To truly integrate the above list of components requires a level of organization that is currently lacking in most coffee zones.
- Farmers are busy people, managing (as we have seen in Chapter 3) up to eight or more crops on their farms. They want simple and effective messages, not complex lists of tasks.
- The extensionist is given a truly daunting task, to transfer knowledge that is incomplete and may be impractical for a given farmer's situation.

13.4 Quarantine

Quarantine is crucial at the current evolution of the outbreak, where the four infected countries share borders with a number of unaffected countries. Monitoring and surveillance activities ought to be maintained in order to curb a possible spread of CWD from the affected countries. Dissemination of information and training of farmers are crucial in the process of controlling CWD in order to help slow down the transmission of the infected material. The present project did not include a specific element for training and upgrading quarantine services, but this is now urgently needed, especially perhaps on the border between Ethiopia and Kenya and the northern and western borders of DRC, to try to prevent the movement of CWD to other coffee-growing countries, such as Central African Republic (CAR) and Cameroon.

What has happened in Central Africa should be taken as a case history exercise for other coffee-growing states. Governments of the CWD-affected countries were not prepared for the resurgence of CWD and did not act fast enough to curb further spread of CWD in their countries. It is only a matter of time before CWD spreads to other countries. The control of CWD, therefore, requires joint efforts from all coffee-growing countries, not only in Africa, but in the other continents as well. They need to set aside funds for surveillance activities. For example, Rwanda, though not affected directly, was supported to carry out surveillance activities, and this would greatly help in limiting the spread and impact if there should be a CWD outbreak in the country.

In conclusion, it is important that governments are willing to share the resistant coffee germplasm with those who do not have it. This would be an important step to finally control this disease.

13.5 Eradication

Does Africa have to learn to live with CWD now for as long as coffee is grown there, or should efforts be made to eradicate it? Four countries are presently affected, and in three of these CWD is now very widely distributed. Much more coffee is now grown than in the 1950s when the disease was eradicated previously. And probably more of

it is grown on a very small scale than ever before. The eradication campaigns of the 1950s could count on *dirigiste* colonial regimes, large work forces and smaller areas to deal with, so the success of the previous outbreak may not be easy to repeat.

However, the alternative would be to see the disease eventually spread throughout Africa, infect and deplete wild coffee stocks and add extra burdens to an already overburdened sector. Now, with the development of some promising resistant clones in Uganda, there is the potential for a major eradication and replanting programme that would be of mutual benefit to all African coffee countries. As yet, however, no serious thought has been given to planning such a course of action.