

Mancozeb as a banana treatment, the end of an icon

The European Union's revision of its phytosanitary regulations is a unique opportunity for the banana industry to reinvent itself. The threats weighing down on the use of mancozeb by the production and export sectors could shuffle the deck to such an extent that we could see a before and an after. Cirad brings you a detailed review of what this new world looks like.

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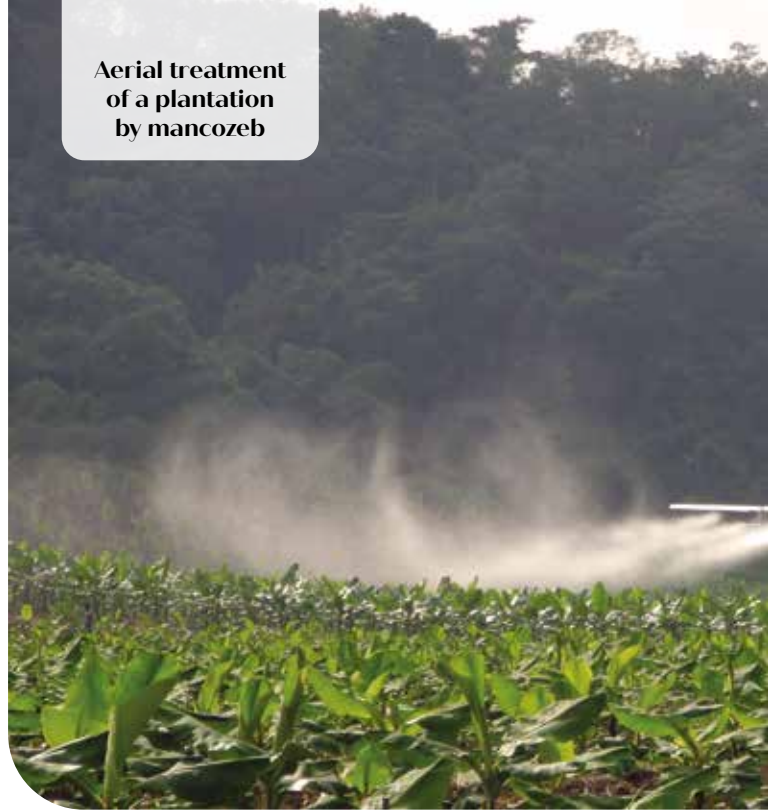
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Will intensive banana production survive the end of mancozeb use? That is the existential question which the banana world is currently asking itself, with marketing authorisation for mancozeb about to be withdrawn throughout the European Union in the coming months, thereby leading to a revision in the maximum residue limit (MRL) on banana imports into the EU – downwards, naturally. While the MRL level is not yet known at the time of writing, the majority of observers are leaning towards a figure reduced to the detection threshold. This issue may seem anecdotal to non-specialist eyes: yet this is not the case. Let's take a step back to identify the importance of this decision, longed for by some and dreaded by others.

Black sigatoka is a foliar disease of the banana plant, which affects all production zones, and means that all growers need to be engaged in a constant control campaign, at the risk of seeing both a collapse in productivity (less photosynthesis) and a potential reduction in lifetime (strong association between intensity of the disease, and green and yellow lifetime). There are two kinds of management methods: cropping techniques and chemical management. One of the foundations of cropping management is defoliation, which limits the development of the disease, and mitigates its effects on quality. Defoliation is a technical operation, and labour-intensive, which on its own does not guarantee a high yield and quality level. This technique is very widespread in the French West Indies, where chemical management is increasingly restricted.

Mancozeb-free banana cultivation?

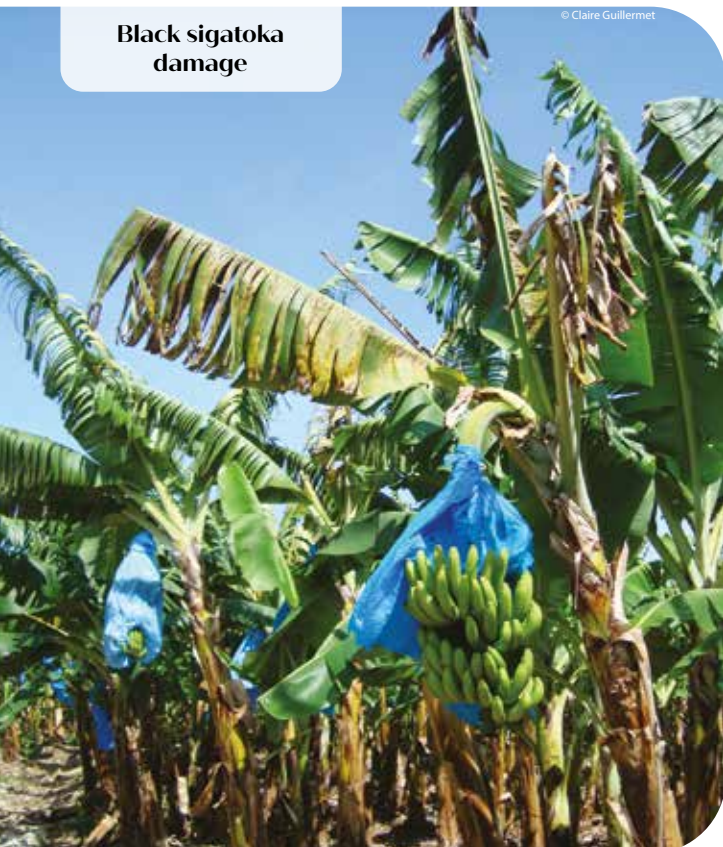
Elsewhere, i.e. on the half a million hectares of export banana plantations, intensive chemical management is the rule. Underpinning this chemical strategy is mancozeb, a contact fungicide with a preventive action. It has an effective action on the disease, a relatively low cost and is simple to apply. The product is very widely used on a systematic basis. In this systematic management mode, mancozeb is the mainstay, often employed in more or less complex cocktails with other fungicides.

The success of this management is based above all on managing the treatment logistics: the treatment products and equipment. Managing these logistics ensures good control of the disease, and minimises the risks on fruit yield and quality: it is a good insurance system! Regardless of the climate conditions (e.g. humidity), the season (wet or dry), the development stage of the disease, etc., mancozeb is sprayed from the air. The aim is to provide maximum protection on the newly sprouting leaves (approximately one new leaf per week in tropical zones), to keep as many leaves active or productive upon harvesting.

There are also systemic products which supplement use of contact fungicides (mancozeb). These include triazoles or benzimidazoles (see table). Mancozeb has a TFI (see "phytosanitary treatment frequency indicator") ranging from 20 to more than 50.

Refraining from using such an effective weapon poses a problem for all growers targeting the European market. Either they think about managing the pesticide residue level on arrival of their fruit into Europe, and hope for the best; or they refuse to take the risk of residue being detected on the fruit, and need to change their practices. In the first case, the "business as usual" approach, if the regulations do not force them to change, their customers – the distributors – will. They are set to ban use of a compound which is prohibited in Europe (as of 31 January 2021), regardless of the authorised MRL.

Black sigatoka
damage





The road to perdition: all-chemical

In the second case, a change in practices, a number of pathways open up. One solution could be to continue with the all-chemical method, replacing mancozeb with its cousins: systemic phytosanitary products. There is a long list of systemic fungicides: triazoles, benzimidazoles, SDHI, morpholines, pyrimethanil or even dodine. Some of these fungicides are already more or less doomed by the appearance of resistance in the fungus (see table). For those who were involved in the FRAC working group on the banana (Fungicide Resistance Action Committee – <https://www.frac.info/>), there is no doubt over rising resistance – which leaves growers with a simple choice to roll back the clock decades by using the notorious dithiocarbamates, the best known of which is mancozeb! Except that the EU's ban on mancozeb and other dithiocarbamate group contact fungicides (maneb, zineb) means that use of contact fungicides to manage black sigatoka is doomed. Thiram (another carbamate) and chlorothalonil have already been withdrawn from the European regulations. More generally, all this is also symptomatic of a really unhealthy way of doing things, with phytosanitary firms combining two functions: advice and sales. That is why in certain countries (e.g. in France since 2021), the regulations have stipulated a separation of these two functions.

And aside from fungal resistance, there is also the effectiveness of these products being too low to build a disease management strategy which is as effective. Use of a 100 % mineral oil strategy (used in the organic segment) is not feasible either, due to insufficient effectiveness under excessively wet conditions, even with weekly application. Which leaves us with good old copper and sulfur, but their effectiveness is low unless they are applied at enormous doses, which are incompatible with air-spraying practices, not to mention the regulations.

Difference between systemic fungicides and contact fungicides

Once applied to a plant or the soil, fungicides either remain on the surface of the plant, or penetrate into the plant. So there are two distinct major fungicide groups:

1. **contact (or surface) fungicides**, which are not absorbed by the plant. When a contact fungicide is applied, the droplets spread over the leaf, but do not penetrate inside it. So leaves that emerge after application are not protected, and the fungicide is washed out by the rain, and sometimes deactivated by the sun;
2. **systemic or penetrant fungicides**, which are absorbed by the plant. When a systemic fungicide is applied, the droplets spread over the leaf, and penetrate inside it. After penetration, the fungicides circulate inside the plant. Plant protection is often longer-lasting with this type of fungicide.

The phytosanitary Treatment Frequency Indicator (TFI)

The phytosanitary treatment frequency indicator (TFI) is an indicator for tracking use of phytopharmaceutical products (pesticides) on a farm or group of farms. The TFI represents the number of reference doses used per hectare in the course of a crop campaign. This indicator can be calculated for a set of plots, a farm or a territory. It can also be divided into major product categories (herbicides, fungicides, insecticides and acaricides, or other products). The TFI enables growers to gauge their progress in terms of reducing the use of phytopharmaceutical products. It also enables them to position their practices in relation to those of the territory, and identify possible improvements.

Source: <https://agriculture.gouv.fr/indicateur-de-frequence-de-traitements-phytosanitaires-ift>

Plan A, since there is no plan B

Faced with what appears to be a complete technical impasse, the only way out is a complete change in practices. Except that the new world opening up to growers is in no way a marginal adjustment, but a genuine revolution. In every case, this will lead to less effective management of the disease (and therefore of the consequences described above on fruit life-time) and to an explosion in management costs. So growers need to contemplate and anticipate a complete change in their way of thinking.

One of the strategies could consist in combining tailored cropping practices and biological warning systems: treatment is applied at the right time, in a coordinated manner, on a production area scale, alternating between treatment products to avoid them becoming ineffective due to adaptation by the fungus. More technology, more risks and less effective disease control! Needless to say, organising all that right across the industry will be easier said than done.

This takes us inexorably toward the most disruptive scenario: varietal change. We can now obtain varieties with tolerance or resistance, especially to black sigatoka, by conventional cross-breeding. As proof, the Pointe d'Or® (or Cirad 925) was the first of its kind to be grown intensively (in the FWI) and marketed in Europe (more specifically in France). Unfortunately, the trade was not ready to accept a genuine disruption to its way of working. Since although the catalogue of resistant or at least tolerant varieties will expand in the short or medium term, the downstream segment remains fixated on the absolute standard: the venerable and indispensable Cavendish variety. Everything is organised, created, adapted and standardised in relation to this benchmark. From price to transport temperature, from box shape to ripening protocol, from agricultural practices to modes of trading, all of the world's industries are hostage to the very thing that has sustained them for more than six decades.



They will need to get over this Stockholm syndrome, which leads them to reject change, and want any varietal innovation in the industry to fail. We would venture to say that the mancozeb case will genuinely put the issue back on the agenda. The other sanitary issue worrying the sector, the arrival of tropical race fusarium wilt, points to the same conclusions: a different banana world is not only possible but essential, both for the long-term future of the sector and its sustainability (see articles in FruiTrop 265, pages 124 to 129 and FruiTrop 266, pages 20 to 25).

In every case, this is the price to pay sooner or later for production industries across the world to be able to implement their agro-ecological revolution, accompanied as they will be by the downstream segment adapting its practices (including commercial and marketing) and its infrastructures to this renewed banana market. Beyond the new constraints, it is a historic opportunity for the industry to regain added value (more segmentation), but also to distinctly improve its social and environmental ratings. Time to take up the challenge! ■

Luc de Lapeyre, Thierry Lescot and Denis Lœillet, Cirad
luc.de_lapeyre_de_bellaire@cirad.fr
thierry.lescot@cirad.fr ; denis.loeillet@cirad.fr

Summary table of substances used in banana black sigatoka management

Mode of action	Molecule	First used	Product effectiveness	Current loss of effectiveness or in progress due to fungus adaptation	Authorised by the EU (Appendix 2)
Systemic	Triazole	1980s	+++	Medium risk, but very generalised	yes
	Benzimidazole	1970s	++	Very high and generalised risk	yes
	Strobilurin	Late 1990s	++	Very high and generalised risk	yes
	SDHI	Early 2010s	+	Very high risk, apparently emerging	yes
	Morpholine	Mid-1980s	+	Low risk	yes
	Pyrimethanil	Late 1990s	+	Medium risk	yes
	Dodine	2000s	+	Medium risk	yes
Contact	Mancozeb and dithiocarbamates in general (maneb, zineb)	1960s	+++	no	no
	Thiram (carbamate)	1960s	+++	no	no
	Chlorothalonil	Late 1960s	+++	no	no
	Copper, sulfur		+	no	yes
Other action	Mineral oil	1960s	+	no	yes

Source: Cirad



World Musa Alliance (WMA) : in the starting-blocks

The arrival of tropical race 4 fusarium wilt in Colombia in August 2019 went down in the banana world like an electric shock: in the absence of any treatment to control it, the disease poses a risk of complete failure for contaminated zones. There are preventive measures, which are essential for the future of production. Yet the fact remains that more sustainable solutions will need to be found in the long term. As with other crops, the varietal route should be among those favoured. Genetic improvement of banana plants is however a highly complex business given its biology (for example, sterility of species cultivated for international trade), and also the very low investment in research and development enjoyed by the banana. The route of non-conventional improvement, via genome editing, represents an opportunity, though European regulations classify this route as GMO, and the reputational risk among consumers should not be ignored.

So are we in a deadlock? While genetic improvement by conventional cross-breeding is difficult, knowledge and experience have progressed in recent years, and resistant varieties have been obtained. The challenge is now to bring together in these new varieties resistance to TR4, but also to other diseases, and in particular black sigatoka, while retaining very good agronomic and technological qualities (transportability and preservability of the fruit in particular, and taste quality). One of the conditions for addressing this challenge very probably lies in the ability to create an agile innovation dynamic, bringing together the industry and research players. This is the strategy proposed by the World Musa Alliance initiative (WMA).

This initiative proposes organising precompetitive research & development, by bringing together the means and know-how of the private operators of the banana industries with those of the research teams, with the aim of creating and selecting dessert banana varieties resistant to TR4 and other diseases. The operational phase of the project will begin in the 2nd half of 2021. The founding members of WMA will test on a multi-location basis a set of varieties already available, using the Cirad creation and selection platform (Guadeloupe). Some of these varieties have already shown a good response in particular to TR4 (Australian bananas, no.59, August 2020, pages 20 et seq.). So watch this space...

CONTACT:

denis.loeillet@cirad.fr

Tel. 33 6 76 21 13 18

Banana and Plantain Industry

Correspondent

CIRAD

TA B26/C

34398 MONTPELLIER CEDEX 5

France



WORLD MUSA ALLIANCE

Towards Resistant Dessert Banana Varieties for Sustainability

Cirad's proposal for setting up
the WMA initiative

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