Assistance and training on Banana Pests evaluation

SBBS technical assistance report

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Summery:

The burrowing nematode, *Radopholus similis* and the black weevil borer, *Cosmopolites sordidus* are major pests of banana and may become a limiting factor of production. Both are present in Surinam. Pesticides available against these two pests cause many problems of safety.

Against *R. similis*, alternative control is based on adaptation of agricultural practice: after destruction of infested banana plantations, flooding and fallow may destroy the nematodes; by planting with nematode free plants (vitro-plants) it may be possible to grow bananas several years without this pest. We verified the efficiency of this technique, which looks successful in Nickerie. In Jarikaba, some banana volunteers have survived during flooding and fallow period, so that limited population have survived. Efficiency of this system of control needs also regular assesment of nematodes population, in fields as in greenhouses. For this reason, SBBS technicians have been formed to sampling, extraction and recognition of phytoparasite nematodes according to standardized procedures.

If population of *C. sordidus* are low in Nickerie, they reach relatively high levels in some plots of Jerikaba. An insecticide application is needed quickly. For the future, alternative biological control methods may be developed; they are based on pheromone trapping, using either mass trapping (monitoring, or in case of low infestation) either traps contaminated with entomopatogenic nematodes (high weevil infestation). These methods need also monitoring and biocontrol efficiency assesment. Technicians have been trained for this purpose according to standardized protocole.

Recommendations are also exposed to improve these methods (i.e. elimination by herbicide injection of surviving banana volunteers plants after flooding, filtration of irrigation water to prevent nematodes contamination of vitro-plants in greenhouses…)

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1. Nematodes

One of the most damaging pathogen of *Musa sp.* worldwide is the burrowing nematode *Radopholus similis* Cobb[1]. This plant-parasitic nematode is distributed throughout most banana-growing areas in the world, causing banana yield reduction that may exceed 50 %[2].

Fig. 1 : female of *Radopholus similis* Cobb

In general, in the intensive banana cropping systems producing fruit for export, the primary means for alleviating nematode yield losses caused is based on chemical control with 2 to 4 nematicide applications per year.). The repeated use of these products on a large scale may cause problems, i.e. workers poisoning, residues in fruits, or water pollution.

During the last fifteen years, many studies have been conducted in Africa and in the Caribbean both by CIRAD and IRD on the conception and improvement of alternative culture systems based on i) the sanitation of contaminated banana fields and on ii) the planting with nematode-free banana plants produced by tissue culture (vitro-plants)[3-4]. This type of control strategy allowed banana producers to delay the application of nematicides for 1 or 3 years after planting; this delay depend mainly of fallow quality: destruction of volunteers plants and host weeds control[5].

After plantation destruction in 2003, an audit of quality of nematode population destruction has appeared necessary. Besides, to avoid systematic use of nematicides, a forecasting system have to be set up; it require trained persons and procedures for root sampling, nematode extraction and counting; and also, a formation to updated technologies of nematodes control.

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[1] Gowen, S.R., Quénéhervé, P., 1990. Nematode parasites of bananas. *In*: Luc, M., Sikora, R.A., Bridge, J. (Eds.), Plant parasitic nematodes in subtropical and tropical agriculture. *Wallingford, UK, CAB International, Institute of Parasitology*, 431-460.

[2] Chabrier, C., Hubervic, J., & Quénéhervé, P.: 2002 : Evaluation of fosthiazate (Nemathorin® 10G) for the control of nematodes in banana fields in Martinique. Nematropica , 32 (2) 137-147

[3] Mateille, T., Quénéhervé, P., Hugon, R., 1994. The development of plant-parasitic nematode infestations on micro-propagated banana plant following field control measures in Côte d'Ivoire. *Annals of Applied Biology*. 125, 147–159.

[4] Sarah, J.L., Lassoudière, A., Guéroult, R., 1983. La jachère nue et l'immersion du sol : deux méthodes intéressantes de lutte intégrée contre Radopholus similis Cobb. dans les bananeraies des sols tourbeux de Côte d'Ivoire. *Fruits*. 38, 35-42.

[5] Chabrier, C., & Quénéhervé, P.: 2003 : Control of the burrowing nematode (Radopholus similis Cobb) on banana: impact of the banana field destruction method on the efficiency of the following fallow. *Crop Protection*, 22 (1) 121-127

1.1 Existing nematodes

In January 2000, 17 roots sample and 16 soil samples have been collected in Jarikaba Surland Plantations for analyses in the nematology laboratory in Martinique[6]. Following banana parasite nematodes have been found:

Nematodes	N° of contaminated roots samples	N° of contaminated soil samples
Radopholus similis	8	10
*Helicotylenchus spp.**	7	7
Meloidogyne spp.	15	15

* *H. multicinctus* Golden in roots ; *H. multicinctus* and *H. crenacauda* Sher. in soil

During survey and training, we have observed:

- ✓ in roots: *Radopholus similis*, *Helicotylenchus multicinctus*, *Meloidogyne spp.*
- ✓ in soil: *Helicotylenchus spp.*, *Rotylenchulus reniformis*

1.2 Support to counting of nematodes (including training of employees and procedures set up)

In each plantation, 5 employees have been trained to:

- ✓ Nematodes attack field symptoms: red-brownish lesions witch evolve to necroses (*Radopholus similis*), superficial lesions (*Helicotylenchus sp.*), gales (root-knot nematodes, *Meloidogyne spp.*)
- ✓ Collecting protocol (see Procedure in annex)

And received basic notions on nematode biology.

To collect root samples, workers need fork spades better than flat spades: flat spades cut roots, doesn't separate roots from soil, are much more tiring to use, increase the risk of injures to banana ratoons and corms.

For nematode extraction, CILOS lend us all laboratories facilities they could. Unfortunately, several apparatus were lacking: an adapted centrifuger (CILOS has only little centrifugers that support up to 15 ml tubes. Using this improper facility was very time consuming, source of mistake and/or nematode loosing (because of multiplication of manipulation while splitting samples). The University of Surinam could only lend us a 60 ml one for one day only; even if its tube were too small, it was possible to form correctly 2 persons to the centrifugation-flotation extraction technique and to nematodes recognition:

- ✓ SBBS technician, Mrs. Daniela MARTASINTONO
- ✓ CILOS laboratory technician: Mrs. Jerilee KARTOWIDJOJO

Mrs Shiva NANHOE and a CILOS researcher, Mrs. Ansmarie SOETOSENOJO received also training on nematodes extraction and management.

To obtain an operational laboratory, following facilities are needed:

- ✓ Flexible tubes (rubber, or preferably, silicone) which fit to faucets size (these tubes are used to control water flow while sieving)
- ✓ A centrifuger with rotor and centrifuge tubes of 300 to 500 ml
- ✓ 4 sieves of 5µ meshes, 15 cm large.

Standard procedure and description figure of the searched species were furnished.

[6] Quénéhervé, P., 2000. Rapport de Mission au Surinam, 11-15 janvier 2000. *IRD Report*, 2 p. + 5 tables

1.3 Nematodes management

1.3.1 Nematicide application

In the past, it seems that only carbofuran (Furadan®) was used on Surland plantations. This product was not the most effective against the burrowing nematode *R. similis*.

In Cameroon, Ivory Coast and French West Indies, the best products are fosthiazate (Nemathorin®) and cadusafos (Rugby ®).

Aldicarbe (Temik®) and terbufos (Counter®) have to be added to this list in African countries; but the former is now forbidden to use it in French West Indies because of risks of residues (revision of Maximum Residues Level from 200 ppb to 100 ppb), high risks of water pollution and risks for wild fauna. Terbufos has also disappeared of European positive list of active ingredients.

3 other products are more or less available on theses markets: oxamyl (Vydate®), ethoprofos (Mocap®) and fenamifos (Nemacur®).

Almost all these products are subject to accelerated bio-degradation. This phenomenon consists on the selection of bacteria that degrade the active ingredient quickly. It may lead to a diminution, or even loss of efficiency when a product is too often used. This is for instance the case with fenamifos in Martinique, formerly a good product now inefficient in numerous areas.
Besides, cross-biodegradation may exist between two products with close with formulae and structure; this is the case with ethoprofos and cadusafos. As Rugby ® has a much better efficiency, Mocap® is not recommended unless cadusafos is not available.
Thus, strategies that combine different product have to be set up. Use of a single product several time per year should be avoided.

Anyway, all these products are either harmful (Nemathorin®) or toxic (all other nematicides); their application is dangerous for workers, may lead to residues in fruit residues, may pollute water and is hazardous to wild fauna (including for instance useful insects). Their use must be thus strictly limited.

1.3.2 Alternative system

The alternative culture systems based on the sanitation of contaminated banana fields by fallow and/or rotation crops and on the planting with nematode-free banana plants vitro-plants have given good results in French West Indies (division by 2 of nématicide application without lost of production). In Surinam, this system has great success chance as:

- ✓ it is possible to flood parcels; this technique is known to be efficient vs. *R. similis* for many years[7];
- ✓ it can be isolated from other banana plantation;
- ✓ it is possible to manage plantation in large scale, avoiding cross-contamination between parcels.

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[7] Sarah, J.L., Lassoudière, A., Guéroult, R., 1983. La jachère nue et l'immersion du sol : deux méthodes intéressantes de lutte intégrée contre Radopholus similis Cobb. dans les bananeraies des sols tourbeux de Côte d'Ivoire. *Fruits*. 38, 35-42.

But to control nematode re-infestation and prevent damages, it is necessary to check regularly each parcels almost 2 times per year. A contaminated parcel should be isolated as soon has it has been found burrowing nematode contaminated, and either abandoned and flooded, either treated as soon as *R. similis* population reach a level upper than 3000 nematodes / 100 g of roots.

1.4 Assesment of the efficiency of flooding + fallow *vs*. nematodes

To obtain a successful eradication of *R. similis*, the land must be free of burrowing nematodes host plants: banana (including volunteers plants), host weeds or rotation culture (which may vary among divers strain of *R. similis*). It needs also healthy vitro-plants, that is to say nematodes free.

To verify the efficiency of the burrowing nematode eradication system, visits have been performed on flooded and fallowed plots.

Fig. 2: A flooded plot with volunteer plant (Jarikaba2-23)

In Nickerie, rooting systems have a safe aspect, except in parcel S2 p2. Due to lack of adapted apparatus (above all a centrifuger) it has not been possible to check an important amount of samples. Thus, we have concentrated our analyses on Jarikaba samples.

In Jarikaba 2, banana volunteers plants may be observed in some flooded plots. These plants may survive has several beds tops exceed water level. In the following fallows, these banana plants will develop as seen in plot 4. These banana plants may host and multiply endoparasitic nematodes.

A survey in fallow have permitted to detect the following nematodes in volunteer's banana roots:

Plot	*Radopholus similis*	*Helicotylenchus spp.*	*Pratylenchus spp.*	*Meloidogyne spp.*
Jarikaba 2 – k4	2310	0	0	450

(All figures express in nematode number/100 g of roots)

These figures, which are not very high, show that undestroyed plants may give a source of inoculum after replanting and that they may be destroyed drastically.

As main nematode damage is toppling over, we have evaluated flooding + fallow efficiency by analyzing root systems of plants (including fallen plants) in Jarikaba 3.

Plot	*Radopholus similis*	*Helicotylenchus multicinctus*	*Pratylenchus spp.*	*Meloidogyne spp.*
Jarikaba 3 – k16	50	50	0	0
Jarikaba 3 – k22	0	235	0	425
Jarikaba 3 – k28	0	0	0	0
Jarikaba 3 – k34	45	120	0	285

(All figures express in nematode number/100 g of roots)

Radopholus similis have been seldom observed, (1 or 2 individuals on half of plates) but are observed. An initial inoculum is also present and nematode counting must be performed regularly (at least 2 time per year) to forecast nematicide application.

Finally, we have analyzed roots and soil samples from vitro-plants in nursery of Jarikaba and Nickerie to check their quality.

Nursery	*Radopholus similis*	*Helicotylenchus*	*Meloidogyne*	*Rotylenchulus*
Nickerie	0	47	14	3
Jarikaba	0	10	1	1

(All figures express in nematode number/100 g of roots + substratum sheath; they don't take in account numerous soil saprophytes nematodes which are present)

These figures are worrying, as they show that nematodes infestation may occur before planting. 2 ways of contamination seem possible:
- ✓ by substratum: which must be disinfected before re-planting (preferentially by physical means, such as vaporization)
- ✓ by water: to avoid it, irrigation water should be filtered with 5 µ filters.

Moreover, vitro-plants should be check to verify absence of contamination. In Martinique, 1 plant each 500 is taken for nematode counting before delivery.

1.5 Conclusion

In Surinam, SBBS has opportunity to use an efficient nematode cleaning technique before fallow. It should be easier to develop an efficient system to control nematodes with agricultural practice. Flooding + fallow *vs*. nematodes gives efficient results but may be improved; top of beds must stay under water level; remaining volunteer plants must be destroyed with glyphosate injection (1.5 ml/mat) as soon as flooding stop.

Besides, control of the absence/presence of *R. similis* has to be checked regularly in plots (2 times / year). Vitro-plants safety must be checked and nurseries infestation risks prevented by sterilizing substratum and filtering irrigation water.

2. Weevils Borer

2.1 Existing weevils

In Jarikaba, two weevils are observed on banana plantation: *Cosmopolites sordidus* (Germar) and *Metamasius hemipterus* L. The first is uniformly black (except young imago which are uniformly brown-red before turning to black after a few days). *M. hemipterus* is brown with orange-red patterns on the back. Both have approximately the same side (about 1 cm length).

Metamasius hemipterus is not very damageful for banana plants; usually, no specific survey is needed.

Fig. 3: ***Cosmopolites sordidus*** **Germar**

At the opposite, the banana Weevils Borer, *Cosmopolites sordidus* is one of the main pests of banana; in Africa, it is often the limiting factor of plantain production[8]. While digging galleries in corms, larvae disrupt feeding of banana plant, and, above all, cause toppling over. Larvae and nymph are found in corms only where they are difficult to reach. Adults are usually either under dead fragments of banana plants or in soil close to banana corms. They enjoy high humidity levels and normally move only when soil surface is wet. They seldom fly, and when they do, quite always during night and for short distance.

In Jarikaba, if the majority of plots are not deeply damaged for the moment, some plots are severely attacked; i.e. in plot 7 of Jarikaba 3 we found about 30 % of plants showing galleries. With such levels, *C. sordidus* may rapidly be highly difficult to control.

Almost no borer's symptoms have been observed in Nickerie.

2.2 support to weevil damage assesement (including training of employees and procedures set up)

As weevil is mainly hidden in corms or dishes and hard to detect, monitoring methods developed around the world (Africa, West Indies or Australia) are based on damage assesement.

For 30 years, in Africa (Cameroon, Guinea and Ivory Coast) and French West Indies Vilardebo assesment method[9] has given good results for monitoring and evaluation of weevils control methods. It consists on peeling corm of recently harvested plants on about 10 cm length x 1 cm depth and to check weevil gallery. Notes, which correspond approximately to the proportion of periphery showing galleries, are attributed. (See annexed draft of procedure). Numerous studies have shown that the average note give a correct approximation of the real percentage of damage circumference with a low cost of handwork.

In dry banana areas (Mayotte, lowlands of Cameroon), it may occur that non-negligible proportion of attacked is located on the base of corm. In such cases, with corm peeling bark no galleries are seen although corm is attacked. Thus, we have cut in piece 50 plants to check that Bark spelling give a correct estimation of attacks. Few differences appeared between both assesment methods; as Vilardebo's method isn't destructive and need far less handwork, it should be adopted alone.

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[8] Gold, C.S., Rukazambuga, N.D., Karamura, E.B, Nemeye, P. & Night, G. (1998). Recent advances in banana weevil biology, population dynamics and pest status with emphasis on East Africa. *Mobilizing IPM for sustainable banana production in Africa, Proceeding of a workshop on banana IPM held on Nelspruit, S.Africa - 23-28 Nov.1998, Frison E.A., Gold C.S., Karamura E.B. and Sikora R.A. edit., INIBAP,* Montpellier, France, 35-50.

[9] Vilardebo, A. , 1973. Le coefficient d'infestation, critère d'évaluation du degré d'attaque des bananeraies par *Cosmopolites sordidus* (Germar) le charançon noir du bananier. *Fruits*, 28 (6), 417-426.

10 technicians and workers have been trained to:

- ✓ Field symptoms assesment
- ✓ Borers larvae +adult acknowledgement
- ✓ Bark peeling
- ✓ Notation attribution

As standard procedure used in French West Indies fit on plots of 1 to 3 ha (approximately the size of plots in Cameroon or French West Indies); it can be temporary used in SBBS plantations. A spatial repartition study of damaged plant have to be realized in order to adapt the assesment protocol to large surface plots (number and repartition of plants to be peeled). The definitive procedure will be dispatched as soon as results of this study will be available.

2.3 Weevil management

2.3.1 Insecticide application

The only product applied formerly on soil, Furadan® (carbofuran) has little efficiency *vs. C. sordidus*. It is no more registered for years neither in Europe (France, Spain and Portugal) because of its lack of efficiency.
Strategies of borer's control with pesticides use two kinds of products:

i) specific products: applied on soil, concentrated around the corm (Regent®-fipronil) or pulverized on trunk surface (Confidor®-imidaclopride; Actara®-thiametoxam)

ii) "double shot" products: nematicide with a correct efficiency against borers when used as a nematicide: crown 30-40 cm large around mats (Nemathorin®-fosthiazate; Counter®-terbufos)

Fipronil (Regent®) is essentially a preventive product. It efficiency is closely related to application quality. Neonicotinides (imidaclopride and thiametoxam) may be used as curative products. These products are developed in western Africa but are not registered in French West Indies.

As terbufos (Counter®) is no longer on E.U. positive list of active ingredients, fosthiazate (Nemathorin®) is the only available product in Martinique and Guadeloupe.

2.3.2 Biological control

2.3.2.1 Pheromone traps

Males of C. sordidus emit an aggregation pheromone, named sordidine, which attract both males and females. Sordidine diffusers can be used to attract weevils in traps that are full of water, in order to kill attracted insects. 2 different traps are commercialized, Cosmolure® (Chemtica) and Cosmotrack® (NPP) which differs mainly by their mode of diffusion: the former used porous membrane diffusers, the latter wick diffuser.

These traps are excellent instrument for monitoring weevil borers infestation. Mass trapping has given good results in Costa-Rica[10] and, in moderate conditions of infestation (less than 20% of infested plants), in Martinique. But when infestations are higher, mass trapping isn't efficient enough to control *C. sordidus* damages.

2.3.2.2 Natural enemies of borers

Fig. 4: *Steinernema carpocapsae* Weiser

Because of it biology (larvae and nymph are very difficult to reach inside corms), use of predators and parasitoids has never given efficient results.

Several teams have studied efficiency of entomopathogenic nematodes. Laboratory studies have shown that some specific strains of *Steinernema spp*. could contribute very efficiently to the control of this pest, especially on larvae and nymphs. Unfortunately, field applications of formulation of *Steinernema carpocapsae* often give inconsistent results due to formulation and conservation constraints, but also to nematode behavior.

2.3.2.3 Combination pheromone traps / entomopathogenic nematodes

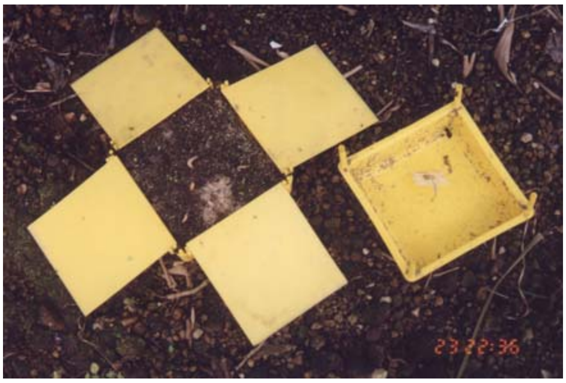

Fig. 5: *Galleria mellonella* infected by *S. carpocasae* in a pheromone trap

Pheromone traps may be use to contaminate weevils with entomopathogenic nematodes instead of killing them. For 3 years, with 5 trials, we have evaluated the interest of pheromone traps using pheromone lure on which we replaced each week 5 G*alleria mellonella* larvae previously inoculated with *Steinernema carpocapsae* (Weiser). Very promising results were obtained, as this method provide a better weevil control than observed with two insecticide applications per year.

Unfortunately, this method isn't developed at a large scale. Several problems may occur while using a technique on experimental plots to industrial plantation.

[10] Alpizar D., Fallas M., Oehlschlager A.C., Gonzalez L. & Jayaraman S., 1998. Pheromone based mass trapping pheromone of the banana weevil, *Cosmopolites sordidus* (Germar) and the West Indian sugarcane weevil, *Metamasius hemipterus* L. (*Coleoptera: Curculionidae*) in plantain and banana. *Proceedings of XIII ACORBAT meet.* Guayaquil, Ecuador, 516-538

2.4 Proposal: biological control large-scale validation

. In a first step, 4 pheromones traps per ha should be installed in both plantations, except in Jarikaba 3 plots where 8 traps will be installed. Trapped weevils will be collected and counted each week; diffusers will be change according to manufacturer recommendations; both operations must be documented.
. During this time, bark peeling should be performed in each plot exceeding one year of plantation according to the draft procedure control.

Of course, the following proposal should be taken in account only if official quarantine services officially agreed it.
. In Jarikaba 3A: as soon as more than 8 weevils per traps will be counted, soapy water in traps will be removed, and trap will be full up with sand. Each week, 5 larvae of *Galleria mellonella* previously inoculated with *Steinernema carpocapsae* strain K27 will be put inside sand of traps. Bark peeling will be performed every 3 month to verify control efficiency.
. In Jarikaba 3B: as soon as more than 8 weevils per traps will be counted, insecticide application (Confidor® or Actara®) will be applied. Bark peeling will be performed every 3 month to verify control efficiency.

2.5 Conclusion

If borers population increase slowly, this pest is especially difficult to control when it is installed, and may destroy a plantation in less than 2 years. A rapid general application of a good curative product (Confidor® 200 EC, 1,25 ml/mat) must be rapidly performed in Jarikaba 3 & 4; thus, it maybe possible in the next future to apply biological techniques on safe bases.

Method combining pheromone traps and entomopathogenic nematodes should be developed to avoid further insecticide application. A large-scale trial with clause exhaustive assesment should be performed to verify that this method fit with local conditions with minimum risks.

3. Other pests

Note: in both plantations, workers have been trained on pests and auxiliaries determination.

3.1 Spider mites

Spider mites (*Tetranychus spp.*) have been observed in all plots we check, in Jarikaba as in Nickerie. But they were present only on old leaves (row 8 and more); above all, several predators systematically accompanied them: *Stethorus sp.* (little black ladybug), *Phytoseiulus spp.* (predatory acaridae), several hunting spider species.

All these predatory arthropods are efficient, but also much more sensitive than *Tetranychus spp.* to insecticides and acaricides (After application, untouched predators will all nourish on poisoned prey). Their destruction may lead to an explosion of spider mites population that may become problematic.

3.2 Trips

Flower trips (*Frankiniella parvula*) is systematically present but its damage are negligible.
Only one little brown trips has been observed in Nickerie; it looked like a silver rust trips but, as it hasn't been catch, it hasn't been possible to determine which specie it was (*Elixothrips brevisetis* and *Hercinothrips femoralis* are very similar; both induce silver rust damage).
No rust trips (*Chaetanaphothrips spp*.) have been detected.

Against trips, the best control technique is early bagging; it has given good results even against *Elixothrips brevisetis*, which is at this moment the most dangerous trips in Caribbean islands.
If bagging is done on time, no chlorpyriphos pre-treated bag is needed. In several trials we followed in Martinique, pre-treated bags don't decrease silver rust when bags are fixed 2 weeks after stage "last hand horizontal". Because of risks for workers and pollution hazards, these bags are inadvisable.

Numerous bunches haven't been bagged in Nickerie. By chance, few trips damages have been observed but in such condition, large amount of harvest may become unmarketable.

3.3 Mealy bugs / scaly bugs

Some mealy bugs (*Dysmicoccus s*p.) and *Diaspinea* have been observed. In all cases, parasitoid hymenopters are present. 2 points ladybug (*Chilocorus tumidus*?), usual predator of mealy bugs, has been observed in both sites.
These pests are considered as secondary pests; usually, no treatments are economically needed.

3.4 White flies

Some white flies (*Aleurodicus sp*.) have been observed. Populations are low and don't seem to be dangerous.

3.5 Symphiles

Some Symphiles have been observed in Jarikaba green house. These arthropods, very harmful on pineapple, are usually considered of no economic importance. But their presence shows that substratum isn't sterilized and that a contamination by other pest (nematodes for instance!) may occurs. Hot water sterilization of substratum before planting should be performed to prevent it.

3.6 Leaf caterpillar

Some damages of little importance have been observed both in Nickerie and Jarikaba. Such pests don't seem to be very harmful.
In vitro-plant greenhouse, diazinon and chlorpyrifos (Dursban®) are used to prevent damages. These applications may be indirectly responsible of spider-mite high population, as these insecticides are poorly efficient *vs*. *Tetranycheae* but harmful on many insects' predators (including ladybug).

3.7 Conclusion

If these “secondary pests” are absolutely not dangerous for the moment, care should be taken to prevent auxiliaries’ destruction (predator or parasites of insects). Spider mites or trips explosion may result of aerial insecticide use.

4 Other plant troubles

In Nickerie, serious glyphosate phytotoxicity symptoms have been observed on vitroplant. This was an occasion to show type of herbicide injuries. Training on good application practice maybe organized if such accident occurs again.

Annexe 1

TERMS OF REFERENCE

Assistance and training on weevil borers and nematodes evaluation

1. BACKGROUND

1.1 General background

The banana sector is important to Surinam 's foreign currency earnings in agriculture and for direct and indirect employment generation. The industry generated approximately $ 10 millions per year in foreign exchange revenues (situation in 2001) and employed directly about 2,560 people. With continuous losses for several years, the financial situation has worsened leading to the closure of the only state-owned production company, Surland NV since 4th April 2002.

The Government of Surinam revised the former Surinam -EC strategic plan of the banana sector adopted in 1999 due to the structural problems of the banana industry in Surinam characterized by a very low productivity below 20 tonnes per hectare, monopolistic relations, small opening to private sector opportunities and confusion of roles of different stakeholders, prevented to undertake accurate measures for restructuring and adapting the sector to national and international markets.

The new strategy encompasses to implement a drastic re-structuring plan and institutional reforms in order to create an adequate framework for the viable long-term development of the banana sector. The objectives of the revised strategic plan aimed at building a sustainable and competitive Surinam se banana industry in a liberalized world market. The revised strategic plan is based on:

- The creation of a new banana company in order to re-launch the banana production on a sound and sustainable basis while the financial and social backlogs will be managed separately through Surland NV. The banana production assets, including the land owning, of Surland NV will be sold to the new company after a valuation. The government as temporary shareholder will bring the working capital needed.

- An important program of investments necessary to make Surinam banana industry competitive in the international market concerning mainly in vitro plants, cableway, packing stations, irrigation system and drainage infrastructure. Over 2002-2006 period, the total investment is estimated at 17,090,608 Euro with an amount of 6,962,211 Euro for Jarikaba and 10,128,397 Euro for Nickerie. The EC special framework of assistance will finance most part of these investments.

- The setting up of a transition phase from October 2002 to May 2003 in order to prepare the re-starting of the banana production operations (cutting down the banana trees, flooding the parcels, reconditioning of the drainage system, building of nurseries) with the re-planting foreseen in June 2004 and the designing of the new banana company organization.

- A divestment of the state from the banana industry before the end of 2004. The privatization is part of this structural reform in order to increase efficiency in the banana industry by promoting wider ownership and entrepreneurship and reducing the Government interference in the economy, to bring foreign capital and knowledge and consequently to alleviate budget problems, reduce the debt and generate future tax revenues.

According to this strategy a business plan and a program of investment 2003-2007, the organisation of the new banana company in different fields (organisation chart, field work organisation, salary and social benefits schemes, jobs description, tasks system, internal regulations, agronomic policies and management information system) are being designed and implemented during this period. The investment program started in March 2003 with the installation of nurseries, the supplying of in vitro plants and the implementation of a complete new irrigation system in Nickerie.

A new commercial policy has also been designed during this period and a dedicated shipping service has been set up to export the new production of bananas in Europe.

The replanting program started in June 2003 and the exports re-started in March 2004. In May 2004 1012 hectares been replanted and the total area of the 2350 hectares will be replanted in June 2005. The employees and workers are being recruited progressively according to their skills and the number of employees in May 2004 amounts to 950 people with the target to employ 2600 people in 2006. The exports foreseen are estimated respectively at 34,000 tons, 85,000 and 95,000 tons in 2004, 2005 and 2006.

The studies required designing the privatisation strategy and to implement the privatisation process has been also achieved in 2003 and 2004.

1.2 Weevil borers and nematodes issues

With the former Surland NV almost all parcels of Jarikaba and about 80% of Nickerie were infested of weevil borers. Nematodes like Radophollus Similes were present but the infestation seems to be on the low side.

The current diseases and common parasites of the banana trees exist in Surinam but the parasitism pressure is low. The heavy soils on which are installed the plantations are known to have a weak receptivity to the nematodes. Furthermore the present banana plantations, installed on polders, allow the cleansing of plantation against soil parasitism by flooding parcels in six month. Following the closing of Surland NV and the resulting agronomic situation of the parcels, and according to the action plan foreseen in the revised strategic plan, all the plantations in Nickerie and Jarikaba have been cut down and flooded in October 2002, before the replanting in June 2003.

Nevertheless this parasitism situation in the case of re-infestations could have a negative impact on productivity and has to be managed.

2. DESCRIPTION OF THE ASSIGNMENT

2.1 Objectives of the mission

Provide assistance in the implementation of the pest and disease policy based on a forecasting and monitoring systems, with the objectives to reduce the use of chemicals or the use of new chemicals for pest and disease management and to build a long-term strategy integrating environment, consumer demand and cost-efficiency methods.

2.2 Requested services

The assistance will consist of making an evaluation about the present infestation situation by weevil borers and nematodes and to train the managers, middle management and employees of the pest and disease department to the suitable techniques.

2.3 Expected results

The technical assistance will deliver the following results:

- Determine the types of the existing nematodes and weevil borers
- Provide support to the counting of nematodes and weevil borers.
- Train the employees of the pest and disease department of Nickerie and Jarikaba estate
- Write the procedures of forecasting and monitoring
- Assessment of the efficiency of the cleansing method against nematodes and weevil borers by flooding the parcels
- Present the updated technologies to manage the weevil bores and nematodes infestation

A report about the achievement of the different results mentioned above will be delivered by the technical assistance.

3. EXPERT PROFILE

3.1 Education, references and experience

The expert(s) must have a long-term experience in the management of weevil borers and nematodes infestation. The expert(s) are engineer in agronomics with a specialisation in banana production. We propose Mr Christian Chabrier, responsible of the nematodes and weevil borers department of Cirad Martinique, whose CV is attached.

The resident technical assistance team (SOFRECO) will provide the expert(s) with all requested information concerning the specificities of Surinam regarding these issues.

The Ministry of planning and Development Cooperation will be the recipient of the studies, annexes and reports.

3.2 Work language

All documents and annexes have to be written in English.

4. LOCATIONS AND DURATION

4.1 Starting and finishing date of assignment

The starting date of the mission is the second and third quarter of 2004. The time estimation for this assistance is one month.

4.2 Location of the assignment

The study will be carried out in Surinam and a presentation will be achieved at the end of the mission.

4.3. REPORTING

All reports and documents will be written in English.