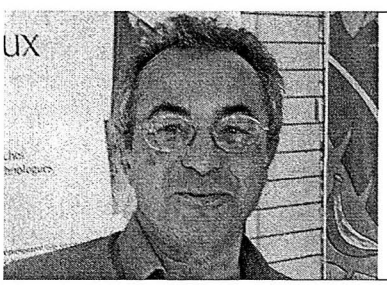
display triadimefon levels lower than the detection threshold. This is the most commonly used fungicide, but it is not impossible that pineapples in conformity with the future standard may not have been treated at all. In such a case, the proportion of fruits that have been treated and in conformity with the standards would be even smaller.

For these substances—unlike the position for ethephon—pineapples from the Dominican Republic and Costa Rica are not in conformity with the standard either.

It should be reminded that it was recommended in the past that these fungicides should only be applied to the cut stem. However, for reasons of economy, treatment has since been by soaking the entire fruit. It is possible that a return to the old practice would be sufficient for respect of the standards.

In conclusion, the application from July 2001 onwards of the new European standard for pesticide residues should lead pineapple producers to pay particular attention to the use of ethephon, with regard to dose, period between application and fruit harvesting, volume of solution and application method. The problems related to the use of this substance should only be considered as extremely urgent insofar as they interfere very strongly with organisation of the sub-sector and have a serious adverse effect on fruit quality. However, the results obtained concerning the two fungicides show that this is not the only problem: if the future constraints are cumulated (ethephon level lower than 0.5 mg/kg, imazalil and triadimefon levels lower than 0.01 mg), only 6% of the batches observed in 1999 and 2000 would have been able to enter the European Union from July 2001 onwards.

The knowledge gained in the past using other crop management sequences, like those shown here, encourage a measure of optimism. However, observations should be broadened, appropriate techniques defined and, above all, their implementation conditions and all their consequences should be specified and applied. Twelve months seems short ■



Research and evolution of the pineapple industry

Claude Teisson, CIRAD-FLHOR, claude.teisson@cirad.fr

The pineapple industry is subjected to two major constraints—maximum residue limits and quality—but it can be seen that the lifting of one will strongly improve the other. Among other things, this involves the extremely interesting Pesticides Initiative programme of COLEACP and Mrs Guichard. In addition, Alain Pinon's talk might be the first technical contribution to this programme.

Ethephon: the reasons for the problem

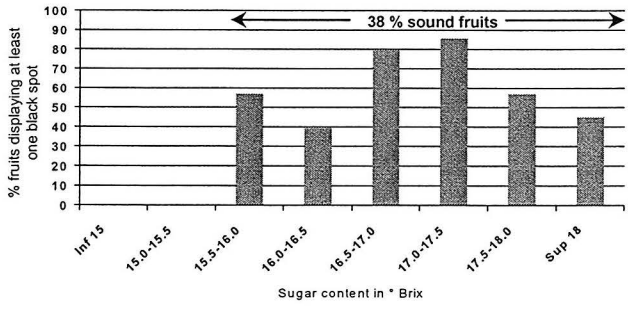
In order to understand the problems of ethephon residues in pineapple, it is necessary to understand above all what has led growers to exaggerate in the use of the substance. Fields are treated with very large amounts of ethephon when the fruits are totally immature, essentially to respond to problems of harvest organisation and logistics rather than problems of cost or collection. The sight of workers harvesting all the fruits in a pineapple field in one operation is a fairly surprising one. It would not seem possible to imagine that peaches, strawberries or bananas harvested in this way would meet the new quality standards.

These difficulties of organisation are more important for smallholders than for large growers since transport facilities and very early freight reservation are required, with the obligation (with a financial constraint) of respecting these reservations.

Another reason for the phenomenon is the risk of the downgrading of fruits because of black spotting or serious blemishes.

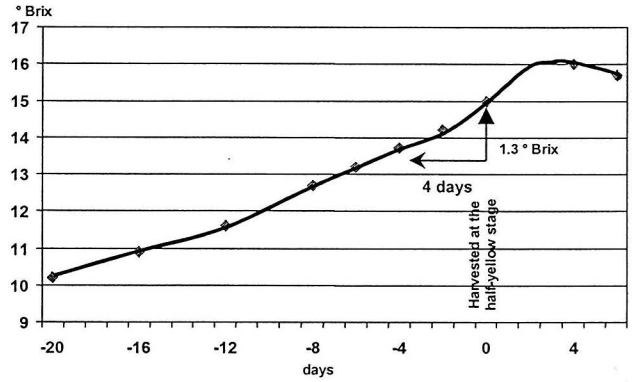
- According to the graph illustrating the percentage of fruits with at least one black spot according to their sugar content, all the fruits with a Brix level of less than 15° were free of black spots during a period of strong occurrence of the anomaly. The problem of black spots is therefore greater when the pineapples are sweet. One can say, without knowing why, that 72% of the fruits are affected or that 38% of the fruits are sound, depending on whether one is pessimistic or optimistic.

Black spots and dry matter in pineapple of the same grade (1.8-2.0 kg) during a period of strong prevalence



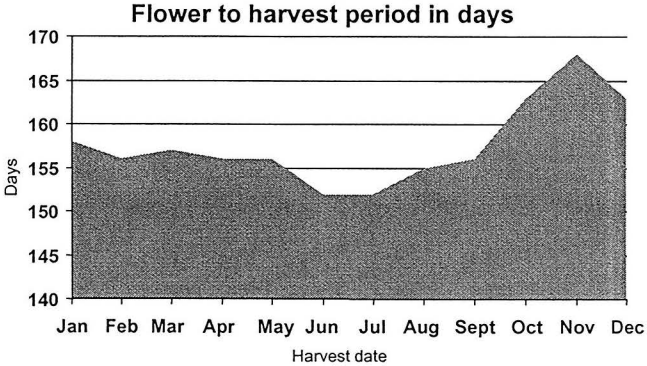
- The second graph shows the movement of Brix values according to a theoretical optimum date corresponding to the half-yellow stage. It can be seen that as the harvest approaches, the sugar content of the fruit increases considerably and that it is sufficient to pick the fruits four days before the optimal date for the Brix level to be over a degree less.

Movement of the refractometric index before harvesting



- The last graph shows the variation in the intervals between floral induction and harvesting, with natural ripening. This interval varies strongly throughout the year, ranging from 152 days to more than 168.

Natural ripening
Flower to harvest period in days



It is obvious that growers will treat the fields and wish to export fruits picked on much earlier dates in order to avoid the black spot problem. I do not think that many growers in Côte d'Ivoire pick fruits 158 days after flowering treatment. This is nevertheless a possible practice or can in any case give good results in terms of quality.

Solving the problem at its base

We consider that the problems of ethephon MRL will only finally be solved if we address the original causes of the harvesting of all the fruits in a field in one go.

If it is the result of problems of transport logistics, should these logistics be improved? Planters, and especially smallholders, already receive aid. Perhaps this should be improved? Isn't it necessary to improve knowledge of field patterns and use modern geographic imaging tools? Should harvest forecasting be improved? We have already developed simple mathematical models based on simple temperature observations to refine estimation of the real time between floral induction and harvesting. However, this is still a theoretical model that must be refined and tested in practice. In short, there is a whole set of actions that are not particularly related to ethephon but which could already improve harvest organisation and logistics.

There are then constraints related to freight reservation. Should other freight conditions be envisaged? Containerisation comes to mind of course. Should not cold relay systems be envisaged? All possibilities are open.

Fear of black spotting has played an important role in the problem. However, it can also be pointed out that it is easier to check the number of black spots than the Brix level during the very strict quality control operation before loading on the ship. There has perhaps been excess zeal, resulting in lower pineapple quality. It is easier to downgrade a fruit with a small black spot but that is very sweet than to downgrade a fruit with a low Brix level and poor taste quality but with no black spots. This raises new problems of the acceptability of black spots and the questioning of fruit control operations. Very little is known about the black spot anomaly and it is essential to perform basic work on the causal factors. It is known in particular that its importance varies very sharply, probably under the influence of the climatic factor. There are agronomic pathways for this problem, other than the application of large doses of ethephon to immature fruits. These lines of research should of course be taken up again.

None of these solutions is either easy or immediate. However, as several speakers have stressed, consumers want better quality fruits and the

European Union wants fruits that meet its import standards, and neither party will change its position. Work should be started on the search for solutions as quickly as possible, even if these solutions are complicated. There is not doubt that it has been wished to date to make the fruits match commercial constraints that are sometimes incompatible with their physiology. It is therefore necessary to find new solutions or, like the Australians and Americans, undertake genetic improvement programmes for pineapple using genetic transformation and obtain fruits that no longer release a single microgram of ethylene and that are totally incapable of turning brown. I do not think that this solution would be preferred in Europe.

In short, to be slightly provocative, I will say that there is no MRL problem in the medium term but that there are problems of organisation of picking, freight and black spotting. This does not remove the importance of immediate action on the MRL problem. My talk is based intentionally on a more long-term view.

Fungicides and rational agriculture

In his talk, Alain Pinon briefly mentioned that a return to good farming practices could alone solve the problem of vegetative constraints with regard to fungicides. This hypothesis remains to be verified, of course. But can we not go further? Post-harvest fungicide treatments respond to a risk—wound fungi. However, these risks are not always there. In the face of the difficulty of consumers in accepting residues in fruits, would not the economic advantage lie in performing no fungicide treatment at all and having not residues, at the risk of accepting the discarding of a small percentage of fruits? This would require cleanliness and rigorous care during packing and transport. We are sure that among the batches of fruits declared as being in conformity with standards for fungicides during the survey performed two years ago, a number had never been treated with fungicide and these fruits batches were not systematically rejected for reasons of fungal attacks.

Completely eliminating post-harvest treatments would also mean making use of a botanical peculiarity of pineapple. It is one of the rare fruits for which no fertiliser or pesticide application is performed later than 5 months before harvesting, because all applications of chemicals can be halted after floral induction. A review is needed urgently in order to profit from this feature of pineapple. Residue problems do not only concern fungicides and ethephon, but also include herbicides, plantation pesticide treatments and fertiliser. It must be admitted that our knowledge of the integrated pest management and rational fertiliser alternatives is very small. We are behind in this field and must try to catch up as quickly as possible in comparison with what has been initiated in banana.

New varieties

The problems of residues and fruit quality are not the only ones to put the industry in a completely new situation. In this respect, the placing on the market of the variety MD-2 is opening the way for new produce with new tastes. It seems to us today that segmentation of the pineapple market is inevitable. It will be possible to find pineapples with very different appearances, colours, sizes and tastes. It is also certain that market segmentation will include other products, such as 'ready-to-eat' goods. A survey revealed that people are finding it increasingly difficult to peel or prepare fruits. 'Ready-to-eat' products may be a response to the problem, but using other varieties because the 'Smooth Cayenne' variety is doubtless the least suitable for this.

I would like to include a reminder of the long work required for varietal improvement. The hybrid 'MD-2' was bred in the 1950s by the Pineapple Research Institute, and the Del Monte company reactivated it more than 20 years ago. The process of developing a new product for the market is extremely long. CIRAD is somewhat behind in this field. We initiated hybridisation programmes about 25 years ago but today none of our hybrids has attained the degree of finishing of 'MD-2'. Nevertheless, CIRAD has other advantages related to its participation in recent years in international germplasm collection programmes in the Amazon basin. We have a collection of more than 400 different *Ananas comosus* genotypes in Martinique, including pineapple types related to the Queen group and the Cayenne group that may possess immediate agricultural advantages.

In conclusion, the pineapple industry is at an important turning-point in its development. More substantial technical progress than that in banana is to be made and great changes will take place in the coming years. A partial settlement of the ethephon problem should improve quality and kill two birds with one stone. Here, the strong threat from European regulations should be considered as good fortune in the medium and long term and an opportunity that makes us take action. An enormous amount of work is to be done but everybody must be involved—researchers, and also all the professionals in the industry from the first stages to harvesting and sale on the European markets ■

Questions / Answers

Jean Harzig, L'Echo

This prospect of transforming an obstacle that seems very difficult to negotiate into an opportunity for a rebound and reconsidering an industry in a positive manner seems to me to be extremely attractive. If consumer representatives were in the room they could only display interest in your proposals.

François Dalle, Pomona

A lot of work is to be done in the pineapple industry. This does not necessarily concern pesticides but the cutting point, new mastery of freight, the cold chain, etc. What is the joint action plan of CIRAD and Côte d'Ivoire professionals?

Claude Teisson

This action plan is to be set up. I have wished to underline here that it is important to address the problems of ethephon in terms of information and control and that it is essential to draw up a programme immediately with the industry in order to improve all these aspects. So far, what I have to say is a proposal for a schedule of action.

Lucien Delzechi, OCAB

As producers, we are aware of this problem. CIRAD has mentioned it. The ethephon problem will certainly help us to improve quality. Professionals in Côte d'Ivoire have tried to face the threat of Del Monte's 'MD-2' for four or five years. However, the role that distribution must play has not been mentioned here. Because in spite of the constraints that have perhaps led us to certain excesses with regard to ethephon, there is freight of course, reservations certainly, facility perhaps, but the commercial constraints have certainly been determinant. We have just discussed black spot as if it were a *bête noire*. You have to know that today, if there is a single small black spot in a batch of pineapples, all the 800 pineapples in the batch are refused.

We had to change the leaflets produced by COLEACP, with the collaboration of OCAB, because we realised that the appearance of fruits coloured with ethephon was not the same as those with natural colour. There was a complete misunderstanding between the trade and ourselves with regard to colour and how to recognise a coloured fruit. In this case, C2 was always the subject of discussion, the base being coloured and the top green, etc. We had to change the alphabet used for product identification. Therefore today, when Mr Dalle of Pomona asks what we have done, I will say that it is more a question of what we are going to do. Since it is essential that distributors and importers realise that a fruit with less and less ethephon treatment will look different. The top will perhaps be greener. And if we do not explain this, if there is no commercial effort to say why this fruit is better, it is true that the appearance will change. I think that a lot of people should be involved in handling this.

Claude Teisson

There has been much discussion of quality. If we provide a fruit with better taste, the consumer should be relatively easily convinced. But I agree with you that a chain that is so long and so cumbersome includes a lot of habits; systems become set up and it is not always easy to change them.

Mathias N'Goan, OCAB

I would simply like to complete what Mr Delzechi has just said. The profession must make efforts to present high-quality produce on the market. However, if all the work carried out upstream is not supported by distributors and importers, it will be vain and the aim—that of increasing growers' incomes—will never be attained. This means that we are always obliged to wish to fully associate importers and they tell us what to do. For if, in the future, MRL constraints mean that we can no longer use ethephon, are our partners ready to help us and pass on to consumers the message that natural pineapple, even when not very coloured but ripened naturally, is better? This is the real problem since we no longer have the choice upstream. The European market is our preferred market and we are going to do everything we can to continue to benefit from this market. On the other hand, however, we still have a marketing system that is somewhat criticised and that we have not managed to replace, that is to say sale on consignment. In principle, this is a true partnership but in practice it is not. And it means that the fruit pays everything except the grower. I don't know who could contradict me today. So are our partners really capable of helping us to pass the message for pineapple that will be practically organic if ethephon is no longer used, for there to be a true financial return upstream?

Daouda Traoré, OCAB

In Côte d'Ivoire, we have now reached the stage at which the pineapple industry sorely needs support from the research sector. One has the impression that production has remained unchanged in the face of these problems of MRLs and black spots. However, it should be specified that much has been done at our level. It should not be forgotten that we have a pineapple industry support project. And this project—initiated by the European Union—has resulted in a fair number of field operations involving growers: training in the use of ethephon during certain periods of the year, training in the use of fungicides, training in packaging—everything that can make an effective contribution to a flow of quality produce appreciated on the market. Unfortunately, it has to be admitted that all these efforts made by the industry are not sufficient in relation to the changes in trade in Europe. It is therefore absolutely necessary today for us to be supported by the research sector to help us to adapt to the new situation, taking climate change into account as this now disturbs all our plans. For example, in Côte d'Ivoire last March when we least expected high temperatures, we experienced a fairly intense sunny period that inevitably upset growers' schedules. And then, more recently, we did not expect a

markedly rainy period in June. Growers are therefore a bit lost today. Ethephon is used in an abnormal manner and the research sector should define how it should be used. And this is why, as far as we are concerned and to sketch a reply to Mr Dalle's question, we feel that close relations with CIRAD would be welcome.

Claude Teisson

CIRAD wishes to participate in all efforts made to improve the industry, whether the initiative comes from OCAB, COLEACP or from any stakeholder. We are ready and willing with regard to any action of this kind.

Catherine Guichard, COLEACP

I mentioned this morning that the pesticide programme being studied at community level should receive its first funding in 2001. I advise the representatives of national industries to organise themselves at national level by setting up 'task forces' whose job is to perform reflection at a national level in collaboration with professionals, research institutions, pesticide manufacturers and the local institutions handling the registration, control and movement of pesticides, etc. The important thing is that if these task forces can establish a network of people. Even in a very initial form, they can contribute to the dialogue necessary and then start to identify the principal demands that they would like to discuss in concrete terms with the research sector.

In addition, we gathered from South Africa the data for setting the ethephon level at 0.5 and the underlying good agricultural practices. In South Africa, the pre-harvest interval is at least 8 days and 1.44 kg active substance is applied per ha with 1 000 to 2 000 litres of water per hectare per application. Thus, if this does not correspond, it should not be transferred unmodified.

Claude Teisson

It is close since we obtained 480 g commercial product per litre, hence 3 litres. This is not far from 1.4 litre and we have got to 7 days and the South Africans to 8 days. It might be a little hotter in Côte d'Ivoire...

Catherine Guichard

This is perfect. Finally, my last point is related to concern about floral induction of organic pineapple, since the authorisation for the use of carbide stops in January 2001. Have solutions been studied in the research sector? The extension of the authorisation has already been running for 6 or 8 months. If not, do we yet know how to perform floral induction on organic pineapple?

Claude Teisson

CIRAD has initiated a certain amount of research on the last point, with a number of isolated experiments on the use of smoke to trigger pineapple flowering. We are still waiting for the results and it is not certain that the technique will be very easy to use, especially to be able to ensure regular supplies for the chain. Our initial approach, in collaboration with certain organic pineapple growers, consists above all of showing that no investigations had been carried out and that it was a subject that interested us. We were surprised and interested and became aware of the problem, perhaps a little late with regard to the legislation. Unfortunately, I doubt whether we shall have a ready-made solution at the end of December and can say 'Treat with smoke in such and such a way and floral induction will be as easy and as rigorous in both organic and non-organic pineapple.' But let's wait... ■

New banana varieties

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Hugues Tezenas du Montcel, CIRAD-FLHOR, hugues.tezenas_du_montcel@cirad.fr

Objectives

CIRAD-FLHOR has been running a banana genetic improvement programme in the French West Indies for many years. It is aimed at producing dessert bananas differentiated from the traditionally grown Cavendish varieties and that correspond to two features:

- criteria for sustainable banana production: resistance to pests and diseases, protection of the environment, economic competitiveness,
- and market demand in Europe.

These objectives were fixed on the basis of observation of the banana production environment in the broad sense and set out at different levels.

At world level

World production is based on a single product, Cavendish banana. This holds a major environmental and phytosanitary risk, especially with regard to Black Sigatoka disease (BS), Yellow Sigatoka and the threat of the appearance of new bacterial, viral or fungal diseases. It is also necessary to seek a different trade position for West Indian production in the face of strong international competition.