PEST ADVISORY LEAFLET NO. 7

Plant Protection Service
Secretariat of the Pacific Community

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Black Pod and Canker of Cocoa

Black pod and canker of cocoa are caused by the pathogen *Phytophthora palmivora*. The cocoa diseases have been recorded from American Samoa, Federated States of Micronesia, Fiji, Palau, Papua New Guinea, Samoa, Solomon Islands and Vanuatu. Other hosts include: cashew nut, coconut, rubber, papaya, betelnut palm, black pepper, pineapple, oil palm, breadfruit and others. The fungus infects other crops in the Cook Islands, French Polynesia, New Caledonia, Northern Mariana Islands and Tonga.

SYMPTOMS

The pathogen infects the leaves, shoots, flower cushion, pods (at all stages of development) and roots. The most conspicuous symptom is on the pods and gives rise to the popular name, black pod, although the lesions are at first brown. Pods of any age including young pods, called cherelles, may be affected.

One or more small, brown, circular lesion occurs anywhere on the pods and increases rapidly in size (Figure 1). As the lesion spreads, the fungus produces a white band of spores just behind the advancing margin and this is especially obvious in humid conditions. Eventually, usually within two weeks, the whole pod and its contents are invaded by the fungus and the pod later becomes black. The diseased pods remain on the tree.

The fungus can spread down the pod stalk into the flower cushion and from there into the bark of the stem or branch to cause a canker. Canker is difficult to detect in its early stages because the outer bark appears quite normal. Initially, it can only be seen if the bark is scraped away. It can sometimes be identified by the shrivelled appearance of the flower cushion. In very young cankers, the underlying tissue is a watery grey colour; later it becomes red and this red colour intensifies on exposure to the air.

Later still, the affected tissue becomes brown. In cases of severe canker, a reddish fluid may exude through cracks in the bark and run down the stem where it dries to a rusty deposit (Figure 2). Cankers can lead to dieback, particularly when they ringbark the main stem or branches.

The fungus can also cause a blight of young shoots, cuttings and seedlings. At first, the fungus travels along the main veins; later it produces angular lesions as it moves into the areas between. Infection of young succulent stems causes them to wilt. Sporulation occurs, but is sparse.

Figure 1: Pod rot of cocoa caused by *Phytopthora palmivora.*

INFECTION

The spores, which are produced in enormous numbers on infected pods, can be spread by rain, wind, insects and rodents—both rats and bats. Flying beetles which breed in infected cocoa pod husk litter in PNG were found to be major vectors. The spores germinate in water and produce very small swimming zoospores which eventually come to rest, develop germ tubes and penetrate the plant tissues. Typical brown lesions appear on the pods within a few days of infection. Rapid spread of black pod is favoured by high rainfall and long periods of high humidity. The spacing of cocoa and shade trees can affect the incidence of black pod through its effect on humidity in the plantation.

Once the epidemic has started, sporangia washed or splashed from infected pods will be the main source of further infections of healthy pods. The fungus can survive in old mummified pods hanging on the tree for up to 18 months. There are, however, other sources of infection which may be important in starting epidemics.

The fungus can survive in the soil or on leaf litter and be splashed from there to infect the lowermost pods. Soil containing the fungus can be moved by ants as they build 'tents' on the pods over colonies of mealybugs. Sporangia washed by rain from infected shoots and leaves can be splashed onto pods in the tree canopy. The fungus can also grow from cankers into the flower cushion, and from there into the pod by way of its stalk. Spores can also be carried to new plantations on pruning tools, and by rats and bats by first chewing on diseased and then healthy pods.

EFFECT OF THE DISEASE

The number of pods lost to black pod varies greatly from country to country, place to place and season to season. Commonly, the loss is 20 per cent, often it is very much greater. In a reasonably productive plantation in the region, it is very likely that control measures would give an economic return.

Canker causes an indirect loss which it is difficult to measure. Severely cankered trees may die, but more usually branch dieback occurs. In this case, there are fewer branches on which to produce pods. A poor canopy may develop and because of the extra light, weeds may have to be controlled. Some pod loss will also occur from destruction of flower cushions, and from spread of the fungus from infected cushions into the pods.

CONTROL

The following section outlines the general principles for control of black pod. The cost-effectiveness of the strategies will need to be worked out locally. The weather, principally rainfall and variety, will play a large part in determining the incidence of disease. The response of growers will depend on the resistance and potential yield of particular varieties, costs and/or availability of labour and fungicides, and the current price of cocoa.

Management of shade, density and pruning

Cocoa should be grown with as light a shade as possible. Light shade lowers the humidity within the crop and reduces the incidence of black pod; it also tends to promote flowering and pod set. Low density of trees also lowers the humidity within the canopy. (In Papua New Guinea a maximum of 625 trees per hectare is recommended). Pruning to create an open canopy, by cutting branches close to the jorquette or fork, by removing chupons and promoting air circulation between trees, is good practice as this, too, will influence leaf drying times and lower the incidence of disease. Pruning should be done ahead of the wet season, but not during flowering or pod development.

Removal of diseased pods

All pods which become infected should be cut off and removed from the plantation; or, in the case of large blocks of cocoa, put into pits nearby. The trees should be inspected at least every 4 weeks during the main production season; ideally it should be done weekly. Once a pod is infected it will be completely rotten within two weeks and may just as well be removed. If it is not removed, it serves as a source of infection for other pods.

Figure 2: Stem canker of cocoa caused by *P. palmivora*.

A pod which is ripe and only partly black can still be treated as good and the beans extracted. Pods which are partly black while still unripe should be discarded. If diseased pods are not removed, it will be difficult to get good results from control measures.

Harvesting of the healthy pods fortnightly will help to prevent the build up of spores in the orchard. After the removal of the beans at harvest, the healthy pods should be removed from the plantation. Husks of healthy pods can become infected, produce spores and become an important source of infection.

Chemical control

Trunk injections for black pod and canker

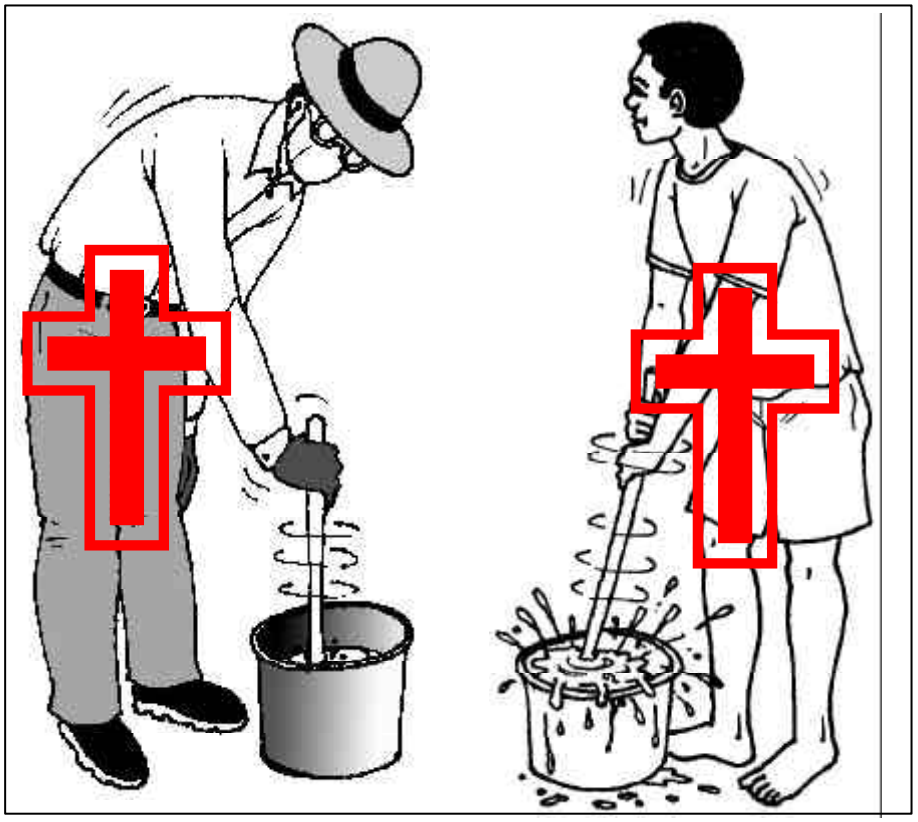
Trunk injections can control both black pod and canker. They give better control than other methods, and are more cost-effective, especially where the disease is severe. A purpose-made syringe (such as Chemjet®) which has a strong spring to force the chemical into the sap flow should be used. Each syringe holds 20 ml. Remember that phosphorous acid may cause irritation to eyes and mild irritation to skin. Suitable eye and skin protection should be used (Figure 3). The strength of the fungicide is usually 400 g per litre phosphorous acid; although some preparations contain 600 g per litre. For injection, a 20 per cent solution is required, therefore the fungicides need to be diluted with either equal or twice the amount of clean water (Figure 4a and 4b).

The recommendations assume the trees are at maturity.

✍ In low disease conditions (low rainfall and humidity): one injection of 20 ml of the diluted product should be made at the start of the fruiting season.

✍ In high disease conditions (high rainfall and humidity):

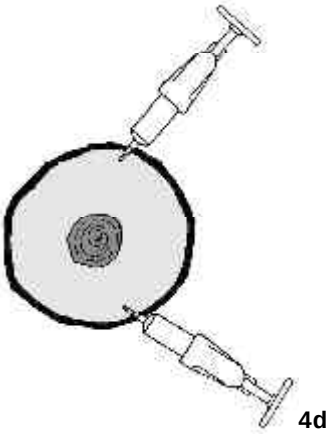
Figure 3: Take safety precautions to protect yourself when handling chemicals.



4a

4b

4c



4d

Figures 4a - d: Tree injection techniques

two injections each of 20 ml of the diluted product should be made per year. The injections should coincide with the two yearly leaf flushes.

Instructions for the preparation of the holes are given in the manufacturers' directions for use of the fungicide. A 6 mm drill is used to make holes 25 mm deep, and at a slight downward angle into the trunk, knee height above ground level (Figure 4c). For two holes, drill on opposite sides of the trunk (Figure 4d).

The time for the uptake of the fungicide from the Chemjet® syringe varies from 5 to 20 minutes. The timing of the application can affect the uptake, on a clear day the uptake is faster than on an overcast day because of higher respiration rates. Newly drilled holes should be used for each treatment.

Varietal resistance

There are some differences in the susceptibility of the pods of different varieties to black pod, but for all practical purposes the cocoa grown in the region is sufficiently susceptible to benefit from chemical control.

Criollo cocoa is very susceptible to the canker phase of the disease and different degrees of susceptibility are found among the various Trinitario varieties. Amelonado has been found locally to be very resistant to canker and this is one of the reasons why it is a preferred cultivar in Fiji and Solomon Islands. It is not recommended in Papua New Guinea as it is susceptible to vascular streak dieback caused by the fungus *Oncobasidium theobromae*. Breeding programmes continue in Papua New Guinea to produce cocoa with resistance to both black pod and dieback. Some clones have been released by the Cocoa and Coconut Research Institute.

QUARANTINE PRECAUTIONS

There are many important diseases of cocoa worldwide that are not present in the SPC region, and some that do occur are not well distributed. Although black pod and canker are caused by *Phytophthora palmivora* in Pacific islands, elsewhere in the world other species are involved. In order to prevent the spread of pests, introductions of propagating material should be as small quantities for scientific purposes under the supervision of quarantine authorities.

Guidelines for the international movement of cocoa have been published (FAO/IBPGR Technical Guidelines for the Safe Movement of Cocoa Germplasm). In general, seed can be moved directly from one country to another, as long as it is properly treated. All vegetative propagating material should pass through intermediate (third country) quarantine where it can be examined for insects and pathogens.

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