REPORT ON THE MISSION TO THAILAND
FROM 13TH APRIL TO 1ST MAY 1988

MR. DE LA SERVE

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MS/PD

MAY 1988

MISSION PROGRAMME

Wednesday	13th April	Departure for Bangkok.
Thursday	14th April	Arrival in Bangkok. Information meeting on the economy of Thailand with Mr. Latour, Commercial Adviser.
Friday	15th April	First Symposium on natural rubber during which Mr. Pellaumail, Cultural Scientific and Cooperation Adviser kindly invited us to lunch with our Thai partners. Kind invitation to dine with the French Ambassador.
Saturday	16th April	
Sunday	17th April	
Monday	18th April	Departure for Phuket with Mr. Bresson, Rubber Association General Delegate and Mr. Pauche, Editor in Chief of *Usine Nouvelle*. Met by Mrs. Kanokrat Thongtan, Phuket Community College Assistant Director. Visits to U.R.C. (Mr. Kumpol) and to Thai Thavee Rubber (Mr. Surin Tanguthai).
Tuesday	19th April	Visit to smallholder plantations and a wood processing centre. Return to Bangkok.
Wednesday	20th April	Meeting with Messrs. Pellaumail and Lelarge - Symposium overview - 1988 cooperation programme.
Thursday	21st April	Visit to ORRAF Head Office Mrs Chamnoon Thitatarn and Mr. Narong, P.M.U. Assistant Directors.

Friday	22nd April		Departure for Hat Yai - R.R.C. visit Dr. Wate Thainugul. Mr. Patthavuth Oewtragoon. Work meeting with Dr. Noparat (P.S.U., Pattani).
Saturday	23rd April		Departure for Pattani.
Sunday	24th April		Mr. Leroux's arrival. Work meeting.
Monday	25th April	a.m.	Meeting with Dr. Boontham and Mrs Nithi Uthai. Mr. Leroux. Introduced to Mr. Theerapong. Kind invitation to lunch by Dr. Boontham.
		p.m.	Pattani Governor's Office. Pattani ORRAF Sector.
Tuesday	26th April		Visit to the Services in Narathiwat Province accompanied by Mr. Theerapong.
Wednesday	27th April	a.m.	Anpoe Khok Pho.
		p.m.	Meeting with Dr. Noparat.
Thursday	28th April		Visit to the Offices in Yala Province accompanied by Messrs. Somsat and Nukoon.
Friday	29th April	a.m.	Visit to a village (Melan) in the Khok Pho District.
		p.m.	Meeting with the Computer Center Directors. Closing meeting with Dr. Noparat.
Saturday	30th April		Departure from Pattani to Hat Yai then to Bangkok and Paris.
Sunday	1st May		Arrival in Paris.

This mission enabled us to participate in the first Franco-Thai Symposium on natural rubber and conduct an inquiry in Southern Thailand to analyze the running of rubber-based production units.

I. THE FRANCO-THAI SYMPOSIUM ON NATURAL RUBBER

This first Symposium concerned the technology of natural rubber and, more specifically, the processing of natural rubber. The aim of this Symposium was twofold : acquaint manufacturers with certain scientific research work on natural rubber and set up contacts between Thai and French manufacturers with a view to setting up partnerships to produce manufactured goods.

Although this Symposium was oriented towards technologies involving the processing of natural rubber, the organizers also thought it would be interesting to discuss rubber production.

A paper entitled ***Towards Optimizing the exploitation of Hevea Brasiliensis*** by M. de La Serve and J. Commere was presented jointly with SODECI.

The purpose of this paper was to explain the utility of a reduced tapping frequency (though not excessively reduced) on latex flow and regeneration (cf. Annex I). Results from a trial using four clones are given, as well as a few orientations or recommendations on techniques to be applied on a large scale.

This first Symposium, organized by Thai research organizations, the French Embassy and IRCA, was a great success (about 250 participants). It enabled contacts to be made between both scientists and manufacturers or businessmen and between Thai and French manufacturers.

Following the Symposium, a general visit was made to the Phuket plantations which enabled Mr. Bresson (General Delegate of the Rubber Association) and Mr. Pauche (Editor in Chief of ***Usine Nouvelle***) to see first hand the sector leading up to natural rubber.

Through Mrs. Kanokrat Thongtan's kind help, we were able to visit :

- a smallholder plantation
- a smoked leaf mill, a subsidiary of Tek Bii Hang
- a concentrated latex and latex granules mill using inferior quality latex (Nganthavee)
- a pallet and charcoal mill.

2. ANALYSIS OF RUBBER-BASED PRODUCTION UNIT OPERATIONS WITH A VIEW TO SETTING UP A TAPPING TRIAL

On the earlier missions carried out in connection with the Ministry of Foreign Affairs in 1986 and 1987, it was felt that a study was necessary to analyze the running of rubber-based plantations with a view to setting up future tapping system trials. This study is to be centred in the Yala, Narathiwat, Pattani and Phuket provinces with the P.S.U. University of Pattani serving as the center.

This mission made it possible to launch this study.

2.1 Reminder of the study's aims

This study was designed to analyze the running of rubber-based production units with a view to proposing tapping techniques adapted to the conditions and motivations of different types of planters.

These techniques will make it possible to improve the planter's standard of living (income, free time, work productivity, etc.) and the economic life of the trees.

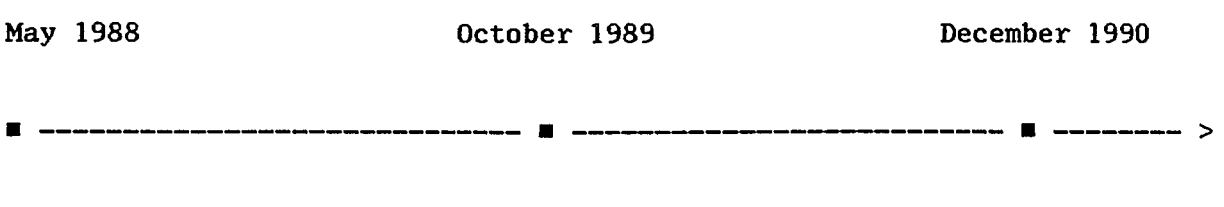
Subsequent to this study, it will be possible to determine which type of tapping trials are to be set up and with which smallholders.

2.2 Partners

The P.S.U. Pattani Science and Technology Department (Dr. Boontham and Dr. Noparat) and the IRCA - EHSS constitute the central working party for launching this study.

The Rubber Research Institute is to contribute to this study by carrying out support missions as and when needed at the same time as the IRCA missions. It should be recalled that this project includes 3 phases (Figure 1) :

Figure 1



It is of course essential for all those involved in the natural rubber sector and in research and development to be motivated by this study and take into account the tapping trial recommendations resulting from the study's conclusions.

In this aim, ORRAF Management and Regional Service Departments (Office for Rubber Replanting Aid Fund) and the Department of Agriculture were contacted and they proved to be very interested in this study, given the extent of the problems involved in tree exploitation.

Finally, it would be worthwhile exchanging views with the Department of Natural Resources and the Hat Yai Science Department which, among other things, carry out research into the methodology of farming system analysis.

If possible, and depending on the progress made in this study, an initial meeting could be held in October/November with the different partners concerned.

Figure 2 lists the different partners involved in phase I of the project : analysis of production unit operations.

Dr. Noparat's expertise in physiology and his visits to the Ivory Coast and France will be important for phase II : setting up of tapping trials.

2.3 Methodology

This study should make it possible to monitor planter activities throughout a complete rubber cycle; hence it should last 1 year.

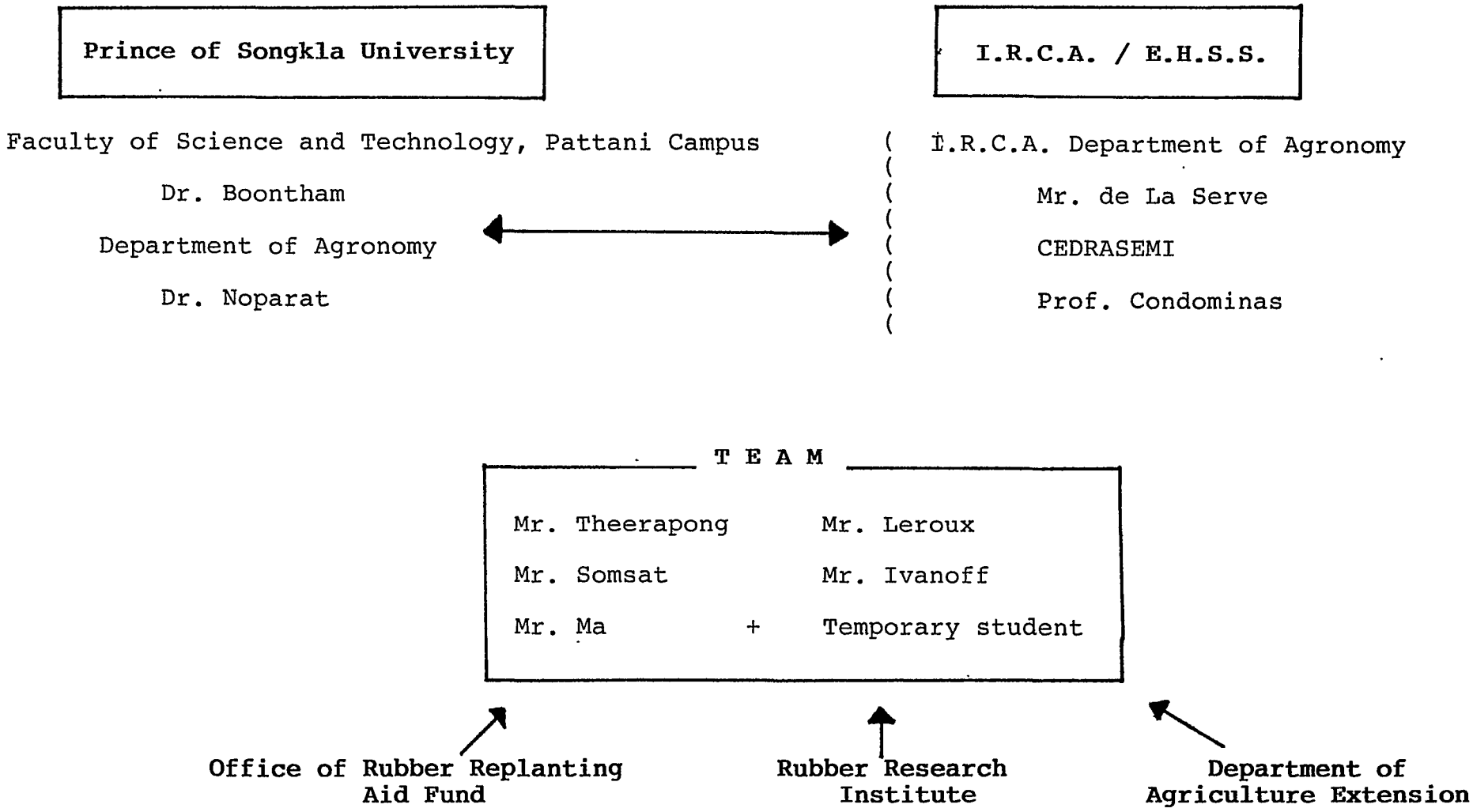
Ten villages will be chosen in the Pattani region and 4 to 5 villages at Phuket; 10 planters per village will be monitored.

The investigations will include :

- a general questionnaire on the farming system in each village
- a demographic and production system questionnaire per exploitation leader (2 to 3 visits)
- an on-going technical questionnaire kept track of by two investigators in each village concerning, in particular, tapping and production parameters, marketing, budgets and work time required.

Figure 2 : Improvement of rubber tapping systems

Phase I : Analysis of smallholder management



In addition to this technical questionnaire undertaken every 2 days, a monthly check will be made of bark consumption, tapping quality and the number of dry trees. This monthly check will be carried out by the village investigators.

The investigator network will be visited once a month, alternately by Mr. Theerapong or Mr. Somsat and by Mr. Leroux or Mr. Ivanoff.

An in-depth analysis of 2 villages will be carried out by Mr. Leroux and Mr. Ivanoff.

2.4 Setting up the study

Through Dr. Boontham's and Dr. Noparat's help, it was possible to launch the preparatory phase of the study :

- Development of the methodology to be followed
- Drawing up of the general and technical questionnaires
- Visit to the Agricultural Service "Governor's Offices" in the districts (Anpoe) and ORRAF provincial offices.

Subsequent to these visits, districts were selected for the future choice of villages :

Province	Village	Districts
Pattani	2	Khok, Saiburi
Songkla	1	Nathawi
Narthiwat	3	Rangae, Ruso Sungai Padi or Djarre
Yala	4	Betong, Tantho, Yaha, Raman

- Definition of the main selection criteria to be taken into account for choosing :

. Villages

- Distance (from main road and town)
- Religion
- Presence of other cash crops
- Geographical relief
- Existence of group processing/marketing
- Proximity to mills

Planters

- Size of plantations
- Age of plantations
- Type of planting material
- Type of wage earning
- Residence or name of the owner
- Adherence to a group

♦ Contact with the "Computer Center" for processing on-going technical data.

2.5 Funding for the study

The budget has been adjusted in compliance with the organization decided upon and the expense book.

Funding for this study is ensured by :

♦ a private grant for Messrs. Leroux and Ivanoff
♦ the M.A.E. and the CIRAD for operating costs.

The University of Pattani has kindly offered an office for this project as well as the different services it can provide (secretariat, translation, data processing) at cost price.

CONCLUSION

The success of the first Symposium on natural rubber, which concerns Thai manufacturers, planters and university researchers, reflects the interest taken by our partners in cooperating with France in the field of natural rubber.

Increasing local tranformation is a priority, improving exploitation systems is another. The stakes are considerable with respect to this latter point, both at the microeconomic level (improvement of the planter's standard of living) and macroeconomic level (increasing the trees' economic lifetime).

TOWARDS OPTIMIZING THE EXPLOITATION OF HEVEA BRASILIENSIS

M. de LA SERVE and J. COMMERE

Abstract :

Latex production depends on two main factors, flow and rubber regeneration in situ. The interval between two tappings considerably influences production; tapping in a half-spiral every one or two days does not lead to an optimization of yields. Reducing the tapping frequency provides for better rubber generation, hence there is more energy available for intercellular transport. Stimulation with Ethrel activates laticifer metabolism.

This paper presents certain results on the yields obtained from a few clones used in various exploitation systems.

* * *

I. Physiological utility of reducing tapping frequency and stimulation

1.1 Reminder of production factors

The production of latex after tapping depends on latex regeneration between tappings and on how long the latex flows during tapping. Latex flow and regeneration in the tree are therefore the two main factors affecting production.

A certain number of parameters influence these factors, particularly :

- Total Solid Content (T.S.C.)
  * expression of rubber anabolism
  * effect on viscosity and flow

- Sucrose
  * precursor of rubber
  * important element in the establishment of the osmotic pressure gradient

- Pi
  * energy element in metabolism
  * element stabilizing latex

- R.SH
  * activates enzymatic reactions
  * stabilizes latex

- pH
  * acts on enzymatic reactions
  * effects latex stability

- R.P.
  * reflects rubber anabolism
  * effects rubber stability

1.2 Influence of tapping frequency

The degree to which the different parameters influence flow and regeneration varies according to tapping frequency : a trial on GT1 planted in 1973, opened in 1979 at 1.20 m gave the following results (Eschbach *et al.*, 1984)

Production per tree and per tapping, the result of regeneration and flow, reaches its maximum when the interval between two tappings is 4 to 7 days, then considerably diminishes. The T.S.C. reaches its maximum at 14 days, then decreases. The

concentration in sucrose, a cis-polyisoprene base molecule, is very low in trees tapped daily and increases correlatively with the time interval between two tappings. Moreover, it has been shown that turgescence pressure in the tree is quickly established, whatever the tapping frequency (Fig. 1). These results indicate that latex regeneration is the limiting factor for production when there is a high tapping frequency.

In addition, it has been observed that rubber synthesis reaches a maximum and then decreases, while the sucrose concentration continues to increase.

The redox potential (RP) of latex is low when tappings are close together (1 to 4 days), which reveals high anabolism. When tappings are less frequent, the redox potential, hence anabolism, decreases. The concentration in acid phosphatase and the bursting index (B.I.) reflect the stability or reconstitution of lutoids, vacuoles playing a role in cell detoxification and latex coagulation.

Analysis of inorganic phosphorus evolution and R.SH (Fig. 2) shows that energy activity, hence metabolism, reaches a maximum 4 days after tapping and returns to normal with R.SH time, cellular membrane protecting systems.

The decrease in metabolic activity after a certain time interval between two tappings largely explains the production drop observed. Flow requires a transfer of water, which is tied to the osmotic pressure gradient. This gradient results from preceding active transport of solution and ions. Thus the reduction in metabolic activity acts on membrane transport phenomena, hence on flow.

This hypothesis was confirmed by applying ethrel, an ethylene generator, to the tapping cut, which activates laticifer metabolism (Tupy, 1969). The drop in production is no longer observed and sugar supply becomes the limiting factor (Fig. 3). Regeneration is complete after 14 days for tapping in a half-spiral and 21 days for tapping in a complete spiral.

Numerous studies have been made on the use of stimulants to increase production, initially copper and 2.4 D, then, from 1968/1969, ethylene (Abraham, d'Auzac).

After applying ethylene, a certain number of biochemical and physicochemical modifications can be observed which result in improved metabolism and flow.

1.3 Recommandations based on physiology

In the long run, daily tapping limits production per tree and per tapping; the sucrose concentration quickly drops and metabolic activity is insufficient to ensure good flow.

Low frequency tapping (every fortnight or less) also results in a drop in production per tree, due, in particular, to a reduction in metabolic activity, thus to a lack of available energy.

Stimulation leads to higher exports of rubber due to an increase in metabolism, and therefore requires more regeneration time.

From this fundamental research it can be seen that to optimize tree exploitation systems, stimulation is required in correlation with lower tapping frequencies. The value of low tapping frequencies compensated for by stimulation had already been hinted at for a long time (Campaignolle, 1955), where stimulation is used not to increase production but to enable the tree to make better use of its metabolic potential (Gener, 1975). Certain positive effects are worth mentioning :

♦ Reduction in bark consumption associated with a lower tapping frequency

Theoretically, the reduction in annual bark consumption should be proportional to lower tapping frequencies. However, in order to remove the microcoagulants located on the tapping cut, the thickness of the bark to be removed at each tapping is inversely proportional to tapping frequency. The following table gives recommended bark removal for downward tapping.

Bark consumption depending on the frequency of downward tapping

Tapping frequency	Bark removal/ tapping in mm	Nbr of tappings	Annual bark removal
d/2	1.3	150	175 mm
d/3	1.5	100	150 mm
d/4	1.7	75	125 mm
d/6	2.0	50	100 mm

Bark savings achieved with low tapping frequencies can even make it possible, with a good monitoring system, to avoid exploitation on renewed bark. Even when the bark has completely regenerated (no wounds), production on renewed bark is less than that on virgin bark. Moreover, bark renewal is better with low frequencies (Paardekooper...)

♦ Increase in labour output and tapper specialization

A low tapping frequency enables the tapper to take on a considerable number of tasks. Tapping every 6 days, a tapper can thus cover 6 to 10 ha of rubber. This increase in labour output tends to make tapping work a specialization as the tapper can let others do upkeep and collection work.

♦ Reduction of the number of dried cuts

A high number of dried cuts is the direct result of too many tappings. Lowering tapping frequency has a favourable effect on the number or length of diseased cuts (Eschbach, 1987). It is certain that clones do not respond in the same way to lower tapping frequencies; tapping systems have to be adapted to each clone.

2. Results obtained in agronomical experiments

On different clones and for orientation purposes, a series of trials was set up to learn how clones react to different tapping systems. Tapping frequency and the number of stimulations varied.

The results for four clones are given in the following figures. Frequencies d/3, d/4 and d/6 6d/7 were compared to frequency d/2 6d/7. Panel stimulations at 2.5 % varied from 0 to 12 depending on the clones.

♦ PR 261

In this trial, planted in 1976 and tapped in 1982, the results after 5 years of production show that :

* A tapping frequency of d/3, whatever the number of stimulations, is better than a frequency of d/2; production increases with the number of stimulations.

* On the other hand, for the lower frequencies d/4 and d/6, 8 and 12 stimulations were required respectively to obtain yields superior to the control d/2.

Growth is satisfactory and inversely proportional to production; the percentage of diseased trees is low.

TABLE 1

TAPPING SYSTEM TRIAL ON PR 261

Tapping System	Stimulation Pa 1/1 ET 2.5 % Number	g/t 1982-1987	Dryness Cut length %
1/2 Sd/2	0	9 310	0,6
1/2 Sd/3	4	11 670	0
	8	14 703	1,0
	12	16 169	5,9
1/2 Sd/4	4	8 487	0
	8	12 609	0
	12	13 700	3,6
1/2 Sd/6	8	8 243	0
	12	9 895	0,3

♦ PB 217

Planted in 1977, this trial was tapped in 1983 using different exploitation systems.

The yields obtained with tapping every two days are low. The best production is obtained on trees tapped in 1/2 S d/3 and stimulated 12 times a year. Lowering the frequency to d/4 makes it possible to obtain yields which are not significantly different from the best treatment (Table 2).

TABLE 2

TAPPING SYSTEM TRIAL ON PB 217

Tapping System	Stimulation Pa 1/1 ET 2.5 % Number	g/t 1983-1987	Dryness Cut length %
1/2 Sd/2	0	11 801	9,1
1/2 Sd/3	4	14 124 abcd	1,7
	8	16 186 ab	3,6
	12	17 293 a	0
1/2 Sd/4	8	15 825 abc	0
	12	14 992 abc	0
1/2 Sd/6	8	11 789 d	0
	12	13 159 bcd	0

This clone is little sensitive to brown-bast and only the S/2 d/2 design shows dry trees.

◆ PB 235

On this trial, planted in 1978 and tapped in 1983, the results (Table 3) show that the stimulations carried out do not compensate for lower tapping frequencies. This clone has a high metabolism which does not require stimulation. When the time interval between two tappings increases, the energy available is insufficient and flow diminishes (Prévôt, 1986).

TABLE 3

TAPPING SYSTEM TRIAL ON PB 235

Tapping System	Stimulation Pa 1/1 ET 2.5 % Number	g/t 1983-1987	Dryness Cut length %
1/2 Sd/2	0	18 052	10,4
1/2 Sd/4	2	14 820	6,5
1/2 Sd/6	4	14 528	0

♦ AVROS 2037

On this plot tapped since 1983, the same type of trial was set up. After two years, the results show low yields using the d/2 tapping frequency compared to yields from d/3 and d/4 tapping frequencies (Table 4). The metabolism of this clone needs to be accelerated.

TABLE 4

TAPPING SYSTEM TRIAL ON AVROS 2037

Tapping System	Stimulation Pa 1/1 ET 2,5 % Number	g/t 1985 - 1987
1/2 S d/2	0	4 699 c
1/2 S d/3	8	6 543 a
	10	6 158 ab
1/2 S d/4	20	6 815 a

The results of these trials show differences in the clones' physiological reactions to tapping. Nonetheless, active stimulation generally activates their metabolism and makes it possible to lower tapping frequency.

3. Lower tapper frequencies at the commercial level

On the commercial plantations in the Africa, the tapping system currently used is 1/2 S d/3 6d/7 ST ET Pa 2.5 %

So as to improve labour productivity, large scale frequency lowering trials are set up and these make it possible to obtain satisfactory results. For example, with clone GT1, tapping once a week gives productions reaching 85 to 95 % of the d/3 productions (Anon, 1988).

Yields on trees tapped in d/6 6d/7 are even better when :

- the trees are old (from 15 years onwards)
- the trees are tapped on virgin bark and high panels
- tapping takes place during the humid period (June to November).

The increase in DRC linked to lower frequencies is compensated for by the effects of increased stimulations. The savings in bark observed in d/6 are approximately 30 % compared to tapping in d/3.

Finally, the tree's reaction to lower frequencies is a clonal characteristic : for example, PR 107, GT1 and PB 217 respond well to lower frequencies.

Conclusion

Latex production depends on the regeneration of rubber in the tree and on flow. The analysis of certain parameters clearly reflects the factors limiting production. Stimulation activates the tree's metabolism and, in particular, active transports, while lower frequencies enable a better regeneration of rubber. The experimental results obtained confirm these fundamental hypotheses.

Clone PB 217, PR 261 and Avros 2037 react well to lower tapping frequencies because their metabolism can be activated by stimulation. On the other hand clone PB 235, with a high intrinsic metabolism, does not react to stimulation and cannot, therefore, be tapped at low frequencies.

On a commercial scale, the d/3 frequency is often used. Depending on economic and social conditions, however, certain plots or plantations are tapped in d/4 or d/6. The advantages most appreciated are better tapper productivity, a reduction in bark consumption and a longer economic life per tree.

Knowledge acquired over the years on tree metabolism makes it possible to orient tapping practices, and, in particular, to adapt exploitation recommendations depending on the type of clone.

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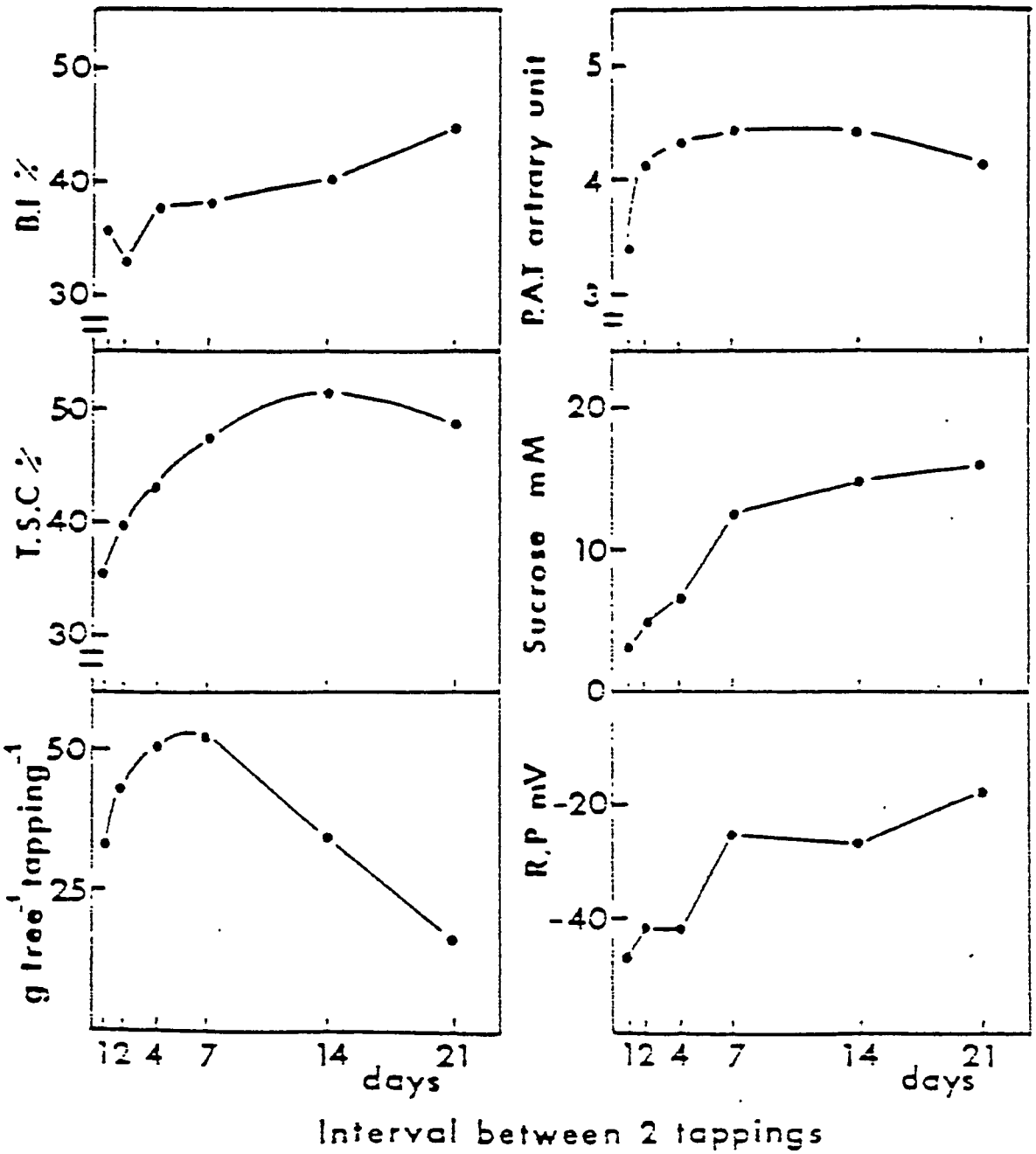


FIGURE 1 : Influence of interval between two tappings on physiological parameters

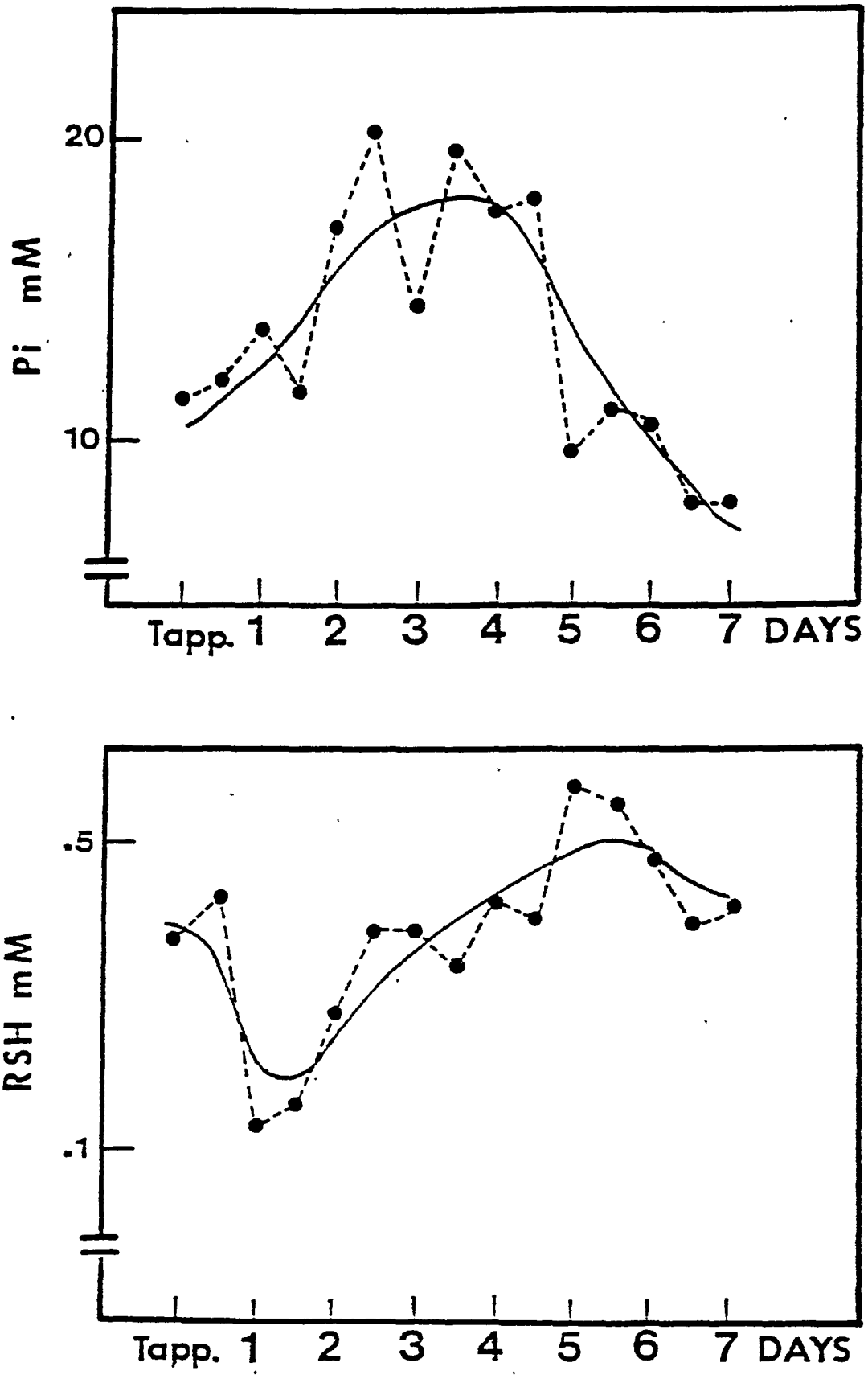


FIGURE 2 : Influence of interval between two tappings on physiological parameters

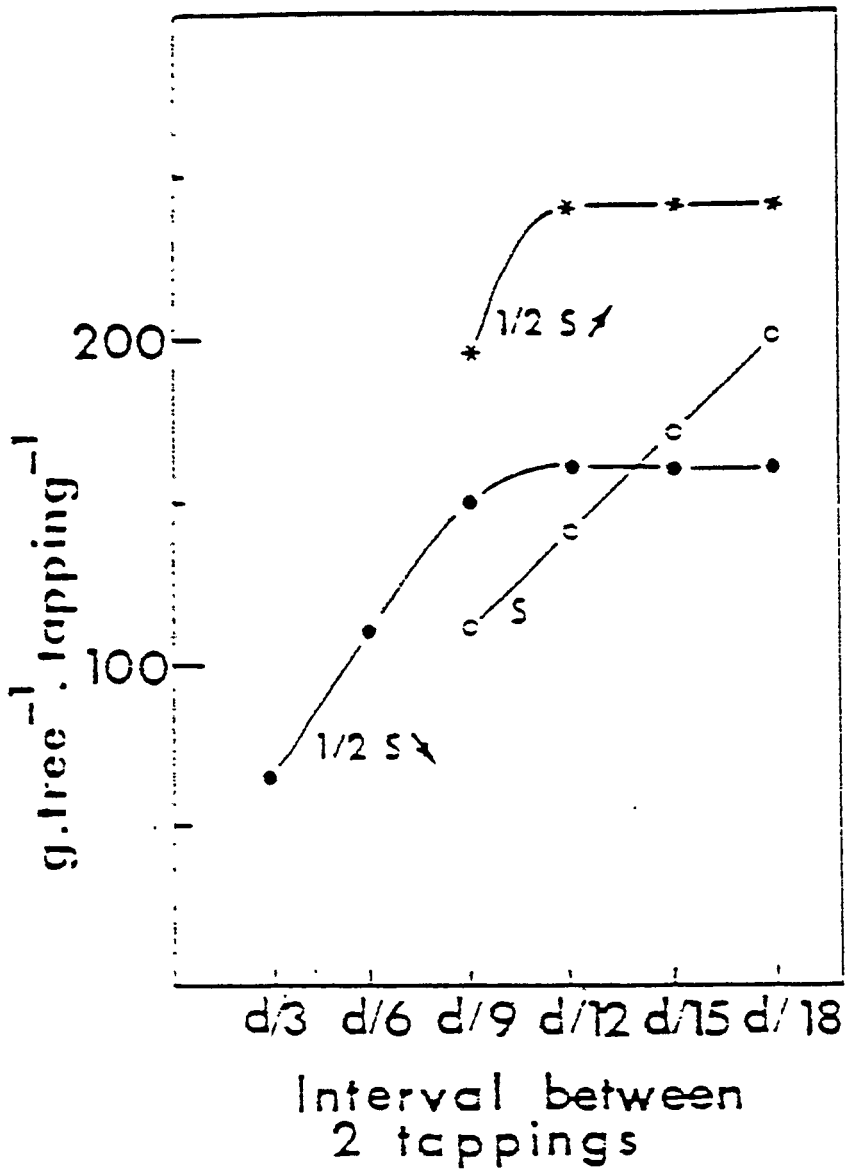


FIGURE 3 : Influence of interval between two tappings on the yield

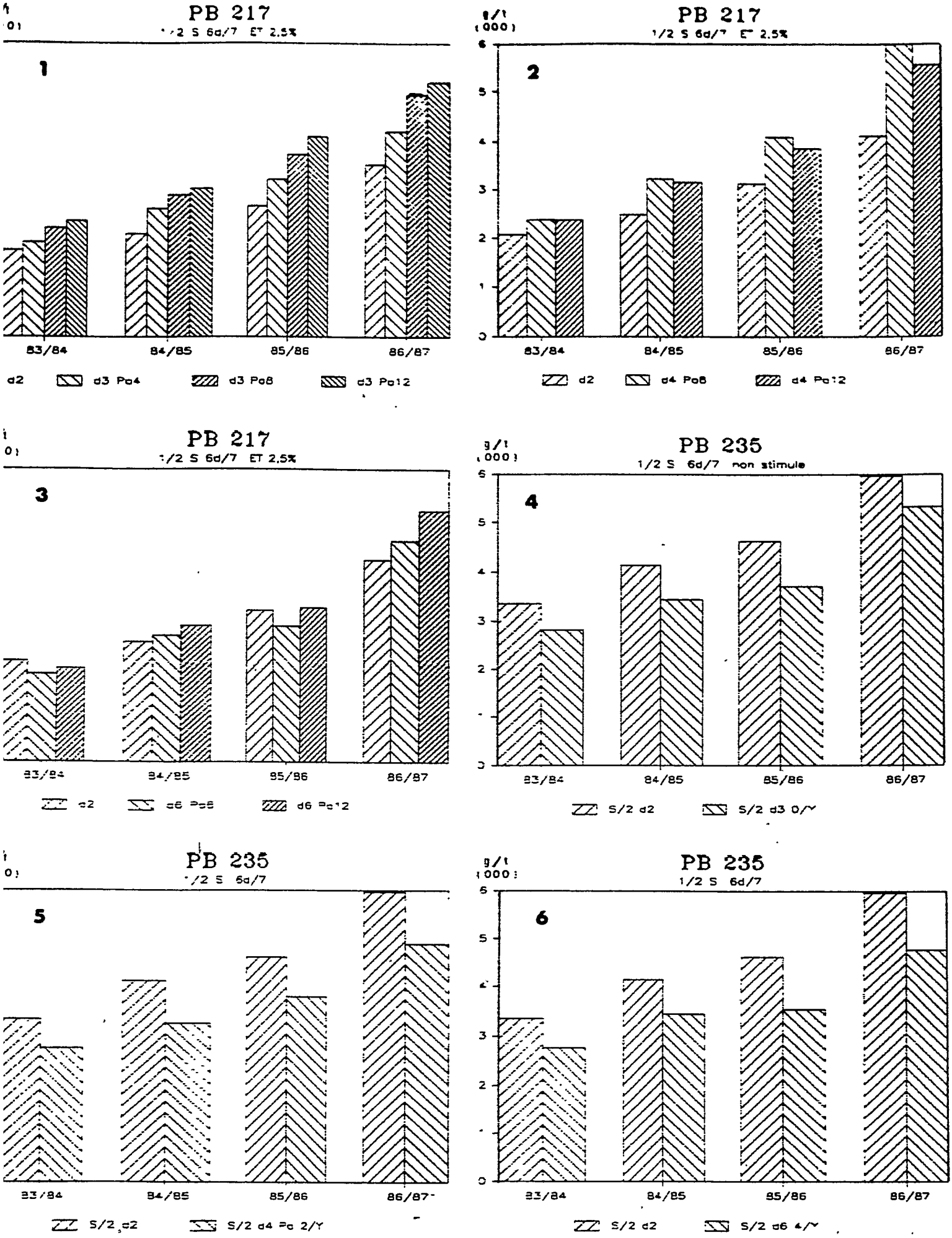
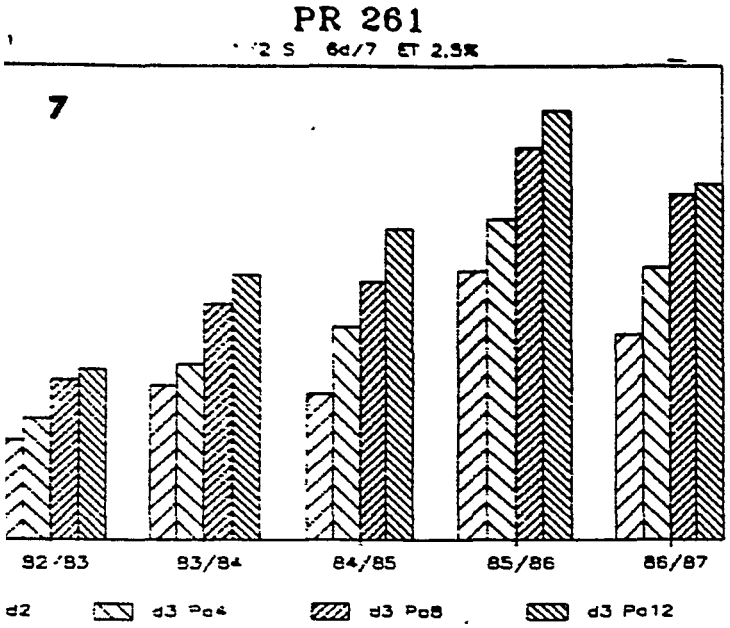


FIGURE 4 : Influence of the reduction of the tapping frequency on the yield for various clones


PR 261
7
82/83
83/84
84/85
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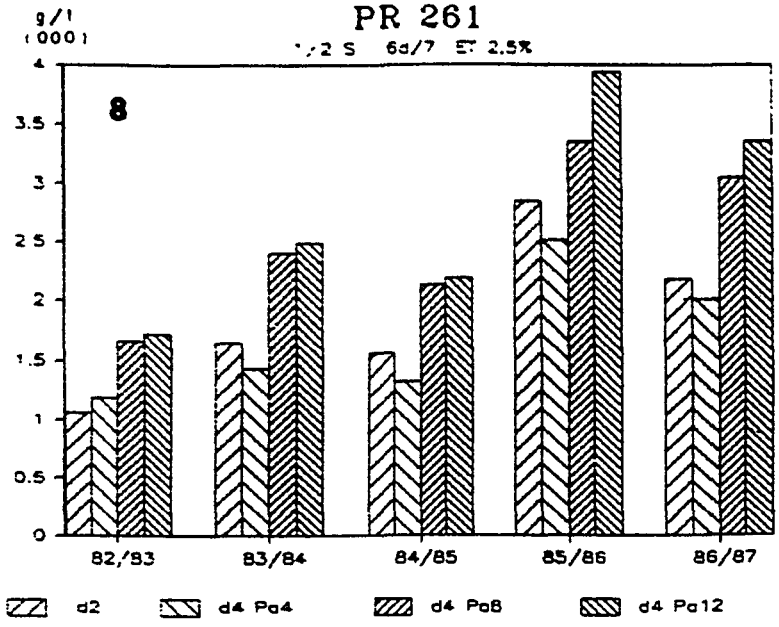
86/87
d2
d3 Pa4
d3 Pa8
d3 Pa12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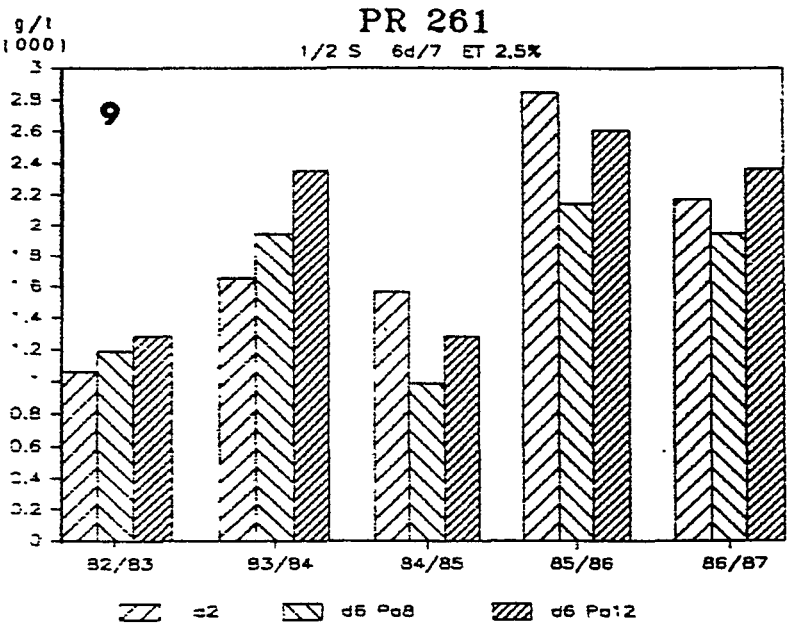
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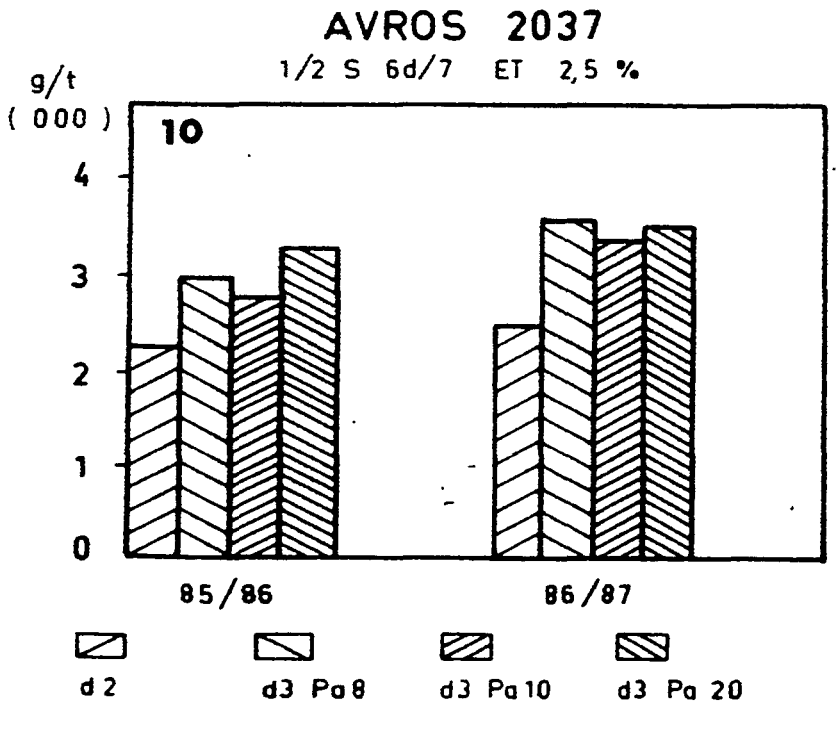
AVROS 2037
1/2 S 6d/7 ET 2,5 %
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d 2
d3 Pa 8
d3 Pa 10
d3 Pa 20