Rational cultivation and reduction of production costs: towards rational, profitable banana growing

Philippe Marie, CIRAD-FLHOR, philippe.marie@cirad.fr

Without returning to the definitions of traditional, integrated, sustainable, rational or organic types of farming, we can say that the current trend aims at:

- improving the economic and social effectiveness of farming,
- conserving the national heritage,
- mastering the quality and harmlessness of products.

These concerns cover a broad range of technical skills, but lead to practices that increasingly match each production zone.

The 'rational agriculture' approach in banana production responds to a double imperative of respect of the environment and a product that matches consumer expectations.

The implementation of rational cultural practices is likely to be accompanied by an increase in the cost price of the product. However, it is difficult to envisage an increase in the selling price of bananas, especially through the 'rational agriculture' procedure. This alone should not increase the value added of the product because it will correspond to the future standard. It can nevertheless form the essential base for other added-value procedures.

I shall use a few examples to show that the trend towards the rationalisation of all cultural practices does not necessarily correspond to an increase in costs but in contrast forms part of a framework of improved competitiveness.

Example of the mastery of tillage in Cameroon

The banana plantations in Cameroon are on a volcanic chrono-toposequence (a mosaic pattern in which the soil characteristics depend on both the topography and the date of the different deposits on which the soils formed) consisting mainly of andosols (of volcanic origin), brown-red halloysite (clayey) and some ferrallitic soils (red soils containing iron). The traditional tillage procedure consists of ploughing with heavy discs (Rome Plow) and crossed runs with a ripper towed by a D8 bulldozer. This results in problems of tillage quality, cost and risks of erosion.

Soil types (or superpositions) were characterised and observations of the stone contents of slopes and other features were made during the mapping of the production zones. An analysis of arable and root profiles was performed on each pedological unit during an appraisal survey. This work made it possible to measure the impact of the physical constraints on root system distribution and consequences for the yield.

This showed that tillage is not useful for the lighter soils, that are also those most sensitive to erosion; these form approximately half of the area. The elimination of tillage makes it possible to control erosion effectively by maintaining plant cover (no ploughing back of the previous crops) and soil cohesion, which reduces the detachment of aggregates by runoff. The soil loss in this land is related more to the movement of whole aggregates than damage by the splash effect.

Improving the structure of the heavier soils makes it possible to obtain better yields. Ceasing the use of Rome Plows and using a spading machine behind a wheeled tractor allows simultaneous cost reduction and the improvement of tillage quality (improved soil structural stability and efficient tillage over a greater moisture range).

The setting up of an agricultural control unit to monitor tillage enables annual analysis of the results obtained. It is then possible to propose improvement and trials leading to a tillage schedule for each field, while taking the plant cover into account.

These new practices make it possible to limit erosion—with the maintaining of soil production potential on a long term basis—and improve productivity while reducing tillage by more than 50%.

This means a convergence between an environmental objective (sustainability, reduction of erosion, etc.) and an economic objective consisting of a gain in productivity and reduced costs.

An example of rational control of Sigatoka disease

The example of widespread rational control of Sigatoka in contrast with systematic control practices is doubtless the best known as it is the oldest (1972) but it is still valid today. The warning system is based on analysis of the climatic factors with an effect on the development of the disease, combined with direct observation of the symptoms. Developed initially for Yellow Sigatoka, it has been adapted for Black Sigatoka and leads to a very marked decrease in the number of sprayings.

The reduction in sprayings — maximum about 20 — makes it possible to set up a strategy of alternating effective products based on periodic monitoring operations for early quantification of the appearance of possible resistance. In some cases, these alternating strategies have made it possible to return to normal substance efficacy after the appearance of resistance.

Conversely, the use of systematic control with or without alternating strategies inevitably leads to the appearance of resistance, loss in product efficacy, an increase in the number of sprayings and a return to the use of contact products. In concrete terms, starting with a traditional control system with 30 sprayings per year, we have observed deterioration leading to more than 60 applications of contact products. In comparison, the rational control used in the West Indies (Yellow Sigatoka) and in Côte d'Ivoire (Black Sigatoka) leads to a stable situation with 8 to 15 sprayings per year depending on the zone. Cameroon (Black Sigatoka) is progressing and tending to drop below 20 sprayings per year.

In this case, the rational approach makes it possible to master an agricultural risk and avoid both economic and environmental deterioration. The system is more sustainable. Here again, the environmental objective accompanies the economic objective perfectly.

Fallows, crop rotations and tissue culture plants

The appraisal surveys that make it possible to rank the limiting factors in banana plantations have shown in all cases the prime importance of soil pests and especially *Radopholus similis,* a nematode strongly associated with banana. In addition, the use of nematicides alone does not thoroughly purify crops and may well be limited by regulations.

In the face of this situation, a complete revision of the crop management sequence has been proposed, based on the use of clean plant material in soil cleansed by fallows or crop rotations. The main stages of this work are as follows:

- the destruction of old banana plantations,
- the management of fallows or choice of crop rotations,
- tissue culture plants (genetic, sanitary and horticultural quality, production cost),
- field creation (tillage, planting techniques, etc.),
- the management of a number of special features (susceptibility to CMV, desuckering, etc.).

A preliminary approach shows that the cost of this crop management sequence is higher than that of traditional sequences (frequent replanting after banana, perennial cropping). The most costly items—the costs involved in fallows and the purchase of tissue culture plants—are only counterbalanced by savings in nematicides (at the moment, it is possible to do without treatment for a period of 12 to 18 months, whereas it would be necessary not to use nematicides for three years to compensate the cost of the tissue culture plants). Nevertheless, there is considerable room for improvement through improvement of cleansing and better mastery of recontamination and the replacing of fallows by profitable crop rotations.

All this requires the performance of complementary research and calls into question the principle of banana monoculture. A more overall approach to farming systems at farm scale or possibly production area or country is essential today.

The economic efficiency of these rational management sequences is achieved by very significant increases in yield (of some 10 tonnes per hectare). This is an essential feature in terms of gain in competitiveness. Economic efficiency can nonetheless be called into question in a transitory or definitive manner by lack of mastery of the inherent risks of the techniques to be used.

Poor mastery of fallow quality (maintaining of nematode host plants) or of plant material (contamination of nurseries by nematodes) can put the gain in productivity at risk. Substantial losses can even be observed in case of zero nematicide application during the first year of cultivation.

Tissue culture plants must be available for the crop management sequence, enhancing transfer of plant material between producer countries. The importing of weaned tissue culture plants or plants with no virological guarantee involves a risk of the introduction in the production zone of pathogens whose virulence might compromise the profitability or even the survival of banana plantations as a whole.

This rational crop management sequence is preferable for both economic and environmental reasons but has its own risks that it is essential to master. This requires the development of complementary diagnosis or guidance facilities.

Rational fertilisation

The work performed in recent years in appraisal surveys and studies on the dynamics of mineral elements has made it possible to set the basic principles of the nutrition of banana plantations. This means the development of rational fertilisation:

- adjustment of fertiliser quantities to match plant requirements (productivity objective),
- adjustment of fertilisation to the exchange behaviour of soils (taking soil specificity for cations into account),
- soil and plant analyses for appraisal and monitoring purposes (guidance facility).

These data can be used to draw up fertilisation plans suited to the soil type, the season (rainfall), field productivity and plant cycle.

Drawing up these fertiliser schemes shows that the re-establishment of cation balances is more effective than the simple correction of deficiencies. Improving nutrition with major elements solves part of the trace element and mineral nutrition problem. The efficiency of applications is distinctly improved in the context of use of tissue plants on fallow.

Nevertheless, the safety margins allowed in the drawing up of fertiliser schemes in order to ensure the maintaining of optimum productivity potential do not lead to substantial savings of fertiliser. However, the logistics of fertiliser distribution is considerably complicated: fertiliser schemes must be different from one field to the next and applications are more split up in general.

Periodic soil and plant analysis operations make it possible to monitor the effectiveness of the fertiliser schemes with regard to correcting deficiencies and imbalances and envisage the gradual reduction of application of certain substances as experience is gained and complementary trials performed. Thus the implementation of effective rational fertilisation can only be done gradually and requires long-term adaptive research.

This kind of work is often very profitable in terms of gain in productivity and quality. However, it is not necessary to complete the process to draw the largest part of the economic benefit. As a general rule, the deficiencies and imbalances with a strong impact on yield can be corrected fairly rapidly. However, considerable long-term efforts are required to reduce impacts on the environment.

The rational fertilisation approach must therefore be an overall one. The constant efforts to be made here for protection of the environment should make it possible in the long term to stabilise plant nutrition at an optimum level in order to ensure the maintaining of quality and productivity.

Conclusions

These few examples show that rational agriculture can benefit both the natural environment and the financial equilibrium of farms.

The development of these crop management sequences requires a substantial body of research aimed at understanding mechanisms, followed by adaptive field research. This cannot be achieved efficiently without strong interaction between the profession and the research sector. This should enable the better measurement of the scope for progress in these fields (environment and economics) where we have hitherto just used qualititative approaches.

These techniques can only be used in banana plantations within the framework of an overall approach taking into account the mastery of the agricultural risks.

Rational agriculture is becoming a reality in banana production, resulting in the use of a large mass of scientific results. It is essential here to set up procedures for the validation and monitoring of the performances of cultural practices and to respond to the specific requirements of further fundamental research.

Rational agriculture can only form part of a movement of progress. For this, it will be essential to be able to adjust specifications and techniques so that there is continuous innovation.

Rational agriculture aims at being a general approach for implementation at the farm or production zone level and must make it possible to perform more concrete initiatives for more specific enhancement of the value of produce, either by continuing the process (e.g. the use of non-Cavendish varieties resistant to Sigatoka) or by using local characteristics (e.g. recognition of the specific characters of terroirs). With a rational agriculture base, these initiatives could lead to segmentation of the banana market leading to added commercial value ■

Questions / Answers

Jean Harzig, L'Echo
Could this work be used in an ISO 14000 type approach?

Philippe Marie
Of course. This is an overall approach. It is clear that the ISO 14000 procedures are very closely involved with environmental aspects and enable a rational agriculture approach.

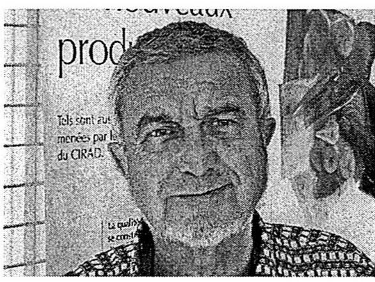
Jean Harzig
You did not mention water aspects and especially the question of nitrogen residues in water. Is work being carried out on this?

Philippe Marie
In the tropics, priority must be awarded to pollution by pesticides, which is much more serious than nitrogen pollution. The tropical environment has specific features in this respect in comparison with the situations in metropolitan France or in Europe. This does not mean to say that one should not approach the problem of the nitrogen and potassium 'greediness' of our banana plantation crop management sequences.

Jean Harzig
Alain Normand mentioned the question of potable water with regard to pesticides but couldn't we also have addressed it with regard to nitrates?

Philippe Marie
Absolutely. But there are also problems of bacteriological quality.

Michel Griffon
To take up the point of nitrogen, an interesting question that does not only concern banana plantations is the fact that a large proportion of nitrogen fertiliser is released in gas form (NO_2), whose radiative effect in terms of the greenhouse effect is between 100 and 104 times that of carbon dioxide, accused as being the leading culprit. When an international market of rights to pollute—or rather complexing certificates—is truly established, it is to be hoped that it does not cover only carbon but all the formulae that reduce NO_2 emissions and enable the rational reduction of fertilisation. This will be extremely useful because this concerns not only banana plantations but also all very intensive cropping ■



Residues in pineapple from West Africa on arrival in Europe

Alain Pinon, CIRAD-FLHOR, alain.pinon@cirad.fr

The question of maximum residue limits (MRLs), and especially that for ethephon, is currently the most acute problem weighing on the pineapple industry. Large-scale actions such as those envisaged by COLEACP at European Union level are therefore a priority, but they should be based on technical data. Some are presented succinctly here.

In export pineapple growing, two types of substance are generally applied to the fruits before or after picking:

- ethephon sprayed on the fruits in the days before the harvest to activate and homogenise peel colour;
- fungicide applied just before the fruits are packed to control rots caused in particular by *Ceratocystis paradoxa*, which penetrates via wounds and the cut stem. The two substances mainly used are triadimefon and imazalil.

This talk mainly concerns ethephon, but data concerning fungicide residues and quality criteria will be covered rapidly.

Ethephon

Ethephon, in the form of the commercial product Ethrel, is applied manually by spraying on the fruits. It is an ethylene generator that causes the break-down of the chlorophyll in the peel and thus the appearance of orange pigment, but without accelerating any other fruit maturation process. Application too early will therefore result in the colouring and harvesting of immature fruits (with a low sugar content and excessive acidity), and taste that is all the more deplorable as pineapple acidity increases during chilled transport. In addition, only very strong doses of ethephon are effective on immature fruits.

Until recently, no European Community regulation set a specific limit for pineapples. The reference was