

## Research Note

### SYMPTOMATOLOGY AND CONTROL OF SCION DIEBACK IN GRAFT-PROPAGATED COCOA (*THEOBROMA CACAO* L.)<sup>1</sup>

Cocoa (*Theobroma cacao* L.), grows well under high humidity in the tropics.<sup>2</sup> West Africa, Central America, Brazil and the Dominican Republic are among the principal cocoa producing countries. Except for Brazil, most producing countries consume relatively little of the crop domestically. It is primarily grown for export to the Federal Republic of Germany, the Netherlands, the Soviet Union and the United States, which are the four largest consumer nations.

There are several species of *Theobroma*, a genus native to tropical regions from Mexico to Brazil.<sup>2</sup> These include *Theobroma bicolor*, *T. guianensis*, *T. sylvestris*, *T. ovatifolia*, *T. augustifolia* and *T. pentagona*. These are species totally different from *T. cacao*, from which the marketable product, chocolate, is obtained.<sup>2</sup>

The cocoa germplasm Collection at The Tropical Agriculture Research Station (TARS), USDA at Mayagüez, Puerto Rico, is maintained as a central repository and a valuable source of genetic material. New clones are added as they become available. Any material added to the collection must be certified disease-free.<sup>3</sup> The authenticated, disease-free clones serve as reference collection and as a reliable source of budwood. Material from the collection is available for research and for the establishment of commercial propagation.

Grafting has been widely used in horticultural crops for the rapid and uniform propagation of desirable germplasm. In addition, grafting is very useful for producing dwarfing, in propagating virus-free budwood and in indexing material for viral incidence. Generally, the success of cocoa grafting technique has exceeded 85%. However, from August to November 1982 only 10% of a total of 1500 grafts survived under greenhouse conditions at TARS. Scions showed chlorosis, tip dieback, defoliation, and finally scion death. Necrosis was evident in the graft union.

Both moist chamber and agar plating techniques showed the fungi *Botryodiplodia theobromae* and *Fusarium lateritium* consistently associated with scion dieback.

*Botryodiplodia theobromae* was first described as a dieback pathogen in cocoa. Legg<sup>4</sup> reported that *B. theobromae* infects cacao pods on trees under severe stress conditions. *Fusarium lateritium* has been related to dieback of various tree species of tropical areas.<sup>5</sup> In 1971, a grafting dieback disease of mangoes on the south coast of Puerto Rico was shown to be caused by *B. theobromae*.<sup>6</sup> Considering the apparent fungal incitation of the 1982 grafts dieback in cocoa, chemical control was tested. Three parts of captan 50 WP (Stauffer Chemical Co.; 50%-trichloromethylthio-4-cyclohexene-

<sup>1</sup>Manuscript submitted to Editorial Board 29 September 1988.

<sup>2</sup>Hart, J. H., 1900. "CACAO" Printed at "The Mirror" Office, Port of Spain.

<sup>3</sup>Gaskins, M. H., 1970. The Horticultural Research Program of the Federal Experiment Station in Puerto Rico. *HortSci.* 5 (6): 468-69.

<sup>4</sup>Legg, J. T., 1970. Black Pod Diseases: Pod Infection. Ann. Rep. Cocoa Res. Inst. Tafo, Ghana pp. 37.

<sup>5</sup>Holliday, P., 1980. Fungus Diseases of Tropical Crops. Cambridge University Press, New York.

<sup>6</sup>Alvarez-García, L. A., 1967. A dieback disease of mangoes (*Mangifera indica*), *J. Agric. Univ. P. R.* 51 (2): 191-93.

1-2 dicarbimixede) (weight basis) were mixed with Benlate 50W [E.I. Du Pont de Nemours & Co. a.i. methyl 1-(butylcarbamyl) 2 benzimidazole carbamate.]<sup>7</sup> The mixture was diluted in water at a 2.5 g/L and applied with a hand-operated pump sprayer to young grafted cocoa trees. Applications were repeated at 10-day intervals for 2 months after which time grafting success increased from about 10 to 45%. The partial control obtained with fungicides and persistence in chlorosis suggested that nutritional deficiency could also be involved in the cacao scion dieback. Magnesium deficiency and/or iron deficiency, were treated by applying Epsom salts and chelated iron as described by Wood.<sup>8</sup> Individual solutions were prepared and applied over the young trees. Foliar applications of 2.5 g/l of magnesium sulfate failed to improved graft success or to reduce chlorosis. However, the application of 2.5 g/L of iron chelate increased graft success over 80%.

During the study we noticed a variation in the compatibility between scions and graft stocks among diverse combinations. For example, when grafted on Amelonado rootstock, UF-29, UF-669 and Pound 7, had over 85% graft success. However, when grafted to the same Amelonado rootstock, ICS-6 and APA-4 failed 80% of the time. This suggests that a physiological incompatibility, along with pathological and nutritional constraints, influences grafting success. Analysis of the soils in which scions showed chlorosis indicated a pH of 7.4. Cocoa trees grow better in acid (pH 5.5) soils.<sup>2</sup> Besides in cocoa, iron chlorosis has been observed in coffee nurseries and in the

commercial propagation of poinsettia in perlite based media in Puerto Rico. We believe the rootstock of cocoa escapes chlorosis by relying on the seed iron supply. However, the immobility of iron does not permit accumulation in the scions. Improved soil availability is the best solution to this problem by adjusting and monitoring substrate pH.

Based on our experience a number of cultural practices are suggested to increase grafting success in cocoa: 1) Carefully select budwood; 2) use an acid soil (pH 5.5) in propagation of rootstock for planting; 3) clean grafting tools before each graft with 70% ethyl alcohol; 4) use rootstocks less than 4-month old; 5) maintain proper shade 70-75% and good ventilation in areas where the grafted material is to be placed; 6) when irrigating grafted plants apply water only to the soil avoiding moisture contact with recently grafted areas; 7) apply fertilizer biweekly in aqueous foliar-spray solutions of soluble foliar fertilizer to prevent nutritional deficiencies; 8) when dieback is associated with fungal pathogens, apply biweekly a suitable formulation of fungicides; 9) if iron deficiency is suspected apply an aqueous solution of iron chelated 2.5 g/L biweekly until recovery; 10) do not cover grafted scions and their rootstock union with parafilm tents.

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<sup>7</sup>Wood, G. A. R., 1975. Cacao, Longmans, Inc., New York.