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The Planter

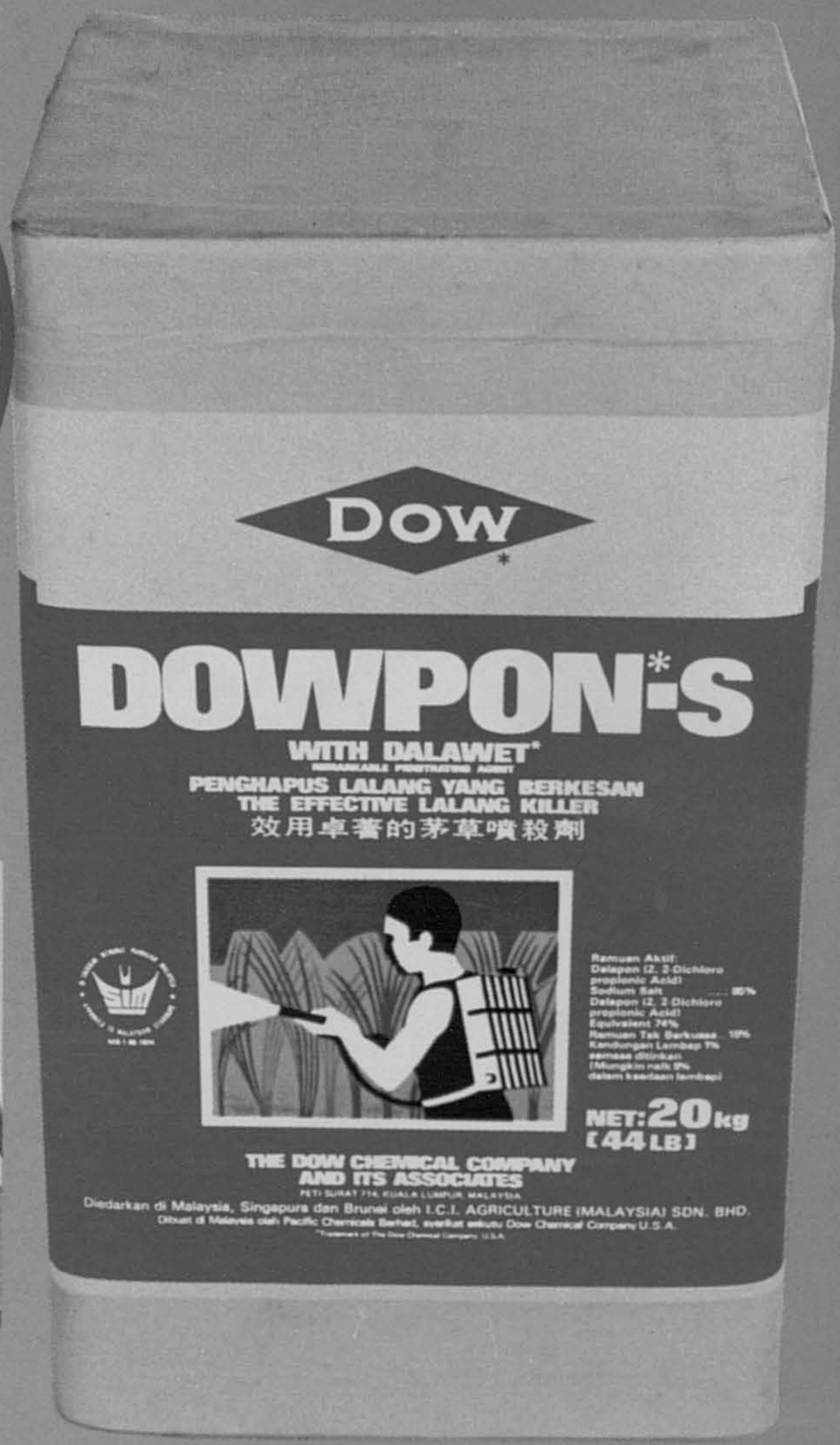


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20 kilo
BARU



SEBELUM
BEFORE

SELEPAS
AFTER



DOWPON*-S

RACUN RUMPUT
di dalam tong baru 20 kilo yang menjimatkan

Dowpon*-S ialah satu-satunya racun rumput yang di-rumuskan dengan Dalawet*, bahan peresap luarbiasa yang membolehkan racun rumpai itu cepat menyerap ke akar pokok dan membunuhnya dengan segera.

Dowpon*-S cukup mudah digunakan dan menjimatkan. Cuma campur dengan air yang diperlukan dan kemudian sembur pada lalang. Tidak ada bahan pembasah atau bahan lekit diperlukan.

Dowpon*-S di dalam tong 20 kilo adalah lebih menjimatkan untuk mengawal lalang tebal dan yang tumbuh sikit-sikit dengan berkesan.

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Dowpon*-S is the only weed-killer formulated with Dalawet*, a remarkable penetrating agent that allows quicker absorption of the weed-killer into the plant system for a faster kill.

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Dowpon*-S in the 20 kilo drum is even more economical for effective control of sporadic and sheet lalang.

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The Planter

KDN 9432

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The Planter assumes no responsibility for the statements and opinions expressed by contributors.

SENTIASA MAJU

The Incorporated Society of Planters

Founded 1919

THE SOCIETY REPRESENTS the Planters of Malaysia and other territories, whose personal and professional interests it is bound to endeavour to secure and promote.

OBJECTS foremost in the Society's Memorandum of Association are:

To promote the general interests of the planting profession.

To promote the advancement and facilitate the acquisition of that knowledge which constitutes the professional qualification of planter.

To watch over, promote and protect the mutual and individual interests of its members in respect of matters pertaining to or arising from their employment in the planting profession.

To promote and maintain good feeling, co-operation and understanding between members and their employers.

ACHIEVEMENTS of the Society are a technical education scheme, the publication of authoritative works on tropical agriculture, a monthly magazine featuring original technical articles, the sponsorship of conferences and symposia on tropical crops, and the organisation of joint consultation with employers.

MEMBERSHIP of the Society is open to: —

A Those directly employed in plantation management such as estate managers, assistant managers, superintendents, supervisors and cadets, and

B Executive engineers, estate medical officers, and qualified scientific or administrative staff of estates or organisations mainly concerned with the planting industry.

Category B may include those employed in such other senior executive, administrative, professional or advisory capacities as may be deemed by the Executive Council as being equivalent thereto

Neither category shall include clerks, conductors, hospital assistants, etc.

ENTRANCE FEE for new and rejoining members is $10/- and must accompany application.

ANNUAL SUBSCRIPTION RATES* are as follows: —

	During the calendar year in which eligibility for membership occurred and the 4 succeeding calendar years.	Subsequently
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Ordinary Members employed as Managers, Assistant Managers etc. and normally resident in:		
Malaysia and Singapore	$ 48	$ 78
New Guinea and Brunei	$ 44	$ 60
Approved Overseas territories	$ 44	$ 44
Category B		
Ordinary Members employed as Executive Engineers, Estate Medical Officers, Research Staff etc., wherever resident	$ 48	$ 48

* Rates are proportionate for a part-year when joining.

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The Planter

KDN 9432

MAGAZINE OF THE INCORPORATED SOCIETY OF PLANTERS

(1) *The Planter* is published monthly from the Society's Office at 1, Pesiaran Lidcol, Kuala Lumpur 04-06, Malaysia.

(2) It features original technical articles in tropical agriculture, for the benefit of the planter (in active service or practice), papers relating to the Society's Technical Education Scheme, and other contributions of more general interest.

(3) The magazine's current print order is 2 000 copies and this is steadily rising.

(4) *The Planter* is read in some 51 countries*.

(5) Copies are exchanged with a wide range of agriculturally based institutions.

(6) Subscription copies go to 32 countries.

(7) Annual subscription is M$36, including postage by surface mail.

(8) Regular advertisers include national, regional and international organisations.

(9) Of particular interest to advertisers is the fact that the readership comprises largely executives and professional persons with considerable spending power.

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Editorial:

THE CREATIVE CLIMATE

Sages and savants, in the days of yore, renounced worldly interests and took to the hills whenever they wanted to create a work of significance.

What with the varying degrees of invasion of the hills and the jungles by today's civilisation, it is becoming increasingly impossible for any one to so 'retire' to be creative.

In fact, it is now widely believed in management circles that creativity, like charity, must begin at home. If the 'creative' climate does not exist in one's own office, factory or other place of work, one can hardly be blamed for the lack of enthusiasm or the lower calibre of output resulting.

'Job satisfaction' is an important parameter of corporate success today, and top-ranking organisations take undue pains to build it into every job, however big or small.

For, a man (or woman, in modern corporate circumstances) does not live by the pay packet alone. He (or she) needs pleasant working conditions and viable relationships. Otherwise, frustrations set in and affect the quality of work in many ways.

Especially in 'outdoor' professions like planting, where the calibre of results is often controlled by intangibles like good personal relationships with colleagues and others, excellent 'sixth sense' or perception as well as an innate pride in what one is doing currently.

It is in this context that we welcome the recent remarks made by the Director of the Rubber Research Institute of Malaysia about the pre-requisites of the creative climate in professions connected with science and technology.

We have published these remarks elsewhere in this issue and would commend them to any director, manager or entrepreneur who has long-term interests of his organisation or enterprise in mind, in dealing with people.

Yes Sir! It is becoming widely recognised in all aspects of corporate life today that 'the people factor' is among the most important criteria of success. Even with the best resources, no organisation can succeed in the long run if its own 'people factor' continues to remain at a low ebb.

Of course, research and development must be proved to be viable under current conditions, as otherwise, they may be deemed to be curious throw-backs in corporate history.

But, research and development vitally depend upon people who alone, notwithstanding the state of the equipment and other facilities, can well and truly 'create'.

We wish to underscore this aspect of management in the planting industry, in the light of some recent tendencies to regard the planter as the expendable end of the management ladder. Where this has been the rule rather the exception, the (progressively poor) results obtained by the organisations concerned are proof enough to convince others that the path to glory does not lie strewn with scalped heads.

To quote Tuan Haji Ani, "are we (now) at the point where we can identify the ingredients necessary to produce the creative climate?". This is the poser head-office whiz kids have to answer prior to wielding the axe against the planter—whether personally or in relation to his advice and ideas.

For, even as Tuan Haji Ani rightly pointed out, "we need to set our sights on *realistic* goals, *viable* programming and monitoring norms and *right incentives* to encourage people into utmost creativity in their respective fields". In relation to planting, agency houses know what is the emphasis in the words in *italics* in the context of good management.

Our agro-based industry vitally depends upon the creativity of the planters to translate the results of research and the decisions of the boards into reality at ground level. Their ranks comprise the 'colonels to corporals' echelons in the chain of command and it is on their job satisfaction that directors will be able to report "excellent results attained once more by the company".

Hence, there is urgent need for the captain of our industry to recognise the 'people factor' in dealing with the planter-fraternity who need to be reassured of the 'creative climate' to maximise production at the most viable levels of product costs, against the background of desirable political and social equilibria.

Malaysia is currently undergoing a period of trial and problems, largely as a result of the aftermaths of worldwide inflation and recession. The security situation is also causing concern, especially in outlying areas which repeatedly hit headlines during our first Emergency.

Who but the planters are industry's front rank pioneers in such age of speedy change and social upheaval? If they should continue to remain loyal sentinels ensuring peace and prosperity in plantation areas, they desperately need the creative climate which the rest of the Malaysian community have been assured of.

We thank Tuan Haji Ani for the timely reminder which may be the beginning of corporate tendencies towards the creative climate.

Planter, Kuala Lumpur **52**: 161–171 (1976)

The I.M.U. (integrated mechanical upkeep) concept herbicide spraying

JOHN ANDERSON*

SUMMARY

This section of the IMU concept deals with the application of herbicides, potentially in all plantation crops, although the bulk of the work described has been carried out in oil palms, with some work in rubber. The spraying machine is an imported unit modified in Malaysia to suit local conditions and to meet the flexibility required in estate useage. It provides a means of application of herbicides at very low application costs.

THE MACHINE

This consists of a unit fully mounted on the tractor 3 point linkage together with a diaphragm type pump driven off the P.T.O. shaft and distribution lances and booms.

The frame of the unit is of tubular steel and carries on it a tank of 150 gallon capacity made of seamless high density polythene. This tank is equipped with a sight tube and scale to indicate the gallonage remaining in the tank at a glance. The driver's control panel is mounted on the front of the unit, that is directly behind the driver, and consists of an "on—off" lever, pressure control knob and pressure guage, selectors for "boom" or "lance" and the auto-fill fittings.

At the rear of the unit is mounted the spray pattern controls and in the estate context it is anticipated that these will be set by a member of the supervisory staff. The panel consists of five valves, three controlling the boom outlets (left, right and centre) and two controlling the lance outlets (left and right). For ease of operation the lance and boom flexible tubing is colour-coded.

The boom consists of a centre frame which is adjustable for height from the ground. This adjustment is made by simply sliding the frame up and down on the carrying section mounted in the main frame. Locking bolts are fitted with tommy-bars for easy slackening and tightening, thus avoiding the necessity for the drivers to carry extra tools. On each side of the centre frame are mounted the telescopic booms carried on spring-loaded hinges. These hinges operate in deep grooves which can hold the boom parallel to or at right-angles to the direction of travel, thus allowing a variety of spray patterns to be set-up. When extended fully the light weight square section booms extend to eight feet on either side of the centre line of the tractor. When travelling or in storage the booms fold back vertically to the centre frame, but can in fact operate in the vertical position for upward spraying. While the spring loaded hinges are sufficiently tensioned to hold the booms in the selected

* Nova Scotia Estate, Teluk Anson, Perak.



Plate 1



Plate 2

Monsanto®

ROUNDUP* NEWS 1976

Additional recommendations for new Roundup* uses.

*Trademark of Monsanto.

Monsanto's Product Development team explained that additional recommendations for Roundup now extends the uses of this unique herbicide.

Same product: Extended uses

Roundup's success in lalang control under rubber has been firmly established. Continuous research into applications now makes it possible to recommend Roundup for:-

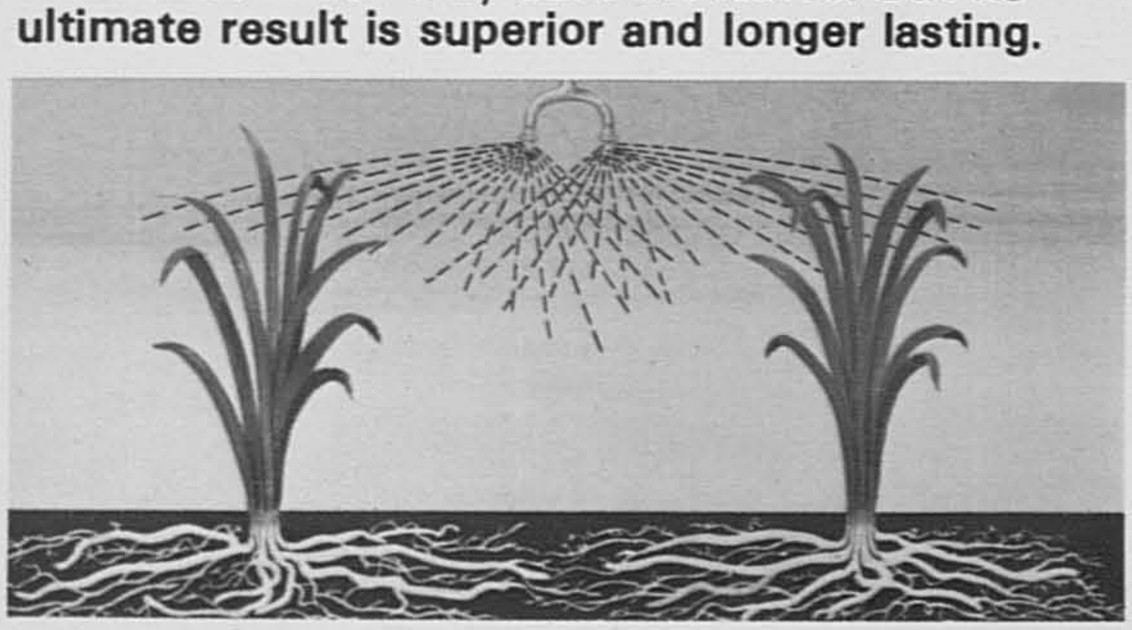
* Paspalum conjugatum and Ottochloa nodosa control in mature rubber.
* Lalang control in all stages of rubber.
* Lalang control in pre-plant areas for rubber and oil palm.
* Lalang control in non-fruiting (i.e. immature) oil palm.
* Lalang wiping.

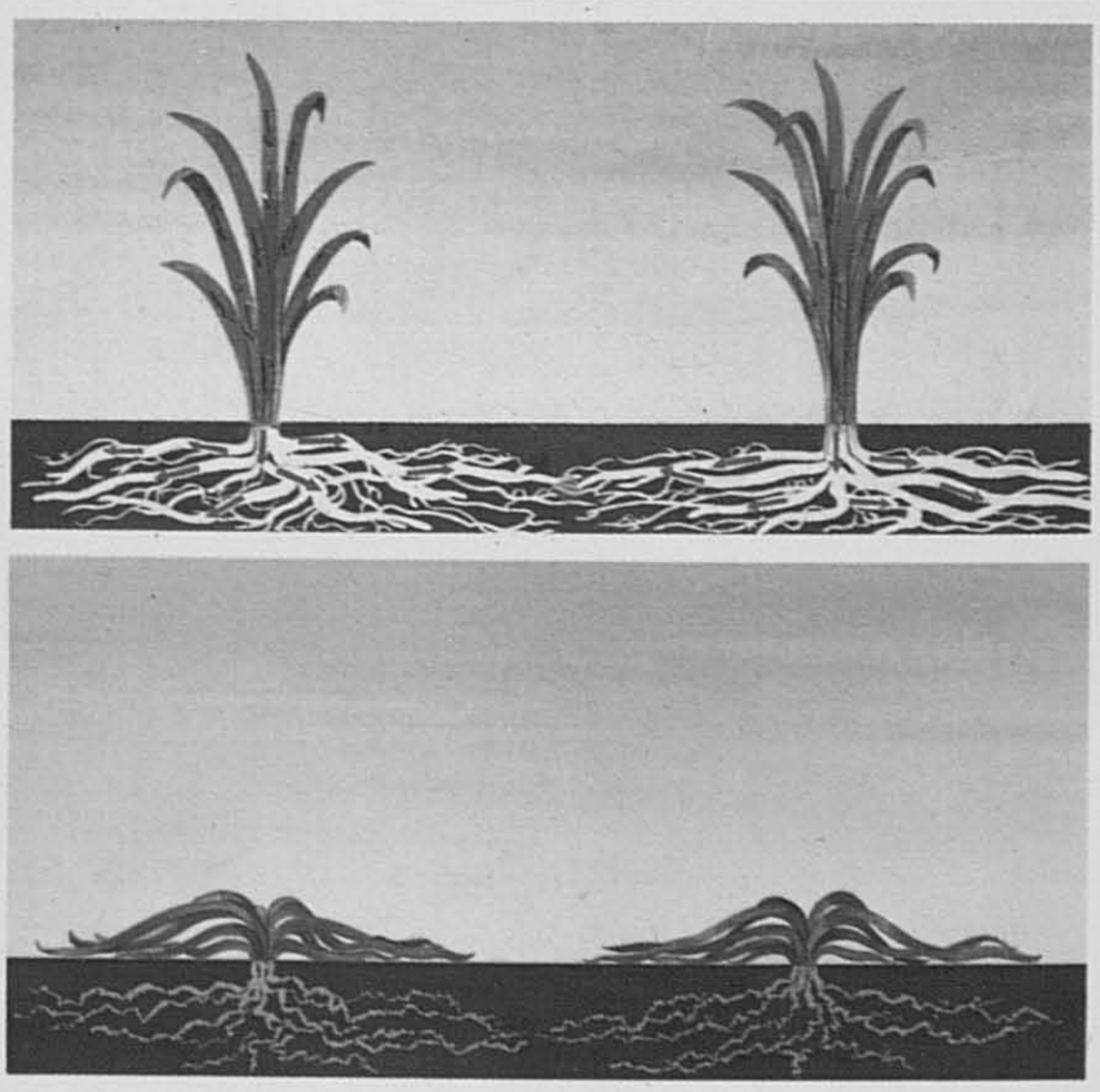
One-shot treatment

As planters have found, Roundup is effective with **a one-shot treatment.**

"Translocation" the basis of Roundup's effectiveness

Roundup works itself from the leaves into the root system **to destroy the entire weed** and not just the leaves. It is a **translocated weedicide.** The initial effects of Roundup may become evident later than in the case of contact weedicides which only burn the leaves. **But its ultimate result is superior and longer lasting.**

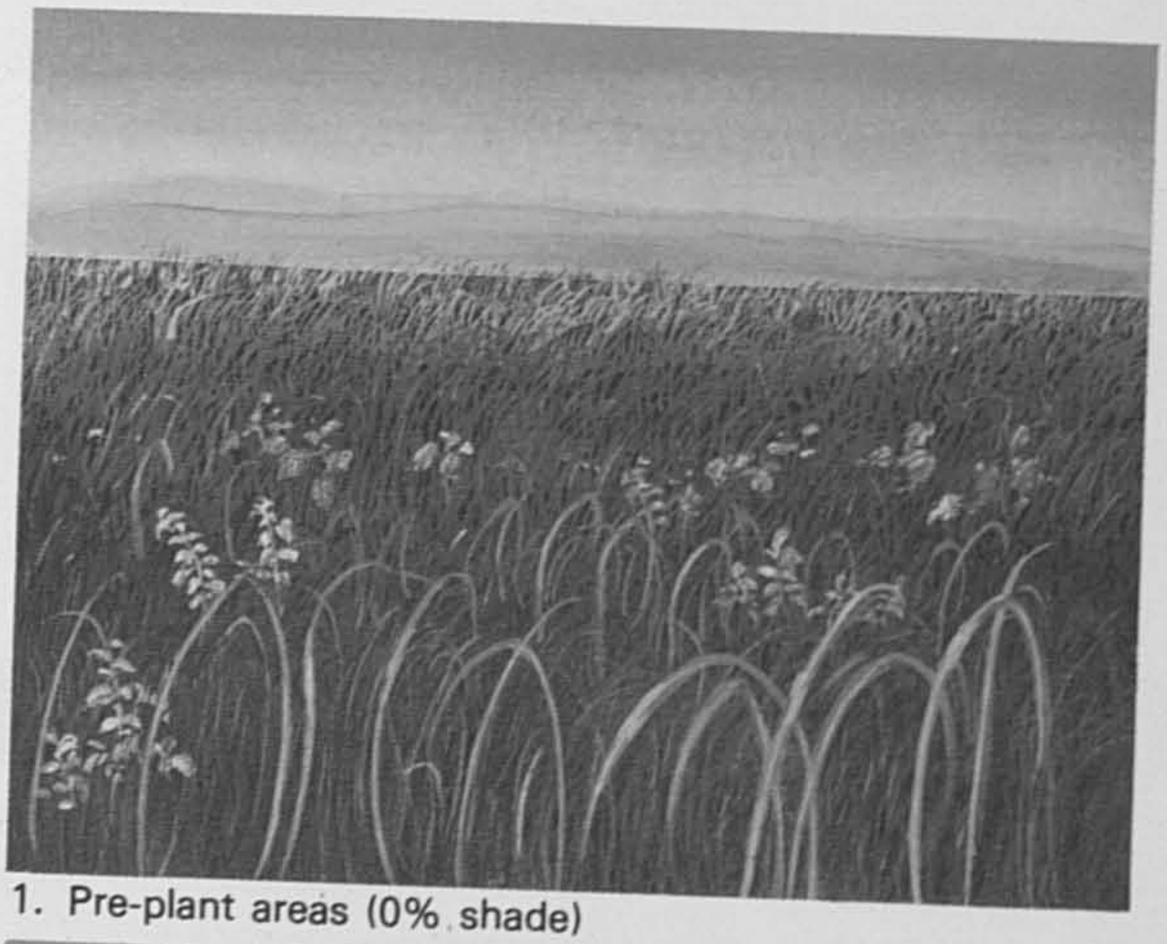




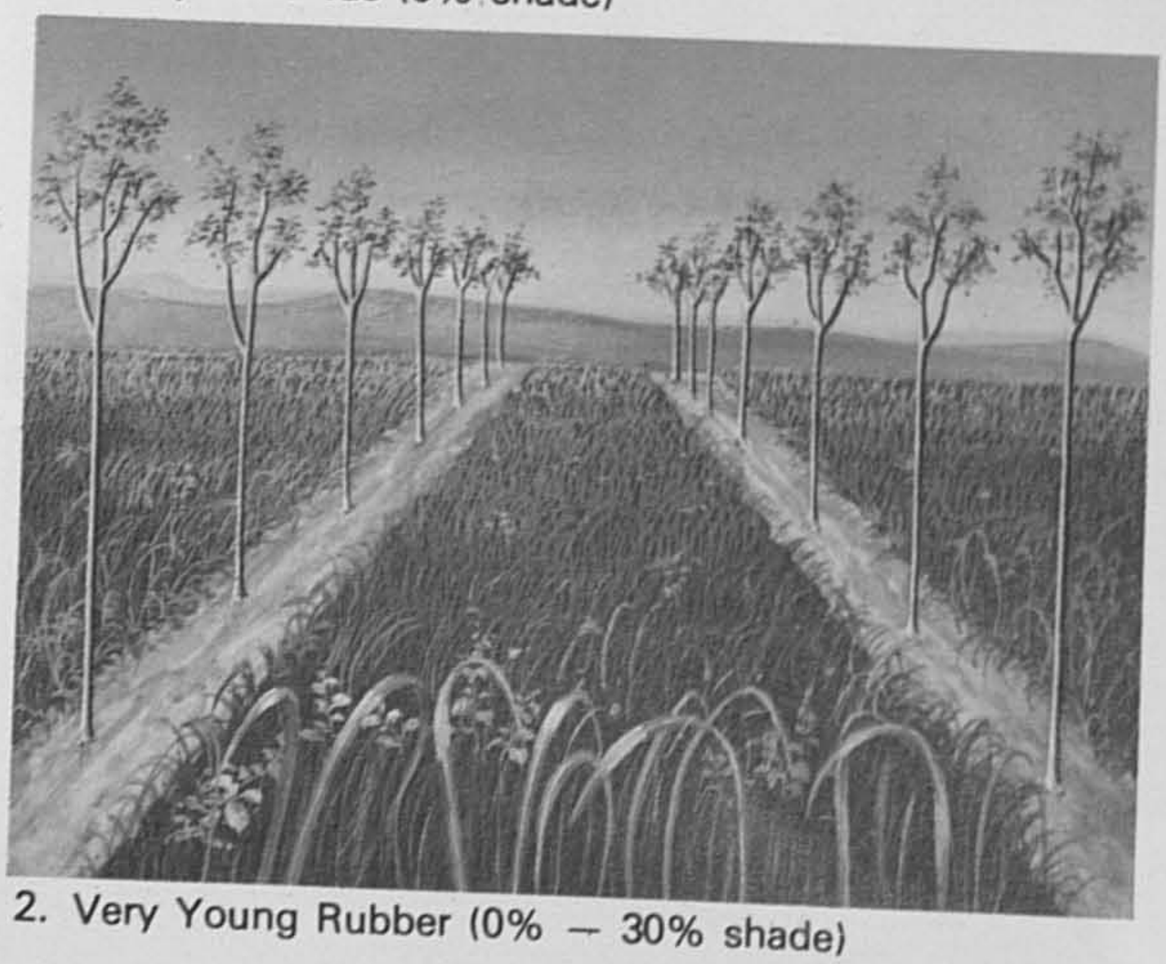
Roundup discovery : Shade is the key to weed growth and vigour

Monsanto found that shade is a determinant of weed growth and vigour. In open conditions, weeds are tougher and less susceptible towards weedicides than those weeds growing under shade. For optimum results, Monsanto's Product Development team therefore suggests dividing your weed problem areas into percentages of shades. This will enable planters to judge more accurately the appropriate dosage rate of Roundup to use.

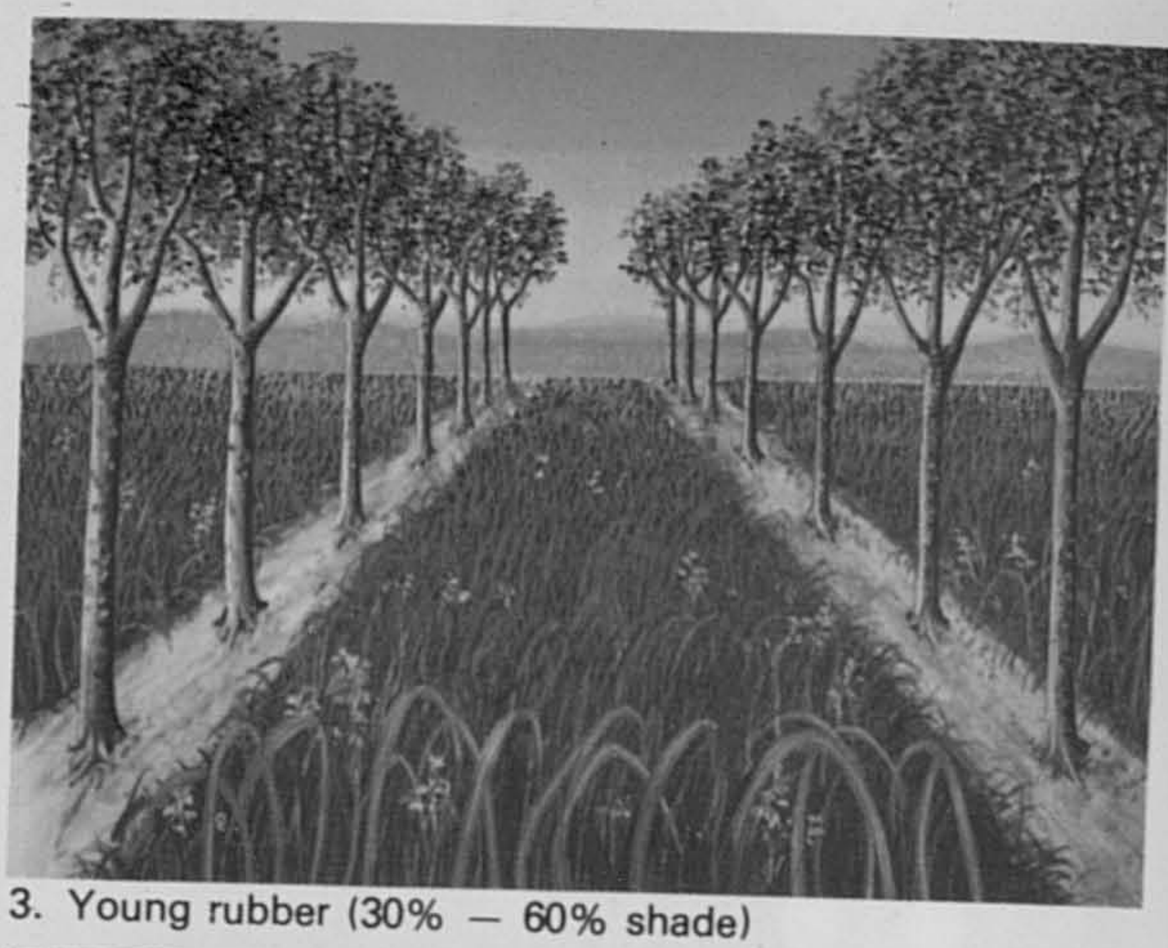
The picture below show the four broad divisions of shade which field survey indicates that planters and their experienced field staff can easily differentiate and use as a practical guide.



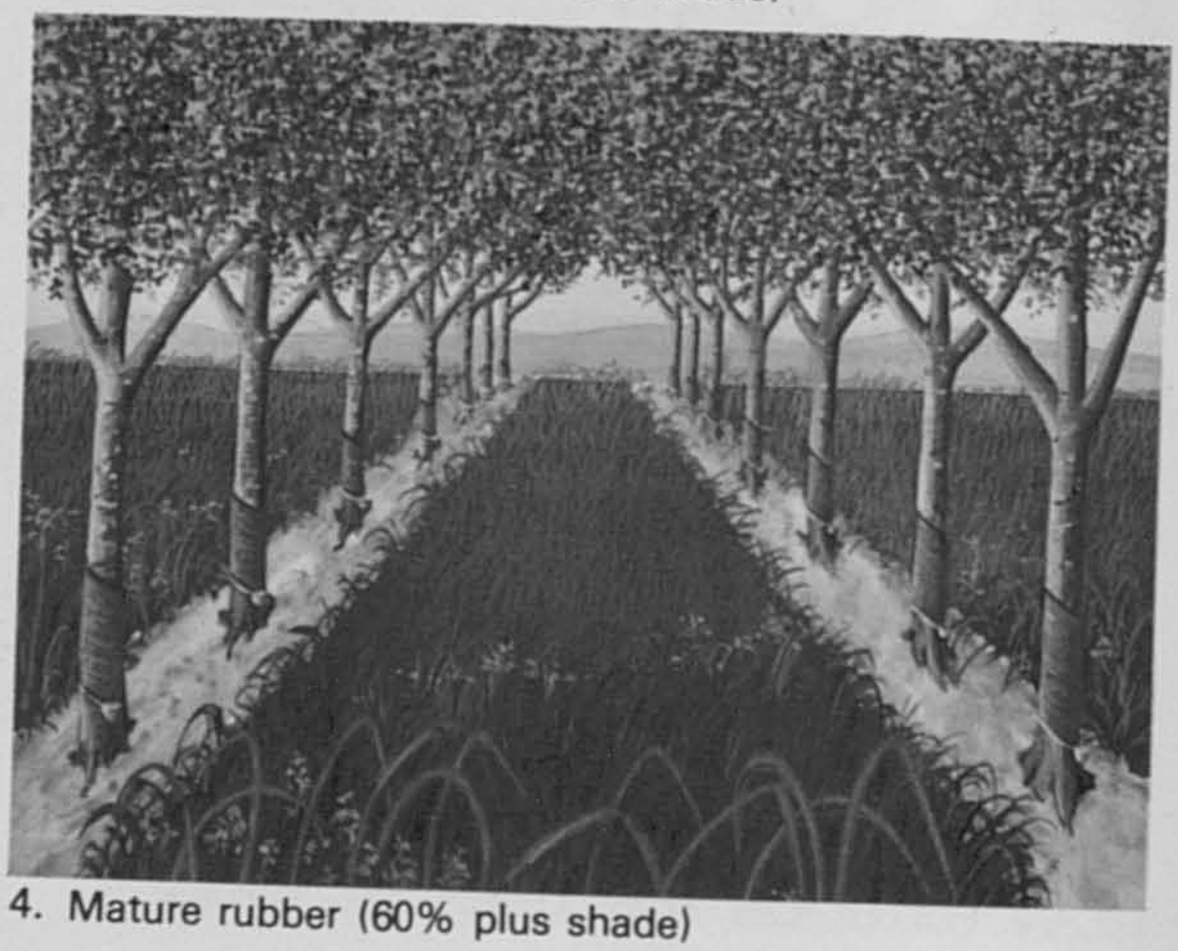
1. Pre-plant areas (0% shade)



2. Very Young Rubber (0% – 30% shade)



3. Young rubber (30% – 60% shade)



4. Mature rubber (60% plus shade)

These extended uses are the result of continuous research and testing Monsanto conducts to establish additional applications of Roundup in all areas of weed control.

You can expect recommendations for further uses of Roundup from Monsanto in the years to come.

Continuous research for extended uses.



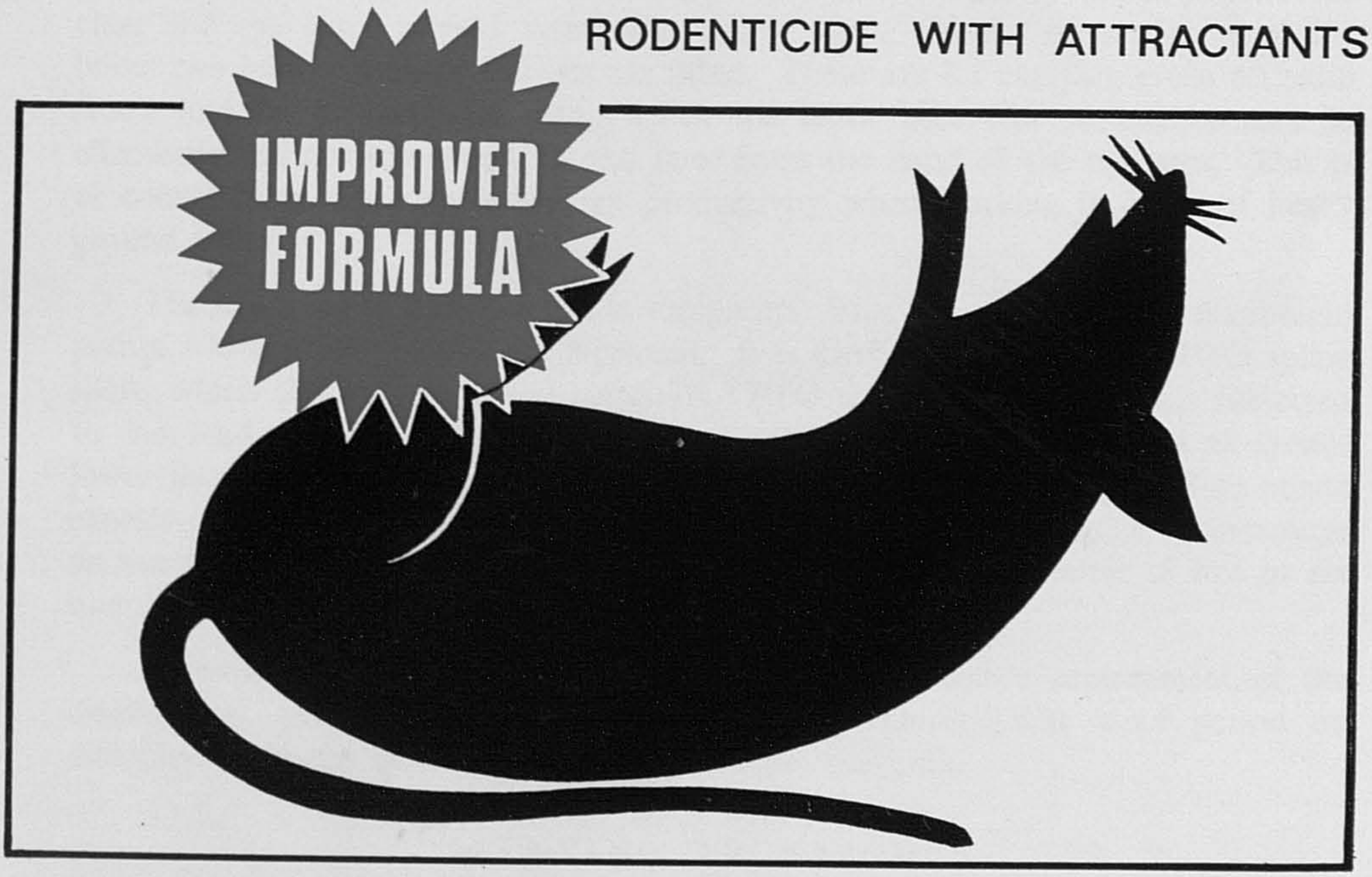
ROUNDUP.

POSTEMERGENCE HERBICIDE BY Monsanto

BUAH EMAS

RAT BAIT

RODENTICIDE WITH ATTRACTANTS



The Rat Killer for Plantations

Distributed by:

HARRISONS & CROSFIELD (M) SDN. BHD.

position, they do allow the booms to swing back should any obstruction be encountered. When the boom is extended horizontally there is no restriction on its vertical movement, thus allowing a degree of movement to avoid damage to the machine when travelling over uneven ground.

Boom nozzles are mounted in three pairs, one at the end of each boom mounted in a universal type joint and one pair mounted centrally immediately onto the centre frame of the boom. Considerable use has been made of off-set nozzles, these giving a very good range of spray pattern variations and coverage. Where very heavy vegetation requiring a penetrating spray has been encountered it has been found useful to use fan type nozzles. These are made up onto special mountings and fitted along the booms with simple brackets fitting round the boom at such spacing as may be required and subsequently plumbed into the boom hoses.

The lances consist of lengths of rubber hose, thirty to forty feet in length, on the end of which is fitted a standard spraying lance fitted with a trigger release mechanism. Noozles of the standard types available in the market (cone, flood-jet or fan) can be fitted. On each side of the main frame of the spraying rig is a large cleat with a hollow stem. The hose can lie conveniently coiled around the cleat and the lance stowed inside the hollow stem. On the centre frame of the boom two hollow tubular sections are fitted. These are for carrying green oil palm frond midribs or bamboos along which the lance hose can be hitched and so effectively remove the weight of the hose from the hand of the operator. This is of considerable value in improving productivity when working in areas of heavy ground cover.

The heart of the machine lies in the pump. This is a three cylinder diaphragm pump, which gives positive displacement. It is directly coupled to the PTO spline shaft, which should be in good condition. PTO shafts which have been subjected to end loading (a usual occurrance, when rotary slashers are operated at speeds lower than 540 rpm on the PTO shaft) may have become distorted and so create excessive viabration on the pump. The pump and associated piping incorporates an automatic filling device. This allows very quick filling (a matter of five or six minutes) of the 150 gallon tank.

A pump of this nature was run for 1,378 hours before replacement of the diaphragms, seals and valve seats was required. During that same period no difficulty had been experienced with leaks from the tank.

SPRAYING TECHNIQUES

Operational sequence

The tank is filled with water and herbicide before leaving the base area for the field. Clean water is transported by tanker/trailer to the field and parked in strategically chosen points. It is assumed that the value of using clean water for spraying herbicides is appreciated. If clean water sources exist in the fields these can easily be utilised as the auto-fill device can easily draw up water from such sources. Herbicide is transported to the field and the tractor driver instructed on the mixture to be applied in the tank. It is essential to leave about 10 to 15 gallons of liquid in the tank to actuate the venturi method of filling by use of the auto-fill.



Plate 3



Plate 4

When using the booms it is essential that the spray pattern desired be considered before going to the field. Ideally the tank should be filled with water and the configuration of boom and nozzles adjusted over a clear area (*e.g.* a factory floor, badminton court etc.) where the pattern shows up well. In setting the pattern, care should be taken to adjust boom length and position to give the required width of spray and nozzles to give even coverage without "thick" or "thin" patches.

At the beginning of each new operation, it is essential to determine application rates being achieved. In all operations the rate of application is dependant upon three factors:

(1) Forward speed of the tractor

(2) Type of nozzle in use

(3) Pressure at the nozzle.

In practice it is found that when operating at 30 psi with the tractor moving at about 4.5 mph and using the off-set nozzle, an application rate of 20 gallons per sprayed acre is achieved. Adjustment of chemical rates to give desired rates per sprayed acre is a simple matter once the application rate has been determined by field observations.

When using the hand lances the additional factor of operator technique comes into the calculation.

Boom spraying

Using two pairs of off-set nozzles a sprayed swathe of a little over 30 feet can be achieved at maximum. This can be utilised in rubber areas should overall spraying be required. By use of only three nozzles, one mounted at the end of a boom operating at right-angles to the direction of travel and one pair mounted at the end of a boom set parallel to the direction of travel a 26 ft. swathe can be sprayed. A very satisfactory 26 ft. swathe can also be obtained by using five fan type nozzles mounted equidistant across the full width of the spraying rig with both booms extended at right-angles to the direction of travel. It is therefore apparent that overall spraying in oil palm areas is feasible. It is understood that this may not be desirable in all cases, in which case the estate manager decides on the pattern he requires and selects a combination of nozzle number and position and boom length/position to suit his requirement. It will be seen that it is a simple matter to spray two six foot wide swathes along planting rows (say to the left of row 1 and the right of row 2) and by turning right-about at the end of the row and driving down the adjoining avenue to spray a further swathe to the right of row 1 (which has now had a 12 foot wide swathe sprayed, including the palm circle) and the left of row 3. See *Fig. 1.*



Plate 5



Plate 6

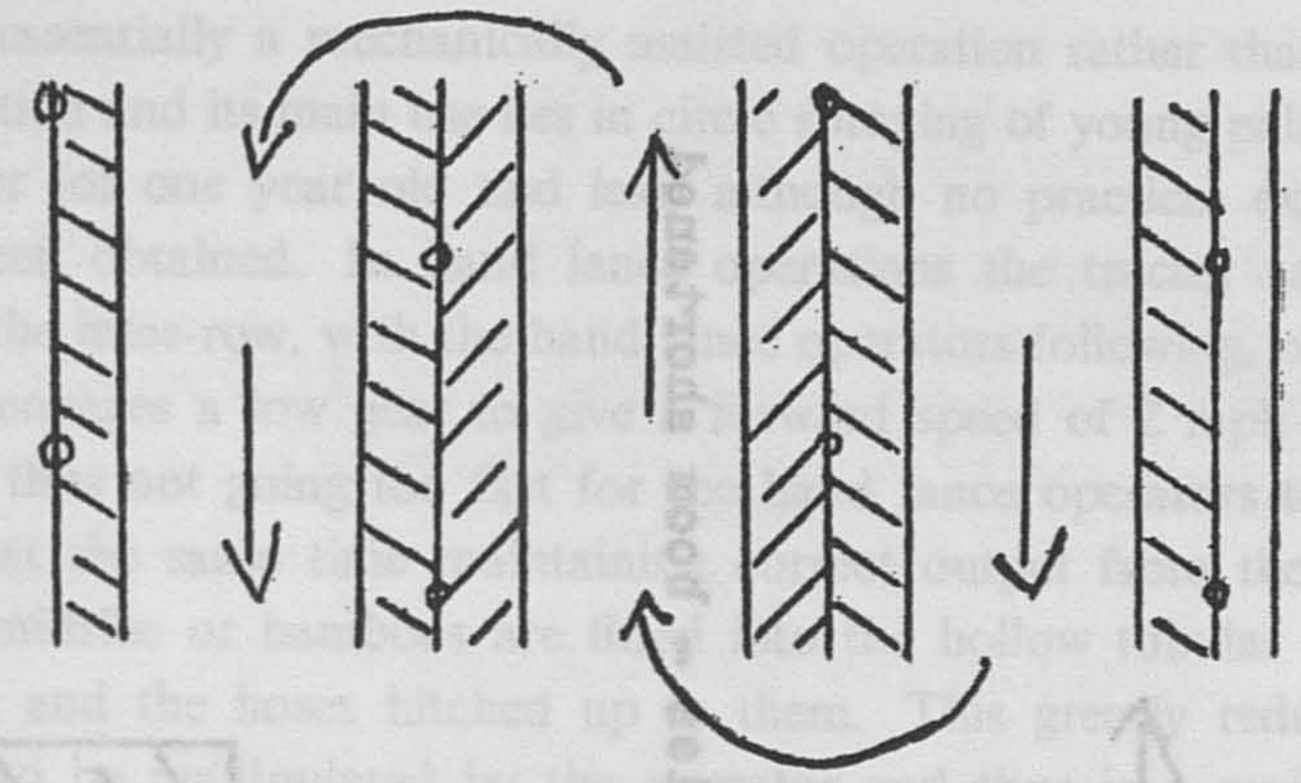


Fig. 1. Diagram showing method of spraying planting row (including palm circle).

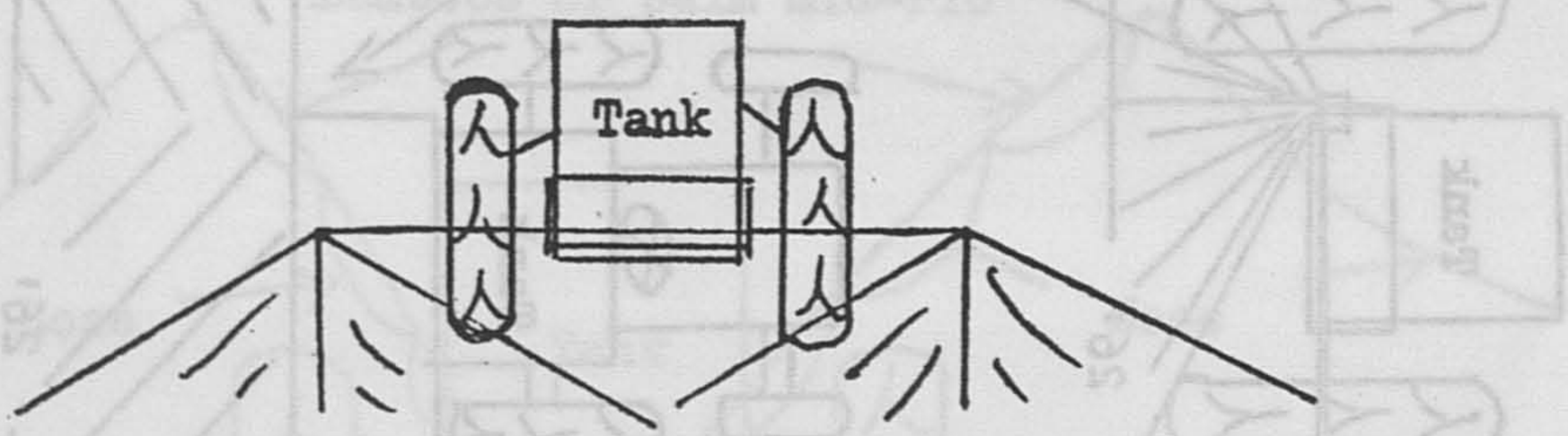


Fig. 2. Diagram showing setting of 4 offset nozzles to give sprayed swathe of 30 feet.

In mature oil palms the placement of the cut fronds assumes some degree of importance. Most of the work done so far has been in areas where the fronds are cut and stacked in between the palms along the planting row. This certainly facilitates the passage of the tractor but an objection has been raised concerning the apparently wasteful spraying of chemical onto piles of dead fronds. Work is now in progress in areas with fronds stacked in the avenues and with the tractor wheels set out to straddle the frond pile and the spray pattern so adjusted as to avoid spraying chemical onto the stacked fronds. Results of this work are not yet to hand.

As an indication of the sort of results that can be obtained with boom spraying it can be shown that in the period September, October and November of 1975 one machine operated with just the driver covered 3,755 acres, blanket spraying. The cost of application was 42 ¢ per acre and the actual acreage covered each working day during this period was 62.6 acres. The cost of application includes all direct running charges for the tractor (including drivers wages, insurance, fuel etc. etc.), together with a set rate of accrual towards a repairs reserve for both tractor and spraying rig, but exclusive of depreciation.

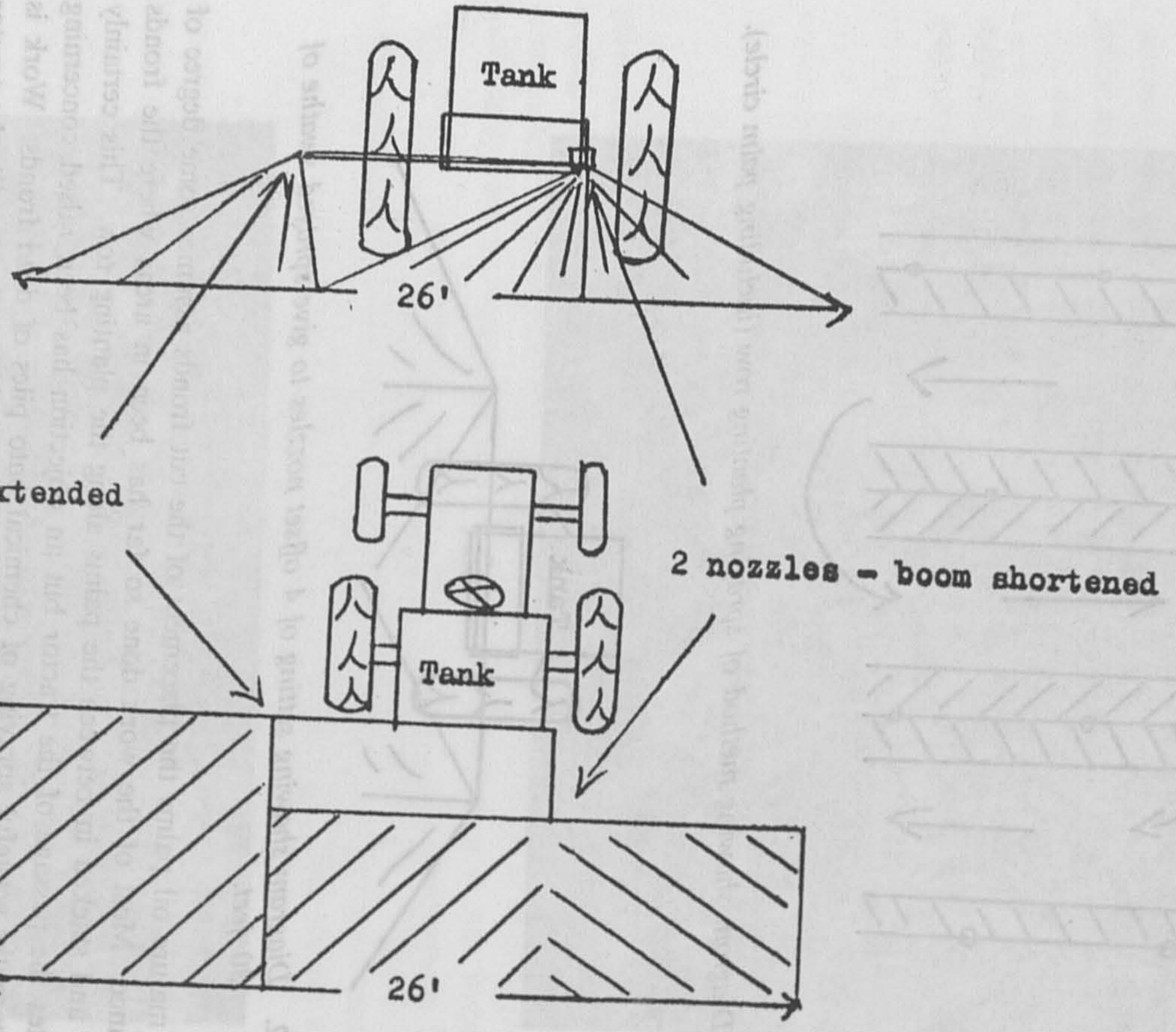
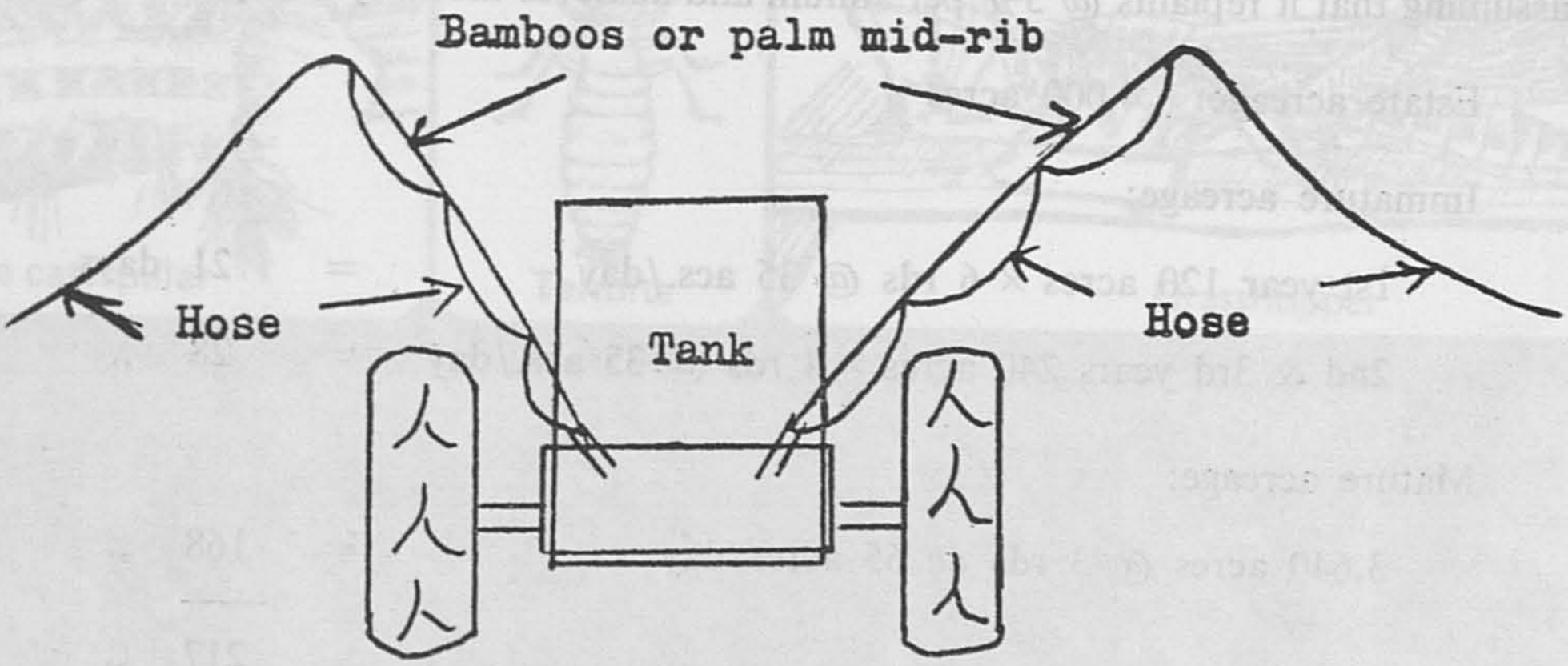


Fig. 3. Diagram showing setting of 3 offset nozzles to give sprayed swathe of 26 feet.

Hand lance spraying

This is essentially a mechanically assisted operation rather than a fully mechanised operation and its main use lies in circle spraying of young palms and possibly young rubber (of one year old and less) although no practical experience of the latter has been obtained. In hand lance operations the tractor and spraying rig move down the inter-row, with the hand lance operators following, one to each side. The tractor engages a low gear to give a forward speed of 2 mph and PTO shaft rpm at 540, thus not going too fast for the hand lance operators to keep up with the rig and at the same time maintaining correct output from the pump. Green palm frond midribs or bamboos are fitted into the hollow tubular sections on the centre frame and the hoses hitched up to them. This greatly reduces the weight of the hose to be manipulated by the operator and thus is a major contribution to increase productivity.



It has been found that a team of one driver and two hand lance operators can move steadily forward when spraying circles around palms of up to one year from planting. When palms become bigger it is necessary to increase the hand lances to four, two on each side. This is a simple matter of fitting a Y piece into the output hose and having one additional hose and lance on each side. In this situation each pair of lance operators are given one half of each palm circle to spray. It is essential that, in order to maintain productivity, the tractor is not permitted to stop and at all times moves steadily forwards. When the stage of growth is reached at which four lances cannot keep up with the tractor, then the time has come to consider boom type operations.

Lances can be fitted with all standard nozzle type and the choice lies with the user. Experience has shown the fan-type nozzle to be the best for circle spraying at 30 psi, giving good results in dense cover.

Output achieved with this type of rig has been in the order of 35 acres per day, giving total application costs as follows:

Palms of one year old and less	...	83 cts.
Palms of more than one year old	...	1.05 cts.

Wage element of lance operators *excludes* SRA @ $1.15 per day. This would increase costs by 7 cts. and 13 cts. per acre respectively.

GENERAL DISCUSSION & CONCLUSION

The machine described has been found to be eminently practical. It is of particular value where spraying labour is in short supply and/or where their performance is unsatisfactory: One machine can cope with an acreage 4,000 acre oil palm estate, assuming that it replants @ 3% per annum and achieves maturity in 3 years thus:

Estate acreage: 4,000 acres

Immature acreage:

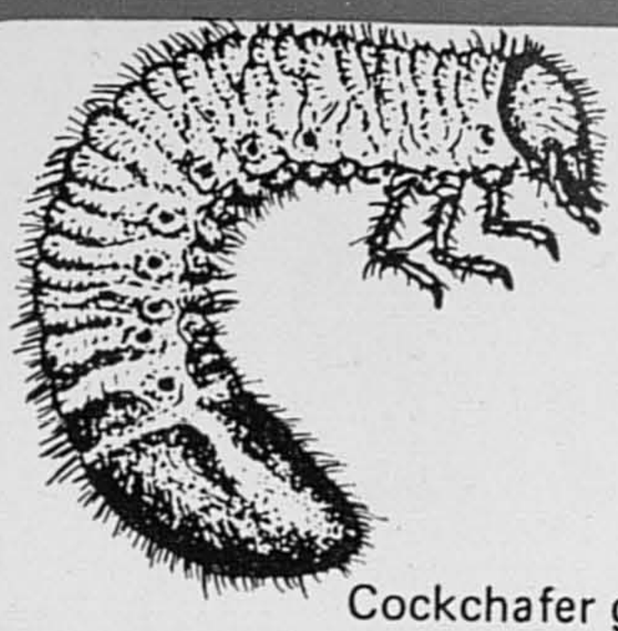
1st year 120 acres × 6 rds @ 35 acs./day	=	21 days
2nd & 3rd years 240 acres × 4 rds @ 35 acs./day	=	28 ,,

Mature acreage:

3,640 acres @ 3 rds @ 65 acres/day	=	168 ,,
		217 ,,

This gives a generous allowance for wet weather and other hold-ups in spraying work. However, in view of the benefits accruing from use of such a machine its restriction to larger acreages needs reconsideration. The ability to spray large acreages quickly can considerably facilitate estate operations when considering a manuring programme. Further, the requirement to retain and house sprayers is greatly reduced or the need to seek the services of contractors, with consequent disadvantages, is eliminated.

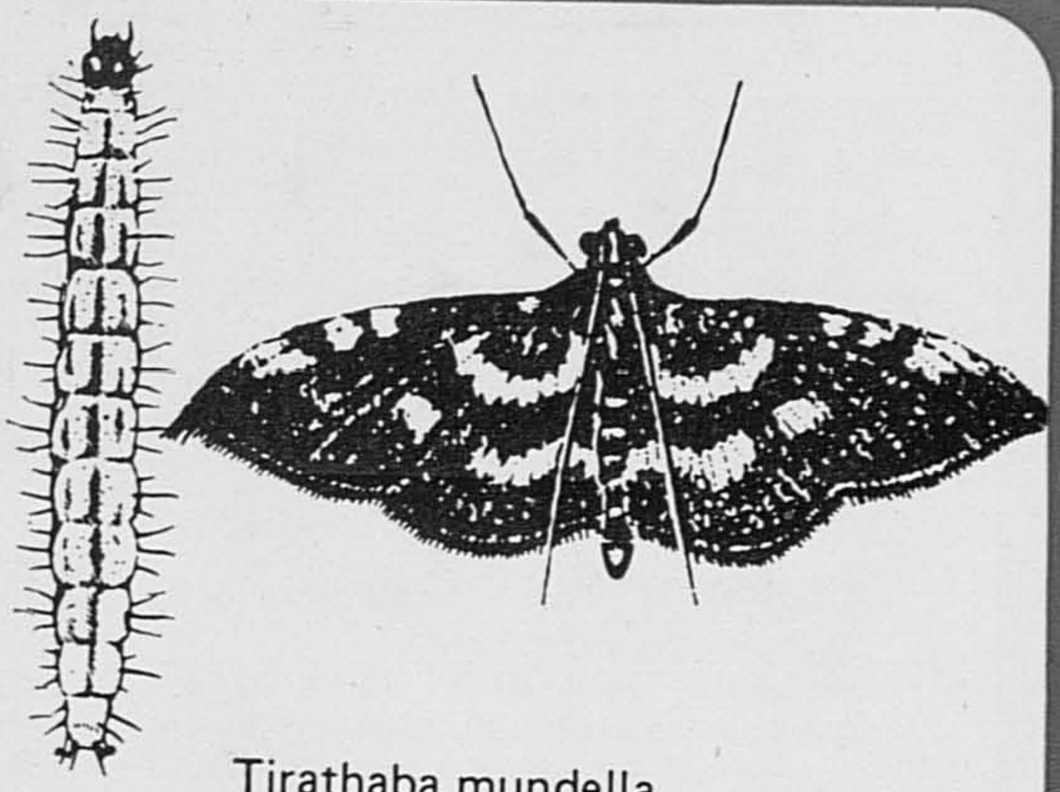
In regard to overall cost it was originally found that these were no lower than hand spraying, due to the increased use of material. However, as the work has been repeated it has been found that the standards of results achieved have been much greater. No longer does the last palm in the row get a perfunctory nod from a passing spraying lance if the herbicide mixture happens not to be at hand. Subsequent rounds of work have shown falling costs with improved standards.



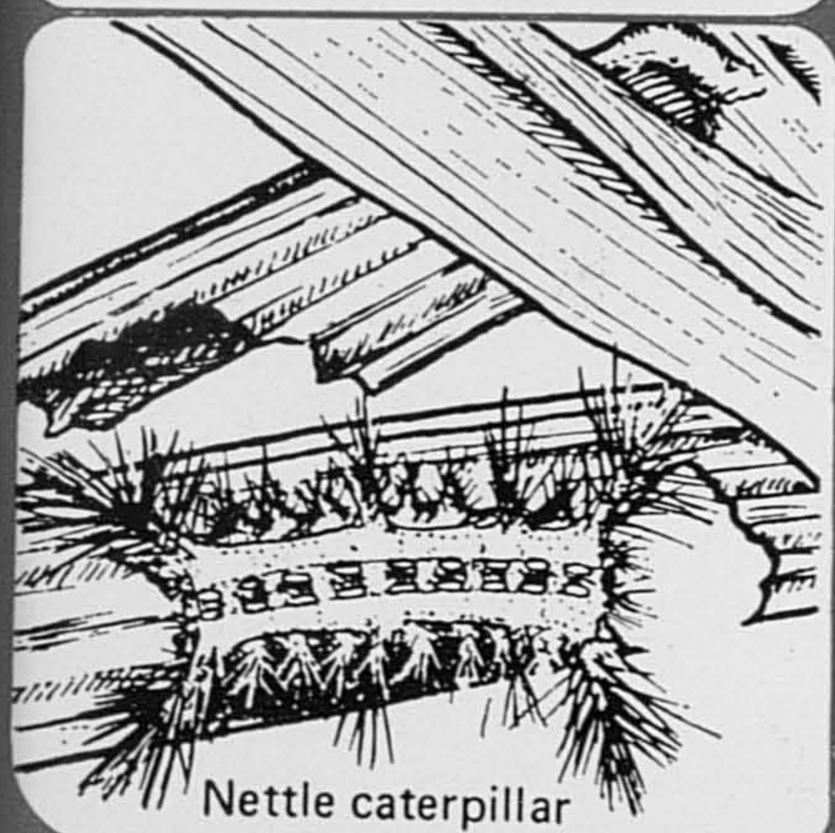
Cockchafer grub



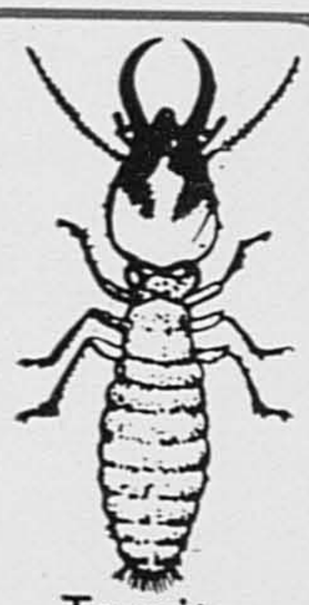
Bagworm



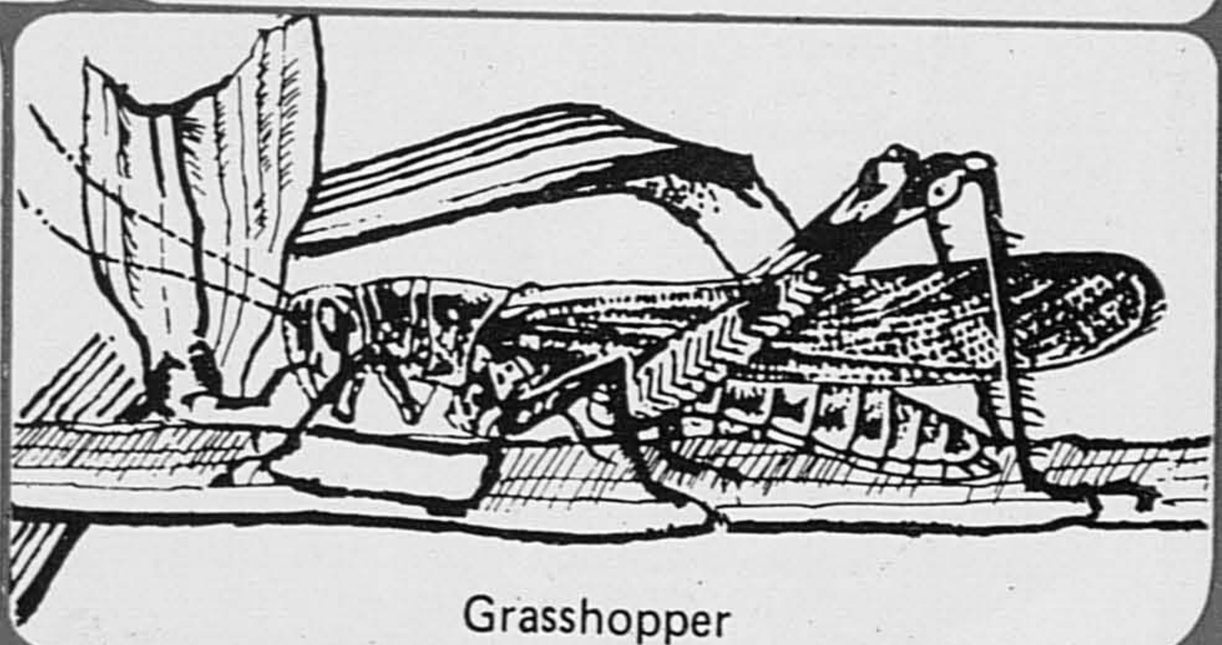
Tirathaba mundella



Nettle caterpillar



Termite



Grasshopper

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+ broad spectrum insecticide + economical + convenient

+ racun serangga berbagai guna + menjimatkan + mudah



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(1) Getah
(2) Kelapa Sawit
(3) Tanaman Penutup bumi
(4) Koko
(5) Kelapa
(6) Tebu
(7) Lada hitam
(8) Dan lain-lain

Kadar bancuhan:

Untuk mengawal ulat-ulat makan buah – bari-bari, ulat-ulat buah kelapa sawit, dll.

Campurkan 2 cawar (70 cc) DURSBAN* 75+ dengan 4 gelen air. Semburkan bancuhan apabila buah telah menjadi atau apabila ulat-ulat mula menyerang. Sembur tiap-tiap 2 minggu sekali.

Untuk mengawal ulat-ulat makan daun – belalang-belalang dan lain-lain ulat makan daun, dll.

Campurkan 1 – 2 cawan (35 – 70 cc) DURSBAN* 75+ dengan 4 gelen air. Semburkan tiap-tiap 2 minggu atau apabila ulat-ulat mula menyerang.

Untuk mengawal ulat-ulat dalam tanah – anai-anai, kumbang-kumbang kaboi, dll.

Campurkan 2 cawan (70 cc) DURSBAN* 75+ dengan 4 gelen air. Untuk mengawal anai-anai, galikan parit sedalam 2 – 4 inci disekililing pangkal pokok. Tuang 1 – 3 pint bancuhan kedalam parit itu. Untuk mengawal kumbang-kumbang, galikan lubang sedalam 2 – 3 inci dilengkongan 12 – 18 inci dari pangkal pokok dan tuangkan 2 – 3 pint bancuhan kedalam lubang-lubang tersebut.

Untuk mengawal ulat-ulat yang menghisap air pokok – teritip-teritip pokok, koya-koya, hama-hama merah, dll.

Campurkan 1 – 3 cawan DURSBAN* 75+ dengan 4 gelen air. Sembur bancuhan rata-rata hingga membasah daun dan ulat-ulat. Untuk mengawal hama-hama merah, sembur disebelah bawah daun juga.

Lipas

Campurkan 1 cawan DURSBAN* 75+ dengan ¼ – ½ gelen air. Sembur atau sapu di tempat persembunyian atau pembiakan, belakang almari, laci, dll.

Awas:

Jauhkan semburan dari terkena makanan atau bekas-bekas makanan dan alat-alat memasak. Jika terkena, basuhkan alat-alat memasak dengan sempurna sebelum diguna.

DURSBAN* 75+ – a highly effective broad-spectrum, multi-purpose insecticide. Its triple action by contact, stomach and vapour will economically control most pests in:–

(1) Rubber
(2) Oil palm
(3) Cover crops
(4) Cocoa
(5) Coconut
(6) Sugar
(7) Pepper
(8) Household pests, etc.

Recommended Mixing Rates:

Leaf pests e.g. grasshoppers, cockchafer beetles, bagworms, nettle caterpillars.
Lamprosema and other pests that damage leaves.

Mix 1 – 2 cups (35 – 70 cc) DURSBAN* 75+ in 4 gallons water. Spray at 2 weeks interval or when pests are first observed. Spray to wet all foliage.

Soil pests e.g. termites, cockchafer grubs, etc.

Mix 2 cups (70 cc) DURSBAN* 75+ in 4 gallons water. For termites, make a shallow trench (2 – 4" deep) around the tree collar. Pour 1 – 3 pints of the solution into the trench. For cockchafer grubs, make holes with a crowbar 2 – 3" deep within a radius of 12 – 18" round the tree. Pour 2 – 3 pints of the solution into these holes.

Fruit pests e.g. Tirathaba, fruit flies and fruit borers, etc.

Mix 2 cups (70 cc) DURSBAN* 75+ in 4 gallons water. Spray only after fruit has set or when pests first appear. Spray interval is 2 weeks.

Sap suckers e.g. Helopeltis, mealy bugs, scale insects, spider mites, etc.

Mix 1 – 3 cups (35 – 105 cc) DURSBAN* 75+ in 4 gallons water. Spray thoroughly to wet all foliage and pests. For spider mites, also spray to wet under-surface of leaves.

Cockcroaches

Mix 1 cup (35 cc) DURSBAN* 75+ in ¼ – ½ gallon water. Spray or paint on all breeding and hiding places, back of drawers and cupboards.

Caution:

Do not allow spray to come into contact with food or cooking utensils. Wash all utensils thoroughly if contaminated.

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With regard to mature palms it has to be considered that it is no more expensive to *apply* blanket sprays than to spray strips (although the cost of material will be higher). In practice it has been found that clearer conditions give better loose fruit collection and assist in rat control. Managers will of course consider their own situations in respect to soil erosion and weed population. This latter will determine frequencies of application and herbicide choice. It is worth considering that in an area yielding 10 tons FFB per acre with an average bunch weight of 35 lbs., the recovery of an extra 6 loose fruits per bunch (a figure found quite feasible in practice) gives an extra 77 lbs. of oil per acre. With palm oil at $800 per ton, this increases revenue by $27.50 per acre, enough to cover a generous weeding estimate.

Finally the question of terrain. Clearly the machine is of limited application on the steepest slopes but until planters experiment with such machinery they cannot be aware of its capabilities. It is considered that the hand lances may be of special value in such cases. This paper makes no claims in this direction but it is emphasised that an essential degree of interested adjustment of both the machine and methods of working will give beneficial results in most situations.

Acknowledgements. The permission of Sime Darby Plantations Bhd. to publish this paper is gratefully acknowledged together with the technical assistance afforded by Agricultural Tractors Sdn. Bhd. to whom enquiries for the type of machine described should be directed.



Eureka FLUID FILM
The perfect answer to control corrosion in agriculture.

Once in place, Eureka FLUID FILM stays put. A continuous soft, non-drying barrier against metal deterioration.

WHAT DOES EUREKA FLUID FILM DO?

FLUID FILM stops rust
FLUID FILM was perfected to stop the highly corrosive action of fertilisers, herbicides and pesticides on steel surfaces. It penetrates down to the base metal where it sets up an unyielding barrier against the destructive effects of chemicals and gases. FLUID FILM actively displaces moisture and preferentially wets metal.

Effective lasting action
One coat of FLUID FILM gives long lasting control, with minimum maintenance.

Big savings in application time, too!
Surface preparation on new surface is not necessary. Apply directly over adhering mill scale or rust. No sandblasting, and no drying time are required. On heavily corroded surfaces, you only need remove loose rust.

Free flow of fertiliser is assured
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WHERE TO USE FLUID FILM

1. All kinds of tanks — fertiliser, bulk liquid, storage, transportation and weed killer tanks. Exteriors and interiors.
2. Hot liquid mixing tanks — exterior.
3. Fertiliser pumps, chains, bearings.
4. Structural member and pipe interiors with corrosive gas or fume environment.
5. Spare parts and small tools.
6. Structural member and pipe interiors with corrosive gas or fume environment, including salt air.
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KACE/LJ7

Towards more viable research and development effort in science

HAJI ANI BIN AROPE*

The recent recession in Malaysia brought home to researchers very clearly that money is not an unlimited commodity. As a result of the recession, stringency has set in the realm of research and development. This will result in a more critical approach to research efforts generally in the country.

There is hence great need to attain greater effectiveness in research and development, which are vitally important in that, through research and development alone can the nation pursue systematic and intensive studies directed towards attainment of a fuller knowledge of any subject, and the systematic use of such knowledge towards the production of useful materials, devices, systems, methods and processes.

Expenditure on research and development has, like everything else, escalated over the years but the greater increase has been in the development portion of the research and development spectrum. In view of this, there are pressures from public and private sectors for a more critical evaluation of research and development efforts by bodies entrusted with these obligations.

It becomes imperative therefore that we should improve our research and development effectiveness. If we have not yet begun to increase the return on our research and development efforts, this is a nice time to re-appraise the situation, to ensure the "leap forward" anticipated in the Third Malaysia Plan.

Since allocation of funds for research and development is important to us all, it may be wise to deliberate on this question in detail, to provide some guidance to policy-makers regarding budgeting for future expenditure on research and development.

Although it is extremely difficult to evaluate the return from an investment of this nature, we may even make an attempt in the agricultural sector to estimate the returns to our investment in the form of research and development expenditure.

Another important area which merits consideration is the relationship between knowledge-transfer and research-and-development activity. The lack of collaborative relationship between extension work and research-and-development activity is worrying us somewhat—we need to adopt urgently a flexible policy that would utilise the most appropriate transfer-module for each particular area.

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* Tuan Haji Ani bin Arope is currently Director of the Rubber Research Institute of Malaysia. The above is adapted from his inaugural address to the National Agricultural Research Management Seminar held on 26th April, 1976 at Universiti Pertanian Malaysia. The Seminar was jointly sponsored by the Rubber Research Institute of Malaysia, Universiti Pertanian Malaysia and the Malaysian Agricultural Research and Development Institute.

Even after some 20 years of independence, considerable importance is still being given to imported research and development, at considerable cost to the nation. Imported research-and-development 'transplants' are usually irrelevant to our local situation. Suitable research and development approaches must hence be rooted in virtues of local outlook and knowledge. It is therefore essential that we should get together to exchange ideas and share experiences among ourselves and improve further our channels of scientific communication.

Having established the broad frontiers of what should be our policy towards research-and-development in Malaysia, we also need to have a closer look at our research-and-development organisations.

Organisations not only need the right individuals, but such individuals must be facilitated to work within climates that nuture, rather than inhibit, their performance. The term 'creative climate' has been used as a vague reference to this situation.

Are we now at the point where we can identify the ingredients necessary to produce a 'creative climate'? We need to set our sights on realistic goals, viable programming and monitoring norms and the creation of right incentives to encourage researchers into utmost creativity in their respective fields.

Planter, Kuala Lumpur **52**: 174–179 (1976)

Climatic changes in water balance and their effects on tropical flowering

ONG HEAN TATT*

SUMMARY

Drought is a major phenomenon in tropical lands. Many tropical plants appear to flower in response to water deficit conditions. Inhibitor hormones are involved in the control over tropical flowering by water stress. Commercial control of flowering of tropical crops may be possible through regulation of irrigation or application of growth retardants and other growth regulators.

In Malaysia, the main climatic changes are seasonal changes in rainfall, resulting in moisture deficits in certain times of the year. Many authors on the subject of flowering have noted that while the effects of light and temperature changes in temperate areas on flowering are well studied, the effect of drought on flowering are not well known (Evan, 1971). Some major crops like oil palm are adversely affected by drought. Flowering in many tropical fruit trees seem related to moisture stress. This paper reviews the limited information available on the effects of water stress on flowering, in tropical areas.

FLOWERING IN TROPICS

From various observations (Holtum, 1961; Corner, 1951, Salter and Goode, 1967), the flowering of tropical plants may be classified into the following categories: —

1. Trees that flower throughout the year. These could be further divided into the following types:
   - (i) Those whose flowers and fruits develop at the same time, e.g. *Wormia suffructicosa, Spathodea,* Pranggipanni (*Plumeria*) Common Hibiscus (*Hibiscus rosasinensis,* Cherry tree (*Muntingia*).
   - (ii) Those whose flowers and fruits develop as successive crops on the shoots, e.g. many Fig varieties.
   - (iii) Those which flower after the leaves drop, e.g. decidious trees like Ficus variegata, Buttercup tree.
2. Trees that flower once a year, usually connected with an early drought period in the beginning of the year. They include:
   - (i) Those whose flowers appear early in the drought period, e.g. December trees (Erythrina subumbrans), many forest trees.
   - (ii) Those which flower with the flushes of leaves, usually just after the drought when rains fall, e.g. durians, mango, rambutans, mangosteen.
   - (iii) The decidious type like Angsan (Pterocarpus indica), Pink Cassia (Cassia nodosa).

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3. Trees that flower twice a year; the first flowering occurs in connection to the early drought as in category 2 above. The second flowering occurs at the time of the mid-year where a second milder drought may take place. They include:

   (i) Those evergreen, e.g. Tembusu, Calophyllum, inophyllum.

   (ii) Rambutans, durians, mango, mangosteen.

   (iii) *Hevea.*

4. Plants that flower according to endogenous cycle. They are:

   (i) Those that flower three times a year, e.g. Sea Apple, Ficus caulocarpa (a strangling fig).

   (ii) Those that flower in a 9 to 10 months rhythm, e.g. *Delonix regia, Cassia fistula.*

   (iii) The annuals which complete their cycle within a year and whose flowering occurs at definite periods from sowing of the seeds. Their flowering varies in the year, depending on when the seeds are sown e.g. most short term crops like rice, maize etc.

5. Very seldom flowers, at intervals of more than a year. e.g. Kapur, Shorea, Balanocarpus.

6. Then there are those plants that flower in response to a strong temperature drop usually during a heavy storm, e.g. Angsana, coffea, pigeon orchid (*Dendrobium crumenatum*), Keng Wah (*Epihyllum oxypetalum*), Angel's Trumpet (*Randia macranta*), Yellow Bells (*Steonolobium*).

DROUGHT AS A MAJOR STIMULUS TO TROPICAL FLOWERING

Generally, water stress is associated with injurious effects on plants. Drought caused abortion of female inflorescence in oil palm (Broekmans, 1957) and coconut (Patel, 1938) and also increased the male-female ratio. Drought during the flowering period would reduce the yields of many crops (Salter and Goode, 1967).

However, as seen in the above list of the different types of flowering, a large number of tropical plants flower once a year or twice a year and these coincide with periods of moisture stress. Holtum (1961) observed that when there was no drought period in south Malaya and Singapore at certain years many fruit trees like durian and rambutans etc. failed to flower in the subsequent years. The mid-year drought is normally weaker than the drought during the early part of the year and yield a smaller crop of fruits, indicating that the more severe the drought the more the flowering and fruits. If the mid-year moisture deficit is too small, there would be no second crop of fruits. These observations indicate that drought is a necessary stimulus to the flowering of such plants.

Evergreens like lime and annonas flower throughout the year but may find that imposed period of water deficits would stimulate flowering and improve the yields (Orche *et al*, 1961). Such drought conditions also stimulate flowering in Bougainvilles and Oleander.

The drought stimulus can be so strong that it may abolish the endogenous flowering of plants like Delonix regia which would flower once a year early in the year. In some crops like maize it has been found that suitable period of water deficits imposed before flowering would stimulate flowering and increase the yield (Sommerfort, 1960; Volodarskij and Zinevee 1960). However at the time of cob formation there should be no moisture deficit.

In their review of the effects of water stress on crops, Salter and Goode (1967) concluded that generally abundance of water supply favour vigorous vegetative growth and reduce the reproductive stages, while water deficits would favour the flowering process. The evidence shows that drought could be a necessary or beneficial stimulus for flowering in many tropical crops.

ROLE OF STRESS IN THE DEVELOPMENT OF THE FLOWER

I. *The Carpel Theory.* According to the conventional and very generally accepted carpel theory, the flower is morphologically and phylogenetically a determinate stem with appendages and these appendages are homologous with leaves. Morphologically, the apical meristems usually develop into branches with leaves. But during the time of flowering, many of these apical meristem do not develop into stems with leaves but into flowers. The floral axis is a modified, shortened stem axis while each floral part is a modified leaf.

Morphogenetically, it thus appears that during flowering there is some inhibition of the normal expansion of the apical meristematic axis. The inhibition of the expansion of the apical axis cause changes in the morphogenetic fields of the leaf primordias which instead of developing into leaves now develop into flower parts. It thus appears that a crucial step in the initiation of flowering is some form of stress or inhibition of the expansion of the meristematic axis.

II. *'Anthithesins'*

Hormones are known to affect profoundly the development of plants, especially flowering. Chailaknyan (1968) postulated that two major groups of hormones are involved in flowering. One group is the gibberellins. The other group is collectively called 'antithesins' which are believed to include many inhibitors. From various studies it is generally concluded that 'antithesins' is involved in the primary inhibition of the meristematic axis while the gibberellins are necessary for floral evocation or differentiation (Evans, 1971).

Chailakhyan said that plants may be divided into groups depending on whether they have enough endogenous supply of either or both groups of hormones. Plants deficient in the "gibberellin group" could be stimulated to flower under long days and cold shock conditions or even exogenous application of gibberellins. This first type includes many temperate plants. Plants deficient in the "antithesins group" could be stimulated to flower with several growth retardants and inducing moisture stress and it appears many tropical crops belong to this group.

Some plants have enough of both groups of hormones, and may not need climatic changes to induce flowering. However, stress still play roles in their flowering. As the plant grows taller it is further up away from the root system and these higher parts up the stem experience greater and greater water deficits. When the plant is mature it would have grown to a sufficient height where the water deficits would be strong enough to cause formation of inhibitors at the axis and lead to flowering.

III. *Flowering as part of Ageing*

Annuals die soon after flowering. Non-annuals that die soon after flowering includes the banana plant, the century plant and practically all the bamboos. Why do such plants die?

It is popularly believed that the flowering and subsequent fruit development consume much of the reserve energy, exhausting and hence killing the plants. Removal of flowers seem to prove this point as the removal of flowers prolongs the life of the plant. However, in the male plant of monoceious species which would also die soon after flowering, the removal of the staminate flowers also prolong the life of the plants. However, staminate flowers would not consume that much energy, so as to lead to exhaustion and death of the plants.

Thus the more acceptable theory is that in the flowering process, there is production of copious inhibitors which finally cause the death of the plant. This is not illogical as evidence show that stress situations cause flowering. Use of exogneous growth retardants do stimulate flowering. Mutiliation methods such as pruning off of leaves also lead to flowering. Breeding research show that many plants that flower earlier often have reduced vegetative features. These evidences show that flowering is the outcome of ageing processes in various parts of the plant or the whole of the plant.

IV. *Floral Initiation and Floral Maturation*

The role of hormones, especially growth retardants and gibberellins, naturally lead to attempts to control the flowering of economical crops by exogenous controls. But the desire to regulate flowering by inducing stress conditions or applications of regulators may not be successful if there is a failure to recognise that the flowering process is divided into two main phases; the first being the initiation of the floral primordia. The subsequent second stages is floral maturation where the flower parts mature and develop to form fruits.

Evidence indicate that stress is a required stimulus for flower initiation in many plants. But once the floral initiation occur the subsequent floral maturation actually require conditions necessary for optimal growth, that is, the stress conditions must be removed. Hence many workers have shown that water stress reduced the final yield by adversely affecting fruit set.

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Thus in commercial attempts to apply flowering—inducing hormones or methods, the difference between the two phases of flowering must be noted. Chemical applications may have to be precisely timed. Otherwise, false conclusions may be made and potentially useful methods to induce flowering missed out.

CONTROL OF TROPICAL FLOWERING

In Malaysia, there is a desire to stagger out the flowering of the tropical fruit trees such as durian, rambutans etc. so that fruits may be produced throughout the year rather than obtain the fruits once or twice as seasonal crops. A control of the flowering of these fruits trees would thus enable constant supply of the fruits. It also appears that many crops may also benefit from water deficits imposed at the proper time. On the other hand, there is also a need to counter the injurious effects of drought on flowering and maturation in crops like oil palm.

Irrigation is used in many field and horticultural crops. It may be possible to induce water deficits by proper withdrawal of irrigation. This method of creating water stress conditions would not be possible for fruit trees such as durian etc. For the fruit trees, the stress conditions may have to be created through application of hormones or growth regulators. This is because water stress essentially cause changes in hormonal levels that lead to flowering. Consequently the application of the correct growth regulators would stimulate flowering. Exogenous application of gibberellins have been used with success in temperate plants which need either long day bright conditions or cold shock treatment before flowering can occur. The use of growth regulators for tropical crops have not been studied seriously. The effects of some growth regulators of some crops are given below as some indication of potential effects on tropical crops. All the plants flower better, on application of the growth regulators.

CCC(2-chloroethyl) trimethylammonium chloride — Rhododendron, tomato, Azalea, pepper

B995 (N,N-dimethylamino succinamic acid) — Rhododendron, apple cherry, tomato, sweet corn

Phosphon — Rhododendron, pineapple

2-4-dichlorobenzylnicotinium chloride — pineapple

Amo-1618 — pineapple

2,3,5, triiodobenzoic acid — tomato, soybean (under short day conditions)

Maleic hydrazides — celery, cabbage, lettuce

Ethriol — mango, pineapple

N-metatolylphalamic acid — tomato

Trimethylammonium bromides — increase in female flowers in cucumber.

Many auxins — snap beans, tomato (usually seed production is reduced), pineapple.

Most of the growth regulators above are essentially growth retardants or inhibitors, the kind of substances that would normally be produced under water stress conditions. Even the auxin stimulation of flowering in pineapple is known to be due to auxin stimulation of ethylene derivative. It is thus possible that the beneficial effects of drought on many tropical crops may be produced by proper use of growth retardants.

On the other hand there may be a desire to counter the water stress effects on the inflorescences of oil palm and coconut. This may be possible through the exogenous application of certain promoter growth hormones that would counter the inhibition caused by the stress. But that remains to be worked out.

Water stress has wide effects on the development of tropical crops and there is a need to seriously study the problem of water stress, particularly the effects on flowering. Commercially it may be possible to stimulate the water stress effects by use of growth retardants or even to counter any injurious effects with suitable promoter growth hormones. All this is of course a rather a new field of study but would have potential beneficial results for Malaysian agriculture.

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Diseases of rubber and their control

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SUMMARY

Most of the major diseases of *Hevea brasiliensis* are of worldwide distribution (with the notable exception of South American leaf blight, against which strict quarantine regulations are enforced by rubber-growing countries outside the Americans to prevent the unauthorised import of *Hevea*) but their local severity and importance vary from one region to another. Root diseases are a serious problem nearly everywhere and regular rounds of inspection and treatment are essential while the trees are still young in order to prevent serious losses. The recently introduced prophylactic collar protectant dressings specific to each of the three main diseases are valuable aids to control.

Diseases of the tapping panel may prevent tapping or hinder bark regeneration; black stripe in particular (*Phytophthora palmivora*) can be very persistent and is often eradicated only by repeated therapeutic fungicidal treatment of the bark. Stem diseases, chiefly pink disease (*Corticium salmonicolor*), are important in certain areas in wet weather, and can lead to severe damage and even dieback in the absence of effective treatment.

Four major leaf diseases can have a debilitating effect on the tree. Abnormal leaf fall (*Phytophthora* spp.) is severe in India, causing the abscission of mature leaves during the monsoon rains; treatment necessitates the application of a pre-monsoon prophylactic copper spray. Secondary leaf fall, caused both by *Oidium hevea* and *Colletotrichum gloeosporioides* which infect the flushes of new leaves produced after the annual leaf change (wintering), varies greatly in severity according to local weather and cultivar. It can be controlled by repeated rounds of an appropriate prophylactic fungicide or, under certain conditions, by artificially hastening the onset of wintering (and thus of refoliation) by removing the old leaves with a contact herbicide. By far the most important leaf disease is South American leaf blight (*Microcyclus ulei*); it is largely responsible for the lack of a vigorous rubber industry in South America, the home of the rubber tree. It can only be effectively countered by the use of resistant cultivars.

The economic importance of the above diseases is discussed and current control measures described. PANS **21**: 268–288, 1975.

INTRODUCTION

The para rubber tree, *Hevea brasiliensis* Muell. Arg., is grown in monoculture over some six million hectares of the world's surface and provides the major source of income or employment for several million families in south and south-east Asia alone. The annual world production of rubber exceeds 3.5 million tons, and is still increasing; the long-term future of the crop is exceedingly bright, particularly in view of the constraints now being placed on the petroleum industry and therefore, indirectly, on the production of synthetic rubber.

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These economic facts underline the importance of a healthy natural rubber industry and throw into prominence factors which might militate against the efficient production and processing of latex. A factor of prime agricultural importance in the cultivation of *Hevea* is how it reacts to disease pressures in what is essentially an alien environment as far as most of the world's rubber-growing activities are concerned. It is a noteworthy fact that when the rubber tree was introduced into the Orient from Brazil in 1877, *via* Kew Gardens in London, it was effectively quarantined: it was collected as seed, germinated at Kew, shipped initially to Ceylon in Wardian cases and planted out as healthy seedlings free from pests and diseases introduced from its country of origin. Stringent quarantine in more recent years has also managed to prevent, at least as far as is known, the transport of *Hevea* diseases from one territory to another. The diseases which occur in each region are therefore of local origin, having spread to the new crop from hosts already present.

The rubber tree suffers from a variety of diseases of leaf, stem, tapping panel and root, the incidence and relative importance of which vary both between and within countries. Nevertheless, the overall disease picture is strikingly similar from one region to another, to the extent that in many cases even the pathogen is the same: thus the ubiquitous root-infecting fungus *Rigidoporus lignosus* (Klotzsch) Imazeki (synonym *Fomes lignosus* (Klotzsch) Bresadda) occurs everywhere that rubber is grown, doubtless because it has a wide host range on tropical trees. Other pathogens are far more restricted in their distribution: *Armillariella mellea* (Vahl ex Fr.) Karsten (synonym *Armillaria mellea* (Vahl ex Fr.) Quélet), for instance, is known to attack *Hevea* only in Africa and *Microcyclus ulei* (P. Henn.) v. Arx is confined to central and South America.

The distribution of the more important diseases is shown in *Table 1*. The list is not exhaustive, several diseases of local interest or of small economic importance having been omitted—the stem and root pathogen. *Ustulina deusta* (Hoff. ex Fr.) Lind, being one and the leaf spot fungi, *Corticium solani* (Prill. & Delacr.) Bourd, & Galz. (*Pellicularia filamentosa* (Pat.) (Rogers) and *Corynespora casiicola* (Berk. & Curt.) Wei, both of limited distribution, being others. The Table also gives a somewhat subjective indication of the relative local severity of each of the twelve pathogens, as well as the approximate percentage contribution each of the main rubber-growing centres makes to the total world annual production. Malaysia alone produces 45% of the total and, together with Indonesia and Thailand, accounts for over 80%. This is reflected in the research effort made by each rubber-growing country, for Malaysia supports by far the largest research institute; India, Sri Lanka, Thailand and the Ivory Coast also have similar one-crop research institutes, and Indonesia has two establishments for research on estate crops. This review draws heavily upon the technical publications and advisory bulletins of these institutes.

Casual fungi

Most fungi attacking *Hevea* are facultative parasites with wide host ranges. The important exception is *Microcyclus ulei*, the cause of South American leaf blight (SALB), which is confined to species of *Hevea* and is indigenous to the Amazon region. It is the most destructive disease of rubber known. Other pathogens have

spread to rubber from their original hosts; many of them, in conditions of monoculture, have developed to epidemic proportions. Their severity varies from region to region, mainly climatic conditions, but cultural practices and the local range of cultivars also influence their behaviour and economic status. The most important of these diseases are the primary pathogens of root, branch and leaf and the wound parasites invading the bark as a result of the tapping operation. Other pathogens, typically dieback fungi such as *Botryodiplodia theobromae* Pat. stem wound invaders such as *Phellinus noxius* (Corner) G. H. Cunn. (synonym *Fomes noxius* Corner) and *Fusarium solani* (Martius) Saccardo and weak parasites, such as *Sphaerostilbe repens* Berk. & Br., *Ustulina deusta* and *Marasmius* spp., are abundant but of little importance in comparison with the pathogens listed in *Table 1.*

Table 1. World-wide distribution and relative economic importance[1] of major diseases of hevea brasiliensis.

	C. and S. America	*C. and E. Africa W. Africa*	*Sri Lanka*	*India*	*Thailand*	*Malaysia*	*Indonesia*	*Indochina*	*Papua New Guinea*
PRODUCTION:[2]	1	6	5	4	11	45	26	1	1
ROOT DISEASES:									
Rigidoporus lignosus (Klotzsch) Imazeki	+	++	++	++	++	++	++	+	+
Ganoderma pseudoferreum (Wakef.) van Over & Stein.	+	+	+	–	+	+	+	+	–
Phellinus noxius (Corner) G. H. Cunn.	+	+	+	+	+	+	+	+	+
Armillariella mellea (Vahl ex Fr.) Karsten	–	+	++	–	–	–	–	–	–
STEM DISEASES:									
Corticium salmonicolor Berk. & Br.	+	+	+	+	++	+	++	++	+	+
Ceratocystis fimbriata Ell. & Holst.	+	+	–	–	+	+	+	++	–	+
Phytophthora palmivora (Butl.) Butl.	+	+	+	++	++	++	+(+)	++	++	+
P. meadii McRae										
P. botryosa Chee										
LEAF DISEASES:									
Glomerella cingulata (Stonem.) Spauld & Schrenk	+	+	+	+	+	+	+	+	+	+
Oidium heveae Steinm.	+	+	+	++	+	+	+(+)	++	+	+
Microcyclus ulei (P. Henn.) v. Arx	++	–	–	–	–	–	–	–	–	–
Phytophthora meadii McRae	+	–	–	+	++	+	+	+	+	–
P. palmivora (Butl.) Butl.										
P. botryosa Chee										
Drechslera heveae (Petch) M. B. Ellis	+	+	+	+	+	+	+	+	+	+

1) Local economic importance ++ major, + minor, – absent.

2) As percentage of 1973 world production.

Nevertheless, that the disease picture is dynamic rather than static is shown by two examples from Malaysia: *Ceratocystis fimbriata* Ell. & Halst., a wound parasite which infects the tapping panel, first appeared in 1916 and in the following 10 years increased in both range and severity to the status of an economically important disease; however, in post-war years it has been rarely seen and is now of very little interest. This example may be contrasted with that of the leaf-infecting fungus *Phytophthora botryosa* Chee, which was first noticed in 1966 and which has since been recorded from a number of localities around the area of the original outbreak. Although potentially destructive, natural barriers appear at present to be confining the disease.

Predisposing factors

As well as such historical and geographical changes, other variable aspects of disease behaviour are of significance. The age of the tree has a profound effect upon the disease spectrum, as does the susceptibility of the cultivar; certain diseases (such as the leaf diseases causing so-called secondary leaf fall) only become important on trees more than about four years old of certain highly susceptible (but widely-planted) cultivars. After the fourth year of growth a 'wintering pattern' becomes established in which an annual leaf change occurs, usually after a pronounced dry season; the simultaneous appearance of the new leaves affords an ideal substrate for the growth of leaf-infecting fungi such as *Oidium heveae* Steinm. and *Microcyclus ulei.*

Climatic differences, both macro- and micro- in nature, are a major source of variability in disease behaviour within and between rubber-growing territories. For example, differences in the amount and distribution of rainfall account for variations in the severity of defoliation caused by *Phytophthora* spp. in places in which abnormal leaf fall occurs; and the higher humidity and wetter soils of the Ivory Coast probably explain the ease with which white root disease can be detected above soil level in new plantings in that country.

Control and prevention

Preventing disease (prophylaxis) is, in general, much to be preferred to treating it (therapy), provided that the expense involved and time-scale of operations are compatible with the grower's immediate needs. There is nowdays a much greater realisation than in the past that, when selecting clones for planting, only those having an adequate degree of resistance to the diseases likely to be of local importance should be used. This necessitates disease surveys to identify high-risk areas as well as some reliable means of assesing the susceptibility of cultivars in current use. A vigorous breeding programme, taking full account of disease susceptibility, is an essential tool in the long-term objective of obtaining disease-free trees or, at least, of containing disease at an acceptable level. These objectives are nowadays being fulfilled to a greater or lesser degree: the Malaysian rubber grower, for instance, is able to choose from a short list of clones appropriate to his state or even his locality, while international co-operation in Trinidad is seeking to ensure that a measure of resistance against SALB is brought into oriental planting material by screening promising eastern selections against *Microcyclus ulei* in Trinidad. The

plant breeding approach to leaf disease control has been refined by selecting clones with disease-resistant foliage and budding them on clones with good trunk characteristics: resistance to wind damage and high yield. Although this technique is in its infancy it is promising for use in areas of high leaf disease risk (such as much of Central and South America, where *Microcyclus ulei* is endemic).

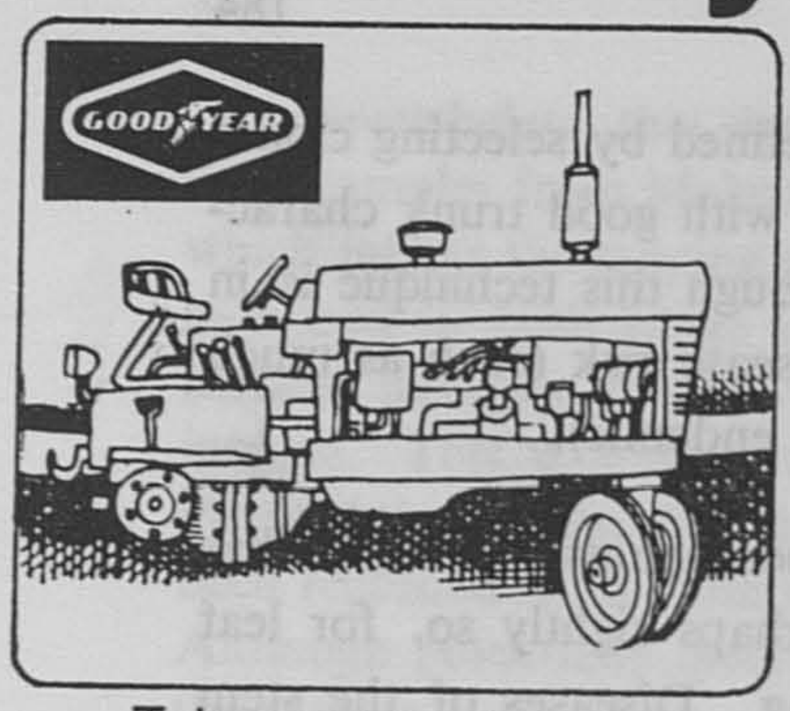
Although breeding for resistance is the ultimate weapon against disease, it has achieved success so far mainly against leaf diseases: perhaps rightly so, for leaf injections tend to be recurrent and continually debilitating. Diseases of the stem and tapping panel are to some extent more transient, more amendable to chemical control and certainly physically easier to treat. Root diseases, against which breeding is impracticable, are susceptible to treatment in other ways which are based largely on biological control, with the judicious use of chemicals as an adjunct. The overriding philosophy in an already labour-intensive tree crop industry with a long generation time, where labour accounts for over 50% of total production costs, must be to plant disease-resistant or tolerant clones wherever possible, to use whatever natural means of control that are available and to employ fungicides or manipulative techniques only as a last resort.

Economic importance

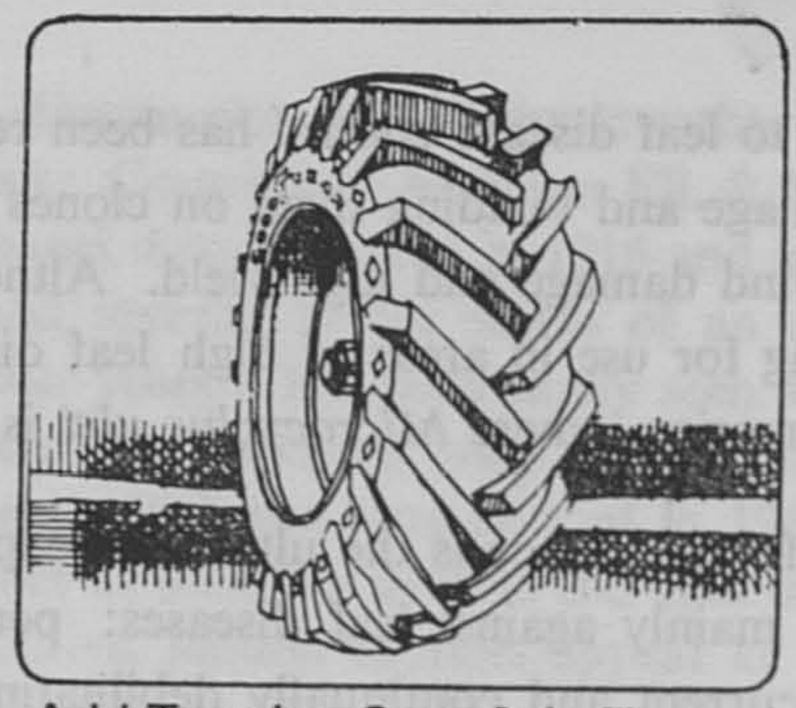
The economic importance of the major diseases varies both in time and space, but with the exception of SALB there are now no diseases of *Hevea* which are not amendable to treatment by one means or another. However, the severity of attack may be such that the cost of control is not economic, leading to the abandonment of the planting. This has happened over several hundreds of hectares in Surinam, Panama, Costa Rica and Brazil through SALB and, on a very much more limited scale in the east, where root diseases have frequently made the continuation of a particular field not worthwhile due to extensive depletion of the stand.

The diseases of greatest economic importance are inevitably those which (a) lead to the death of the tree or (b) severely affect its growth or which (c) render tapping difficult or impossible. The first category includes the root diseases (chiefly white root disease, *Rigidoporus lignosus*); the second includes leaf diseases such as *M. ulei* and *Phytophthora* spp. and the third includes black stripe of the tapping panel, caused by *P. palmivora* (Butler) Butler. These diseases are controlled at a greater or lesser cost, depending on local disease pressure. In addition, a range of less severe diseases warrants control measures under certain circumstances, chiefly at times of the year most favourable to the disease. On the whole, however, and with the exception of *M. ulei*, the modern rubber tree is remarkably healthy and disease is no longer a major limiting factor in its cultivation. This has not always been the case, and may not continue to remain so, but the resilience of the tree, the widespread occurrence of field resistance to disease and a strong research back-up are powerful factors on the grower's side.

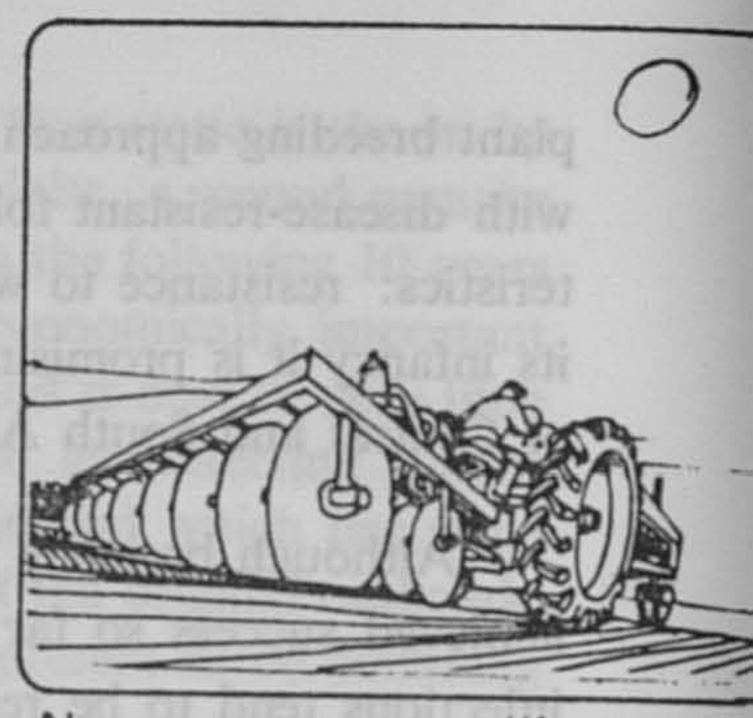
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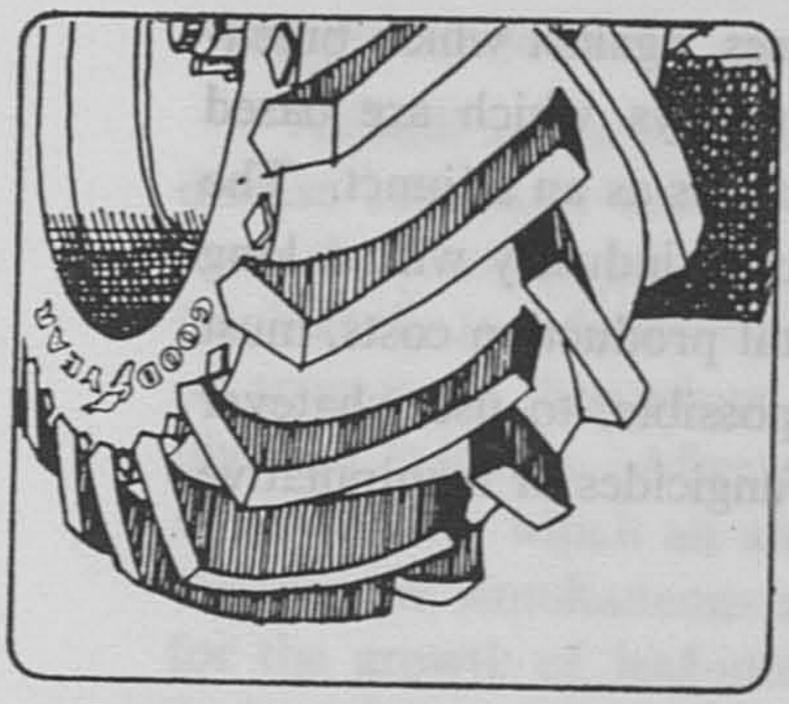
Take your tractor . . .



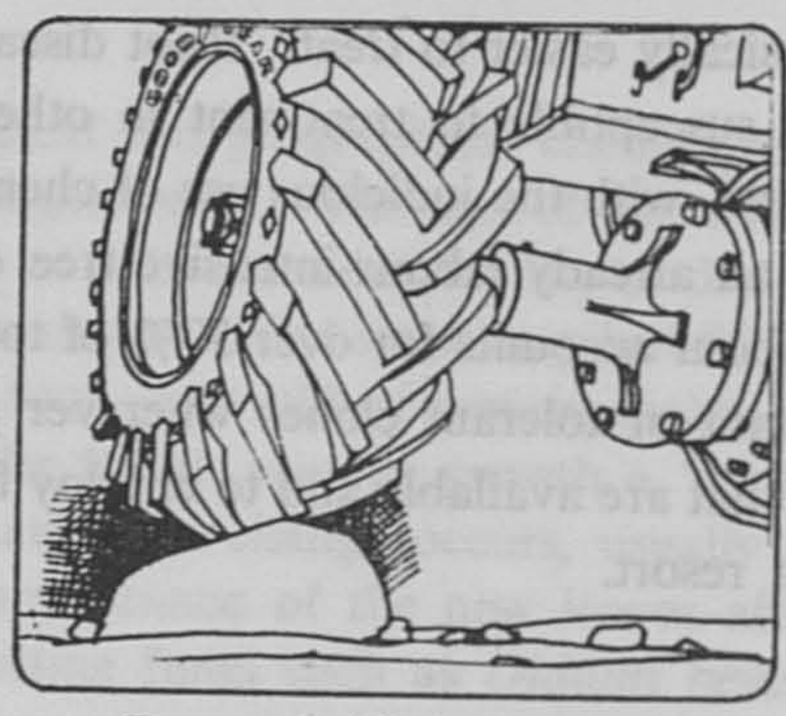
Add Traction Sure-Grip Tyres.



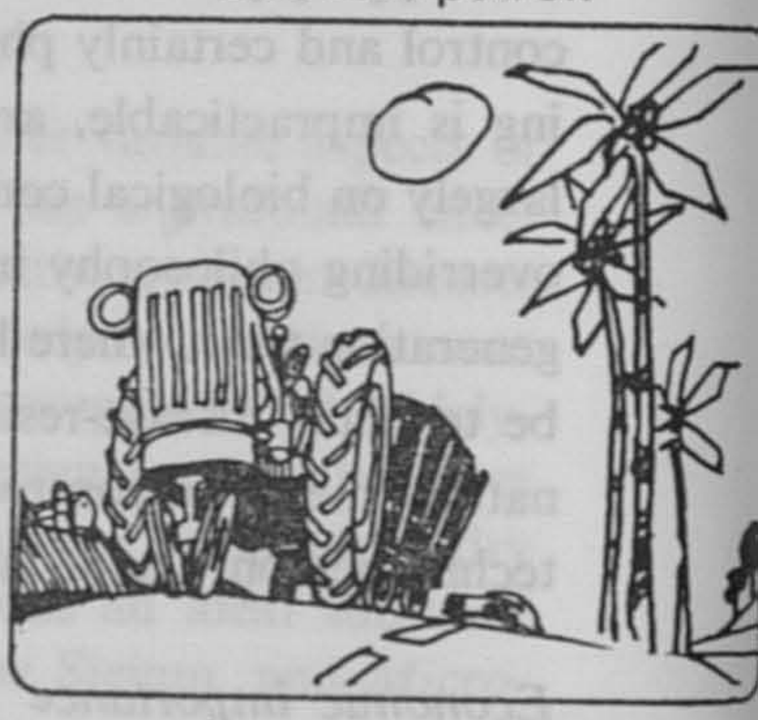
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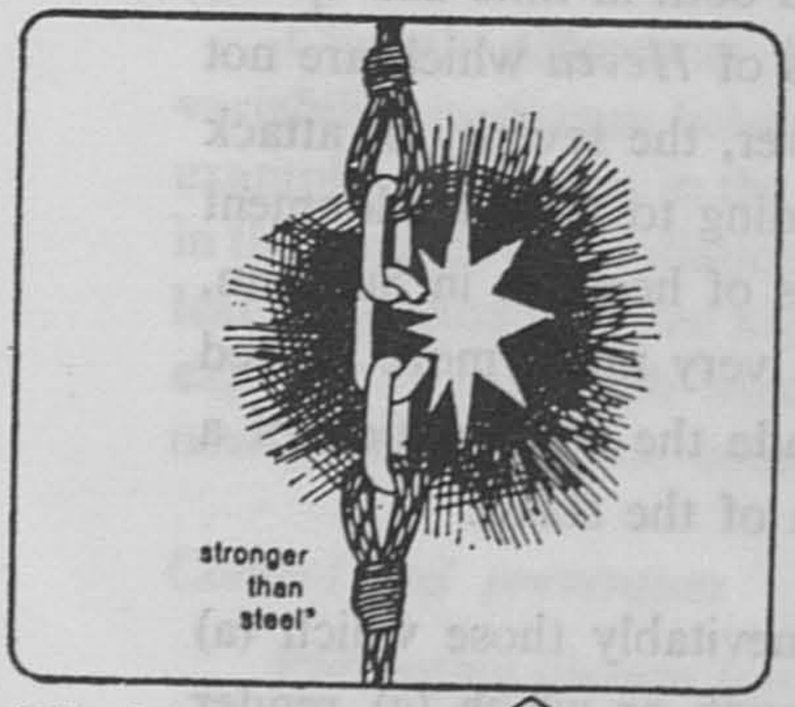
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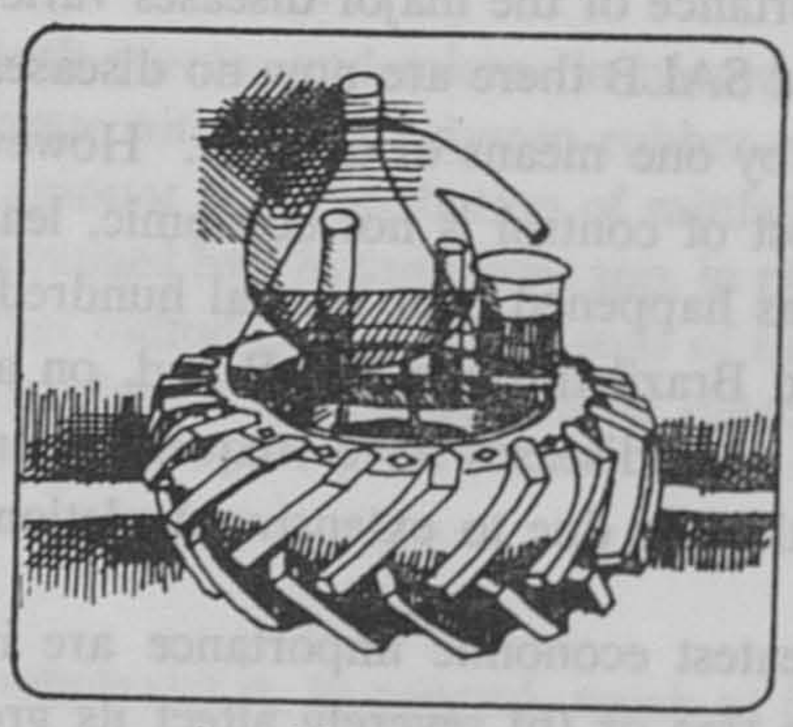
Forget field damage . . .



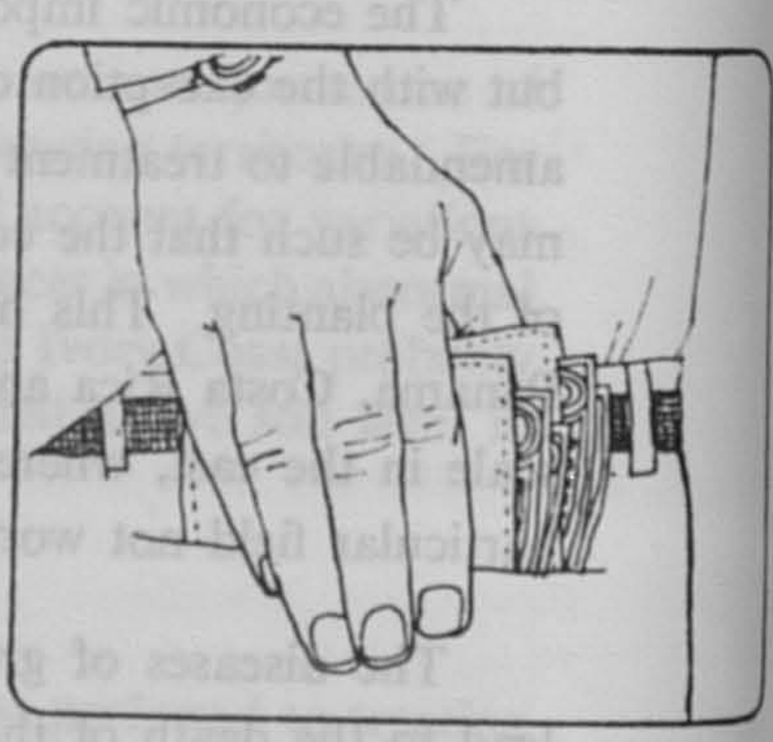
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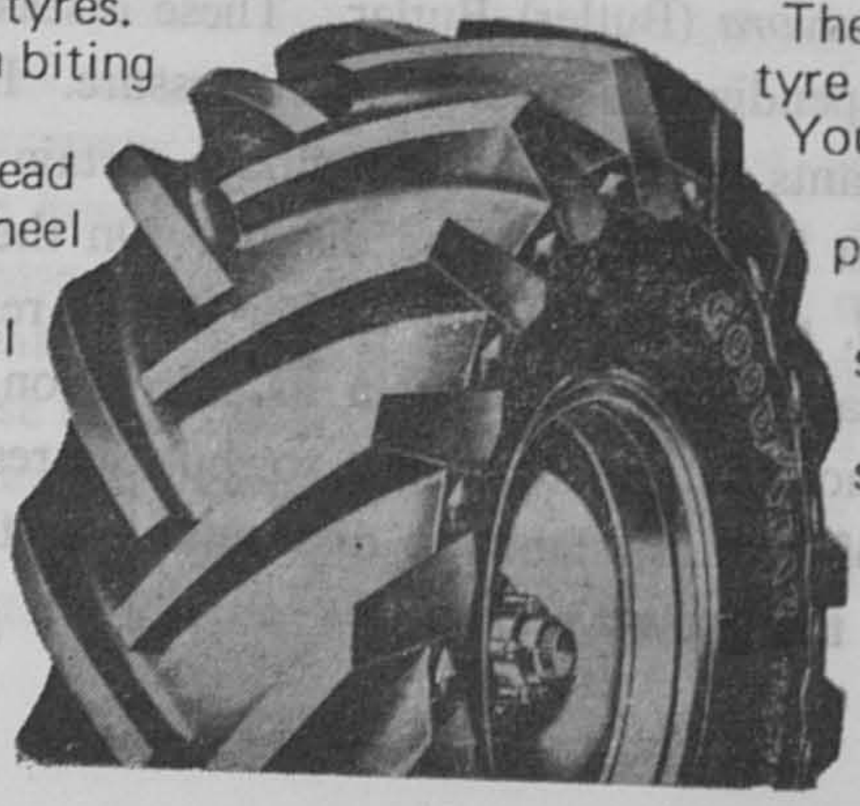
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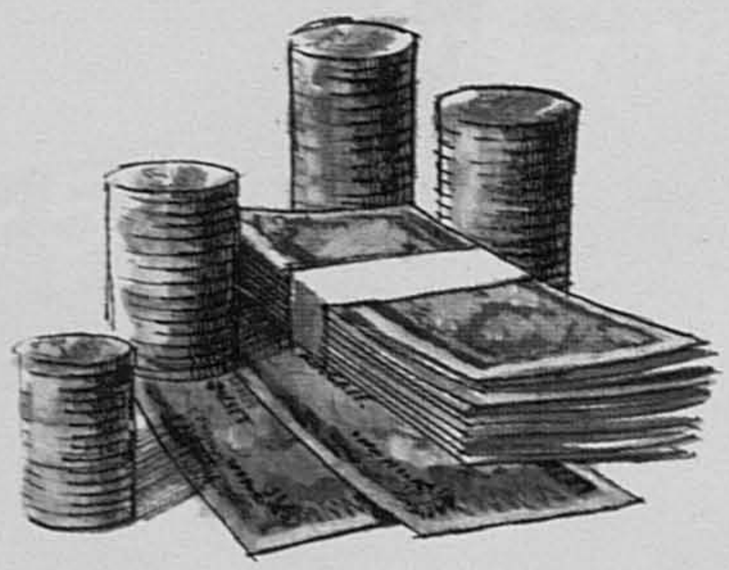
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ROOT DISEASES

Among the local fungi which spread to *H. brasiliensis* wherever it was introduced, none exceeds in importance or potential devastation white root disease caused by *Rigidoporus lignosus.* Second in importance is red root disease (*Ganoderma pseudoferreum* (Wakef). van Over. & Stein.) although it is apparently absent from Sri Lanka. Of relatively minor significance, except perhaps in India, is brown root disease, *Phellinus noxius.* The common names of the diseases refer to the colour of the rhizomorphs or mycelium on the surface of infected roots. A major root disease in parts of West and Central Africa is caused by *Armillariella mellea.* These diseases had reached an equilibrium with their natural forest hosts but immediately attacked newly planted rubber, spreading from the stumps of felled jungle trees by root contact. Travelling along the roots, which decay in the process, the mycelium reaches the collar and tap root and eventually girdles the tree. As plantations were opened up, indigenous trees which had not previously been infected became diseased as a result of wind-borne spore infections of the cut surfaces of their stumps, thus further increasing the potential sources of infection. Much expense was incurred in attempting to remove infected material both before and after planting and some even doubted the wisdom of replanting heavily diseased areas. Happily, current practices are far removed from this viewpoint and, by careful management, root disease can be largely eliminated from a plantation by the time the trees are mature (i.e. ready for tapping), even though the previous stand was heavily infected.

The success of the treatment of root diseases achieved in Malaysia as a result of research at the Rubber Research Institute has influenced disease control practices in many other countries. The essence of control lies in using biological processes to simplify and assist the digging operations needed to remove infected stumps (which are largely encouraged to decay rather than being bodily removed). Treatment takes into account the plantation as a whole rather than the individual tree, for losses of immature trees are considered acceptable as long as they are scattered and kept to a low level (say five trees per hectare per annum).

Since the source of infection is the remains of the old stand, both above and below ground (the soil does not act as a reservoir of infection), mechanical clearing, in which the stumps are removed and most of the timber removed or burnt, largely eradicates sources of infection and remaining root fragments quickly rot away. However, mechanical clearing has disadvantages: it is expensive, it cannot be employed on steep land and it removes much organic material from the soil. An alternative method is to poison the trees with either 5% n-butyl 2,4,5-T in diesel oil or with sodium arsenite paste, the latter being painted on the wood after ring-barking, the former being applied directly to the bark around the base of the tree. The poison quickly kills the tissues which are then no longer susceptible to invasion by root-infecting fungi but become colonised instead by saprophytic organisms. Felling may be done either before or after poisoning but, in the former case, the cut surface of the stump is painted with a wood preservative such as creosote to prevent infection by spores.

That the manner of clearing determines to a large extent the amount of disease in the new stand is demonstrated by an experiment in Malaysia (Newsam, 1967) which compared root diseases losses for six years following four methods of clearing: mechanical, (a) with and (b) without removal of the larger root fragments following cultivation; (c) poisoning standing trees; (d) felling and poisoning the stumps with 2,4,5-T. As shown in *Table 2*, all three diseases were present in the old stand and total losses were lowest following the complete mechanical treatment but at the highest cost (clearing + root disease control). The other three treatments resulted in similar final costs but the easiest (and cheapest) method of clearing gave the greatest root disease losses. However, even this level of disease (representing some four trees/hectare/year) is acceptable, provided the losses are scattered.

Poisoning cannot eradicate root disease from an already infected tree and, where hand clearing is practised, such sources of infection are inevitably allowed to remain. However, cultivating a carpet of creeping leguminous cover plants will assist in the natural decay of infected timber. Nothing more is practicable for it has been demonstrated (Newsam, 1967) that removal of infected trees before replanting is not worthwhile as far as *R. lignosus* is concerned although, in areas known to be infected by *G. pseudoferreum*, removing the larger roots by hand after tree or stump poisoning might be a useful precaution (*Table 2*). An additional prophylactic measure recommended in Sri Lanka is to sprinkle sulphur on the soil around the planting hole at the time of replanting areas infected with white root disease; this alters the balance of the soil microflora and encourages micro-organisms antagonistic to *R. lignosus*. The incidence of root disease is thereby reduced for the first two years, i.e. until the root system explores a larger volume of soil.

Control measures

Clearing methods that take cognisance of the requirements of root disease control and planting of inter-row legumes are followed by inspections to detect the foci of disease which still inevitably develop. The normal routine in eastern countries is

Table 2. Cumulative losses over six years due to root diseases in a replanting, following four methods of clearing.*

Method of clearing	*Trees per hectare lost due to*				*Cost of clearing*	*Cost of disease control*	*Total cost*
	Rigidoporus lignosus	*Ganoderma pseudoferreum*	*Phellinus noxius*	*Total*			
					(M$ per hectare)		
Mechanical, + rooting	4.9	0.9	0.3	6.1	445	40	485
Mechanical, − rooting	11.1	0.9	0.6	12.6	285	58	343
Tree poisoning	5.4	9.0	1.4	15.8	285	63	348
Stump poisoning	11.7	8.9	2.6	23.2	275	80	355

* Data from Newsam, 1967.

to inspect the foliage at regular (e.g. 6-month) intervals for the symptoms of drought or wilting which severe damage to the root system would cause. These symptoms are the same whichever root disease is present and, by the time gross symptoms of attack are detected, damage to the root system is generally such that the tree is beyond treatment and must be destroyed. The loss of individual trees is not important because extensive thinning is practised anyway during immaturity and immediately after maturity, but contiguous losses are to be avoided; the root systems of trees neighbouring the infected one are therefore inspected and diseased tissue excised. The inspection is continued along the row until no more diseased trees are detected. In addition, the source of the infection is traced back along infected roots to the edge of the planting row; if found, it is removed or isolated by digging; if it lies in the inter-row it is left to decay under its covering of vegetation.

The development of a prophylactic treatment against root disease relies on the fact that the external growth of a root disease fungus is unable to sustain an infection in the absence of a food source and that removal of external growth ahead of the tissue that has been penetrated prevents further growth of the fungus. This could be done chemically if effective fungistatic products were available. In 1962 pentachloronitrobenzene was found to control *R. lignosus:* a 20% formulation in bitumen prevents the disease advancing along a treated root for two years (Fox, 1966). Similar formulations containing 10% drazoxolon against red root disease (*G. pseudoferreum*) and 10% tridemorph against both red and brown root disease are now recommended by the Rubber Research Institute of Malaysia (Anon., 1974). After identifying the disease, excising diseased tissue (but not superficial mycelium) and painting tar on the wounds, remaining roots and the collar and roots of neighbouring healthy trees are treated to a depth/length of 25 cm with the appropriate formulation. Treated trees are re-inspected after one year. The use of a chemical in this way has reduced overall disease incidence (Rao, 1972).

Routine collar inspection has long been abandoned in the east partly because of the expense and the damage to the root system it caused, partly because it only detected incipient infections that the host's defence mechanism would overcome. However, a new form of collar inspection, developed in the Ivory Coast, has proved very effective at detecting white root disease in its early stages, when it is most easily treated. The method relies upon the facts that, in the Ivory Coast, the point of infection almost always lies in the top few centimetres of soil and that, when conditions are suitable, the fungus will grow above soil level. A mulch of dry cover plants around the trunk thus encourages the mycelium of *R. lignosus* to appear on the surface of the bark at the base of an infected tree. Collar inspection and treatment then follow.

Differences in the behaviour of *R. lignosus* in the Ivory Coast are further exploited by the use of *Tithonia diversifolia* A. Gray (Compositae) as a cover crop. This plant reduces the incidence of root disease by reducing the moisture content of the uppermost layers of soil, the zone in which *R. lignosus* is most active. A similar depressive effect on root disease (though for different reasons) has been noticed in Malaysia with *Mikania cordata* (Burm. f.), but this plant also has a depressive effect on the growth of *Hevea.*

Cover plants of the creeping legume type confer another, less obvious, benefit in terms of biological control of root disease. This arises from their 'decoy effect' on root disease, particularly on *R. lignosus*. Cover plants encourage the spread of the pathogen but not necessarily that of the disease (Fox, 1965); thus the fungus is encouraged to grow epiphytically in the litter layer and even to produce fruit-bodies on and around infected stumps, thus exhausting its food reserves and laying the mycelium open to destruction by antagonists in the soil flora and fauna. Provided the cover plants (and hence the mycelium) are not allowed to spread to the young trees, the stimulatory effect they exert on the pathogen is a valuable indirect factor in its control. Woody legumes however, which themselves can become infected and thereby transmit the disease to the rubber trees, are generally to be avoided.

This stimulatory and exhaustive effect does not extend in the same way to slower-growing pathogens such as *G. pseudoferreum, P. noxius* or *Armillariella mellea,* the cause of a serious collar and root rot in parts of West Africa such as Nigeria and Liberia. Foliage inspection may be inadequate to detect the presence of the latter disease, and periodic collar inspections are therefore necessary, particularly in the late stages of immaturity, so that the disease does not become well established before the final stand is reached. No collar protectant dressing has been developed against *A. mellea.*

The treatment of root disease of any kind is more difficult in mature rubber; the source of infection (possibly resulting from spore infections as well as a carry-over of infected material from the old stand) must be traced and either removed or isolated by trenching which is, however an expensive and (unless the trenches are re-dug) a largely ineffectual procedure.

A number of other root-infecting fungi are of occasional local importance: *Ustulina deusta* is mainly encountered as a wound parasite and rarely spreads from tree to tree; *Sphaerostilbe repens* is an occasional pathogen favoured by wet conditions.

TAPPING PANEL DISEASES

The regular wounding of the bark caused by the tapping operation affords an entry for a few wound parasites, among which species of *Phytophthora* are by far the most important. The disease they cause (known variously as bark rot, black stripe or black thread) is a serious above-ground disease of certain rubber-growing regions which experience a pronounced rainy season (e.g. Sri Lanka, India and Indochina) The disease is also locally severe in Malaysia, Indonesia and parts of west Africa (e.g. Liberia).

The main causal fungus is *P. palmivora,* but *P. meadii* McRae has been regarded as the chief pathogen in Sri Lanka and *P. botryosa* is an associated cause in those parts of Thailand and Malaysia in which abnorml leaf fall caused by this pathogen also occurs. The common name of the disease derives from the vertical black lines seen in the wood underneath affected bark. The disease only occurs in wet weather, the spores being dispersed in rain and damp wind and requiring a film of water in which to germinate. Once the fungus has penetrated the inner layers of bark, it

becomes firmly established and difficult to eradicate by chemical means. It destroys the cambium, preventing the regeneration of bark after tapping and leaving large open wounds which render subsequent tapping of the same bark difficult or impossible. In extreme cases, individual lesions coalesce to form extensive patches of necrotic bark. The pathogen also travels downwards into healthy untapped bark and, if left unchecked, may cause internal latex bleeding, which in turn pushes off the bark, thus splitting and rupturing the laticiferous tissue.

Clones vary in susceptibility; not only are older planting materials (PB 86, Tjir 1, PR 107) affected, but some of the most severe symptoms are to be seen on more recent selections (RRIM 600, 605, 623). Subsidiary pre-disposing factors are the depth of tapping, the height above ground of the tapping panel (infections are often noticeably worse near ground level), the planting distance and density (increased density and square planting favour the disease) and the nature of the overhead canopy and of the ground cover (any factors hindering drying of the tapping cut after rain will exacerbate the disease). Naturally enough, the disease is halted by dry weather and the cessation of tapping, although the latter is an extreme remedy; but careful supervision to ensure that trees are not tapped when the tapping cut is wet will reduce the spread of the disease.

Research into methods of controlling black stripe has been carried out in Cambodia, Sri Lanka, India, Malaysia and Liberia, with the object of defining a treatment which can keep the disease in check and yet enable tapping to continue. Where the disease is most severe it is necessary to apply a fungicide after every tapping, preferably on the same day, so that the chemical is present on the new cut for as long as possible. Effective chemicals are 0.08% phenylmercuric dinaphthylmethane disulphonate*, 0.8–1.6% captafol and 0.02% cycloheximide applied by brushing or, where many trees are to be treated, by a fan-shaped spray from a knapsack sprayer. The object of treatment is to contain the disease and prevent bark necrosis so severe as to require physical removal. Curative treatment of this nature is damaging to the tree, invariably halts tapping and the wounds made in cutting away dead bark and pads of latex are exceedingly slow to heal.

Routine prophylactic treatment of black stripe is expensive in terms of both labour and materials and attempts have been made to reduce the frequency of application by the use of formulations with a greater degree of persistence or penetrance. Thus Schreurs (1972), in Liberia, used a once-weekly application of 1% captafol incorporating a sticking agent, detergent and colouring agent and Chee (1972), in Malaysia, recommended the addition of 1% Teepol to phenylmercuric dinaphthylmethane disulphonate or of a petrolatum-based panel dressing or palm oil to cycloheximide; however, the frequency of application, after alternate tappings, was still high. The penetrating power of fungicides is insufficient to reach deep-seated bark infections and it seems unlikely that the frequency of application, at least in severe cases of black stripe, can be much reduced.

Waterproof panel dressings of various kinds have been favoured in the past but they serve to obscure rather than cure the disease; unless carefully applied when the bark is dry, they retain moisture and may even excerbate the disease. Non-

phytotoxic dressings, based on petrolatum or vegetable oils, are nowadays mainly used to promote the healing of wounds made in the course of surgical treatment of bark rots.

Compared with black stripe, the other wound parasite gaining entry *via* the tapping cut (*Ceratocystis fimbriata*) Ellis & Halst., the cause of mouldy rot, is of much less importance and of narrower distribution. As with black stripe, mouldy rot is favoured by wet weather, humid conditions (such as those caused by dense undergrowth) and by deep tapping leading to wounding. It is confined to the regenerating bark above the tapping cut, which becomes slightly depressed and covered with a greyish-white mould. In the absence of treatment, large wounds resembling tapping wounds are formed, exposing large areas of wood.

Although the disease is easily spread during tapping, it is also easily cured by therapeutic treatment. The extensive prophylaxis necessary when an outbreak of black stripe occurs is unnecessary, for mouldy rot can be eradicated with a few weekly applications of 0.25% benomyl, 0.02% cycloheximide or 1.6% captafol. Several other fungicides, including 0.08% phenylmercuric dinaphthyl methane disulphonate, tar-acid and quaternary ammonium compounds, are also effective, although less rapid in action and requiring treatment for a longer period or at more frequent intervals.

In recent years an occasional disease of the tapping panel known as panel necrosis has been identified in Malaysia as being caused by *Fusarium solani* or *Botryodiplodia theobromae* (Chee, 1971). It often begins on the initial guide lines cut into the bark to mark out the site of the first tapping panel. Darker, latex-free patches appear on these cuts and on the tapping cut itself; the patches deepen and spread and large areas of the panel may be affected. The disease responds to treatment with one or other of the fungicides recommended against black stripe; alternatively, tapping four or five times in quick succession will often remove the affected bark.

STEM DISEASES

A few fungi are able to attack intact bark but only one of these, *Corticium salmonicolor* Berk. & Br., is an important world-wide pathogen. It has a wide host range and, on rubber, attacks the bark in the region of the branch forks, chiefly on trees 3–8 years old. The disease it causes is known as 'pink disease' from the pink encrustation which develops over the affected parts in the stages of infection. If left unchecked, the fungus penetrates and destroys the bark, resulting in the death of all the stem are branch tissues above its point of entry. The disease is only severe in regions of and at annual periods of high rainfall but, being wind-borne and capable of affecting all clones, it spreads extremely rapidly and soon reaches epidemic proportions in trees of susceptible age.

Although it is most frequent on immature trees before tapping begins (and incidentally before the canopy has closed over, thereby restricting air movement) pink disease also affects mature trees. Although its destructive effects on larger

stems and branches are less spectacular and slower to develop, such infections may become very persistent, drying up in dry weather only to reappear in the wet. These deep-seated infections are harder to detect and to control but, if left untreated, can eventually cause considerable loss of trunk and branches, and result in secondary infections by other fungi, causing further dieback.

The standard curative treatment in Malaysia, India and elsewhere, where the disease is most severe, is Bordeaux mixture, used either as a 10% paste applied with a brush or as 1% liquid sprayed from the ground. In the latter case small knapsack sprayers with the swirl plate removed from the nozzle are used to produce a jet of liquid which will reach to 10 m or more. Although wasteful of liquid, this equipment is rapid and easy to use.

The effectiveness of Bordeaux mixture lies in its persistence; copper is only mildly toxic to the fungus but its retention *in situ* under high rainfall gives a reasonable level of control. However, the treatment (especially at weaker concentration) has to be repeated frequently (1–2 weeks) during wet weather. Prophylactic application is impracticable and frequent rounds of inspection and treatment are essential when the disease season is at its height.

Copper fungicides suffer from the disadvantage that they cannot be used on trees in bearing because of the danger of contaminating the latex. Although a number of other products of far greater toxicity have been tried, all failed because of lack of persistence. However, recent work in Malaysia has produced a formulation based on prevulcanised natural rubber latex as the carrier and 1.5% tridemorph as the fungicide (Yeoh and Tan, 1974). Latex is an ideal carrier for the fungicide for it forms a water-permeable matrix from which the fungicide is slowly leached under the influence of rain. A far greater degree of control than with Bordeaux mixture can thus be achieved with only one application, the effects of which last 2–3 months. The fungicide is applied by brush after climbing the tree. This is somewhat slower than spraying and is sometimes sufficiently disadvantageous to make Bordeaux mixture still the preferred treatment. However, if applied at the beginning of the wet season, no re-treatment is necessary, although frequent rounds of inspection are, of course, still required to locate fresh infections. The latex + tridemorph formulation can be used on both mature and immature trees and its ideal for the small grower who uses family labour and lacks spraying equipment.

Another fungus capable of gaining entry into intact bark (in addition to its main role as a wound parasite) is *Phytophthora palmivora* (Chee, 1968). It causes a bark necrosis, known as stem canker or patch canker, usually on the lower part of the stem. Areas of bark are killed down to the wood and, as the fungus spreads laterally, extensive necrotic patches may result. Latex oozes from the damaged bark both externally and internally and the coagulum so formed frequently causes it to bulge and split open. Treatment necessitates surgery to remove the latex pads and dead bark and spraying the wound with a mercury fungicide before smearing it with petrolatum to promote bark renewal.



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The weak parasite *Pythium vexans* de Bary is sometimes found in association with patch canker and, in Liberia, it affects the roots and collar region as well as the lower part of the stem; however attempts to inoculate it to intact bark and tapping panels have been unsuccessful, both in Malaysia and Liberia.

LEAF DISEASES

The only pathogen confined to *Hevea, Microcyclus ulei,* causes a highly destructive leaf disease (SALB). Originally confined to the natural range of *Hevea* spp. in the Amazon region, it has now spread within South and Central America as far south as the Sao Paulo region of Brazil and north to Mexico, presumably carried there by the planting material used to extend the tree beyond its original range. The disease has been responsible for the failure to establish a large natural rubber industry in the Americas: it wiped out the early plantings in Guyana and Surinam and has severely hampered many subsequent attempts to establish plantations, notably those of the Ford and Goodyear companies in Brazil and Panama respectively.

The disease primarily affects the very young leaves, causing repeated defoliation and dieback and the ultimate death of the tree. Older leaves do not fall and those with a mature cuticle (which develops after about two weeks) are resistant. The severity of the disease is materially affected by the weather; the highest incidence is experienced where the annual rainfall reaches 2,500 mm and there is no long dry season to hinder spread. The fungus produces both conidia and ascospores; they are wind-dispersed and highly infective, although relatively short-lived once released.

The disease is at its most severe on immature trees before the wintering cycle becomes established, in about the fifth year. Such young plants produce susceptible foliage throughout the year and are therefore open to attack whenever the weather is wet enough for long enough. Mature trees tend to refoliate synchronously after the annual wintering and, where this coincides with dry weather, reasonable freedom from infection is likely; conversely, where wet weather is predominant severe defoliation results.

The use of fungicides to control SALB is generally confined to valuable nursery stock and to young plantings, where weekly rounds of zineb spraying have been used with some success; aerial application of fungicides has recently been attempted in Brazil. Evaluation of spraying has continued but resistance to the local races of *M. ulei* (four physiologic races are recognised) is needed to enable rubber to be grown commercially in South America. Certain wild populations with field resistance to the disease, as well as major gene resistance from *H. benthamiana* Muell. Arg. and (more recently) *H. pauciflora* (Spruce ex Benth) Muell.-Arg. have been used and crosses from these sources with high-yielding oriental clones are the basis of the selections currently planted in the Americas.

Eastern closes are mostly highly susceptile to *M. ulei* and, with the ever-present threat of the spread of the disease to Africa and the Far East (increased by air traffic) a vigorous breeding programme to introduce resistance into eastern planting material is underway. In this connection, the Rubber Research Institute of Malaysia maintains a SALB research and screening unit in Trinidad.

An additional technique currently being exploited is to bud a disease-resistant canopy on a susceptible trunk clone. It is a fortunate feature of the genetic make-up of *Hevea* that yield is determined almost exclusively by the trunk whereas resistance of leaf diseases is conferred by the crown. A vigorous, SALB-resistant crown clone can thus be combined with a high-yielding but susceptible trunk.

A third line of defence against SALB, but only as far as Africa and the East are concerned, is the strict quarantine imposed on the importation of *Hevea* and other planting materials from regions where SALB occurs. It is reasonable to assume that *M. ulei* would behave in other rubber-growing regions very much as it does in tropical America and would probably spread rapidly once it had arrived. Emergency eradication procedures have therefore already been worked out in Malaysia and elsewhere, involving aerial applications of n-butyl 2,4,5-T in diesel oil (to defoliate the trees) and pentachlorophenol (in an attempt to kill the fungus on fallen leaves). The success of the treatment would depend entirely on the speed with which an outbreak was discovered and treated: periodic country-wide campaigns to publicise the symptoms of the disease and aid in its recognition are therefore essential.

The other main leaf diseases of *Hevea* may be locally and temporarily severe; in the absence of treatment, they may hinder the growth of the tree and seriously reduce its yield, but they rarely kill it. Nevertheless, complete defoliation may result from the severe outbreaks of abnormal leaf fall that occur annually in India; the disease also occurs in Sri Lanka, Thailand, Indonesia (Java), Indochina and Malaysia. It is caused variously by *Phytophthora palmivora* (India), *Phytophthora* spp. (Indonesia, Sri Lanka) and *P. botryosa* (Thailand and Malaysia). The disease is severe only where there is a long and heavy rainy season to aid the dispersal of the spores (as in south India, where the rainfall exceeds 750 mm per month for June, July and August). Under such conditions, 75% defoliation is probable in the absence of treatment, resulting in the loss of up to half the crop.

Phytophthora leaf fall is the only disease of rubber that attacks mature leaves. The immature fruits are frequently affected first, from which sporangia and zoospores are produced which then invade the petioles. Petiolar infection results in the formation of a premature abscission layer so that the leaves fall while they are still green. Under favourable conditions, defoliation is rapid and, since the tree then remains bare of leaf until the subsequent refoliation season, its vigour and yield are considerably reduced.

The predictable nature of the disease in India necessitates routine prophylactic treatment: one pre-monsoon high-volume application of 1% Bordeaux mixture, or a low-volume treatment with cuprous oxide or copper oxychloride in spray oil, applied either from ground or from the air, confer complete protection against the disease. The treatment is extremely expensive but essential. Fortunately, the severity of the disease elsewhere is much less and routine treatment is generally not considered worthwhile; defoliation however, may still be locally severe, particularly on such susceptible cultivars as PB 86 and RRIM 600. The outbreaks of abnormal

leaf fall that have occurred in Malaysia since 1966 are the result of infection by *P. botryosa*, a species that is thought to have arisen in Thailand. It is currently confined to the extreme north of peninsular Malaysia, regions that experience a particularly marked rainy season.

The other leaf-infecting fungi, notably *Oidium heveae* and *Glomerella cingulata* (Stonem.) Spauld. Schrenk (*Colletotrichum gloeosporioides* Penz.), are generally little more than nuisances, although the extensive and repeated defoliation that they cause on highly susceptible cultivars in some localities may warrant control from time to time. Both fungi bring about a so-called secondary leaf fall by attacking the young leaves that develop during the short refoliation period after the annual leaf change or wintering. At this time an abundance of susceptible young leaves is produced affording plentiful points of infection.

The main pre-disposing factors for infection are the inherent susceptibility of the clone to the pathogens and weather during refoliation: the nature of the pathogens is such that the weather favours one or other and they rarely occur together, although one may follow the other as the weather changes. *O. heveae*, or powdery mildew, which has been of some importance in Indonesia (Java) and Sri Lanka (particularly the upland districts of the latter country), is favoured by relatively cool, humid overcast weather with misty mornings. The fungus grows mainly over the surface of the leaf and is removed by heavy rain. *Glomerella cingulata* (the cause of gloeosporium leaf disease) on the other hand, is favoured by long periods of wetness which facilitate spore dispersal and germination; thus the disease is worst where rain is frequent and persistent. *C. gloesoporioides* causes leaf spotting and necrosis while *O. heveae* is a superficial but fast-spreading mildew. Infection by either fungus on young leaves leads rapidly to defoliation; older leaves (though still without a cuticle, the development of which confers complete resistance) are spotted or mottled and their photosynthetic capacity is impaired but they do not fall.

Whereas powdery mildew is confined to the main refoliation period, gloeosporium leaf disease persists throughout the year and, as well as causing secondary leaf fall, can attack young flushes the year round in areas where rain is frequent and fairly evenly distributed. Repeated defoliation can have a debilitating effect on the growth of the tree, leading to dieback and some loss of yield.

Since secondary leaf fall occurs only on trees old enough to have developed a wintering pattern, it poses some problems of control. Treatment, to be effective, must be prophylactic and it must begin before any appreciable infection is seen; it is therefore only worthwhile in plantings known to suffer regularly and severely from defoliation. Further, several applications are necessary to protect all the developing leaves. Dusting the foliage with sulphur from the ground has been the standard method of controlling *O. heveae* for some 50 years but several applications at frequent intervals are necessary and, except on the most susceptible high-yielding clones (such as PB 5/51 and RRIM 628), the disease is now normally allowed to run its course in the knowledge that attacks are transient. Direct treatment of *G. cingulata* is more difficult and less successful for, in the most severe

outbreaks, the leaves fall before they are large enough to spray; further, the effective application of a liquid carrier to mature trees is impossible unless carried out from the air and repeated applications render any treatment hopelessly uneconomic. Considerable interest has therefore been shown in a technique of indirect control, developed in Malaysia, in which susceptible trees are artificially defoliated from the air with a chemical defoliant (sodium cacodylate) in advance of the normal wintering time. They are thereby encouraged to refoliate earlier than normal when the weather is still mainly dry and unfavourable to the secondary leaf fall pathogens (Rao, 1970). The technique is effective and economically feasible where severe secondary leaf fall would otherwise occur.

The wide range of resistance to the secondary leaf fall pathogens exhibited by different cultivars, as well as the avoidance of the disease shown by early-wintering clones such as PB 86, indicates that systematic selection for favourable resistance and wintering characteristics could eventually greatly reduce the disease, provided no adaptation on the part of the pathogens occurred. Careful selection of clones for particular areas and crown-budding susceptible trunk clones with resistant canopy clones is already practised in Malaysia.

An additional, locally important, cause of secondary leaf fall in Liberia is *Drechslera heveae* (Petch) M.B. Ellis. No treatment is carried out. Elsewhere in the world this fungus is known mainly as a common leaf spotting disease ('bird's eye spot') of nursery plants. Seedlings are more susceptible than buddings and the repeated defoliation they may suffer, particularly in dry or poor growing conditions, weakens them and both delays and reduces the efficiency of green budding. Weekly treatment with a zinc or manganese dithiocarbamate fungicide reduces the severity of the disease but is rarely called for under normal conditions.

Another predominantly nursery disease is target leaf spot, caused by *Corticium solani* (*Pellicularia filamentosa*); it is mainly confined to South America though also known in India. It is not important in the field but can be serious in the nursery during wet weather. It can be controlled with zineb. Of minor importance (and, again, generally only in nurseries in wet weather) are the South American leaf-infecting fungi *Catacauma huberi* (P. Henn.) Theiss et Syd. (black crust), and *Periconia heveae* Stevenson et Imle (periconia blight). Neither warrants control. Finally, a minor nursery disease caused by *Corynespora cassiicola* is recorded from Nigeria, Malaysia and India; in the last it occasionally warrants control with a copper or zinc fungicide.

CONCLUSIONS

Some five hundred fungi have been recorded on *Hevea* or its produce, either as saprophytes, epiphytes or parasites. Of these, fortunately, only about twelve are of importance in one rubber-growing territory or another, although a few are of world-wide distribution. No virus disease of *H. brasiliensis* is known and only one report of a bacterial disease is on record (*Pseudomonas solanacearum* (E. F. Smith) E. F. Smith from Indonesia). The biology of the major pathogens has been studied in enough detail for suitable control measures to have been devised, though it is

Table 3. Summary of control measures used against major diseases of hevea brasiliensis.

	Symptoms	*Disease*	*Action*
ROOT	Roots decayed; white rhizomorphs on surface of root	White root disease, *Rigidoporus lignosus*	Excise diseased tissues, apply prophylactic dressing of 20% PCNB (white RD), 10% drazoxolon or 10% tridermorph (red RD) or 10% tridemorph (brown RD). Inspect and treat neighbouring trees. Trace source of infection to edge of row
	Roots decayed; reddish skin over surface of root	Red root disease, *Ganoderma pseudoferreum*	
	Roots decayed; brown encrustation of soil and felt-like mycelium on surface of root	Brown root disease, *Phellinus noxius*	
	Lumps of coagulum on roots and collar; layers of mycelium under bark	Armillaria root rot, *Armillariella mellea*	Excise diseased tissues, apply wound dressing, inspect neighbouring trees
PANEL	Small wounds just above tapping cut with vertical black lines beneath the bark	Black stripe, *Phytophthora palmivora*	Paint or spray tapping cut with 0.08% phenylmercuric dinaphthylmethane disulphonate, 0.8–1.6% captafol or 0.02% cycloheximide. Frequency according to severity.
	Bark above tapping cut sunken and covered with white mould	Mouldy rot, *Ceratocystis fimbriata*	Paint or spray tapping cut weekly with 0.25% benomyl, 08–1.6% captafol or 0.02% cycloheximide
	Necrotic patches on tapping cut and panel guide lines	Panel necrosis, *Fusarium solani*, *Botryodiplodia theobromae*	Tap away infected bark. Paint or spray with 0.08% phenylmercuric dinaphthylmethane disulphonate or 0.8–1.6% captafol
STEM	Bark bleeds and bulges in patches	Patch canker, *Phytophthora palmivora* *Pythium vexans*	Excise affected bark, spray with 0.08% phenylmercuric dianphthylmethane disulphonate and smear with petrolatum
	White mycelium and later pink crust on upper stem and branches	Pink disease, *Corticium salmonicolor*	Spray with 1% Bordeaux mixture or paint with 1.5% tridemorph in latex concentrate
	Olive or grey-green dull velvet patches on lower surface of young leaves; ragged shot-holes surrounded by spherical black bodies on old leaves. Often severe defoliation	South American leaf blight, *Microcyclus ulei*	Short-term: spray 0.2% zineb Long-term: crown bud with resistant canopy clone, or plant resistant clones
	White patches of mildew on young leaves, which wither and fall. Older leaves with yellow patches	Powdery mildew, Secondary leaf fall, *Oidium heveae*	Short-term: dust with sulphur 4–6 times at 9 kg/ha Long-term: plant resistant clones
LEAF	Sunken black lesions on young leaves, which blacken and fall. Older leaves with raised spots	Gloesporium leaf disease, Secondary leaf fall, *Glomerella cingulata*	Short-term: spray 4– times with copper oxychloride (4.5 kg/ha) or 0.15% chlorothalonil, or defoliate with sodium cacodylate (0.9 kg/ha) before wintering Long-term: plant resistant clones
	Mature green leaves fall, the petioles having a brown lesion with central blob of latex	Abnormal leaf fall, *Phytophthora* spp.	Spray before monsoon rains with copper oxide or oxychloride in oil (4.5 kg Cu/ha)
	Spots with papery white centre and brown margin on old leaves	Bird's eye spot, *Drechslera heveae*	Spray weekly with 0.2% zineb or 0.15% chlorothalonil



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not always clear at what level of disease attack such measures should be applied. But, for a plantation crop like *Hevea* with a useful life of some 25 years and subject to fluctuating commodity prices, commitment to long-term disease control measures is not undertaken lightly.

Sufficient understanding of these problems exists to suggest that future planting materials will be chosen with a far greater awareness of the need for all-round disease resistance than has been the case in the past. Especially this is true of leaf disease susceptibility which, with hindsight, can be seen partly as a man-made problem; although, in the early days of oriental planting, leaf diseases were of little importance and were therefore largely ignored by the plant breeder, events have proved this neglect to have been unfortunate.

Chemical control is, of course, an acceptable alternative to planting resistant cultivars provided it is only temporary. This attitude has now been justified with respect to root diseases which, given the necessary expertise and persistence, can be largely eradicated by the time the final stand is achieved, a few years after the start of tapping. Biological control is used, too, to supplement chemical control and has, of course, great economic attractions.

There remains, inevitably, a residue of intractable problems for which chemical control is the only answer. *Table 3* summarises the control measures used against the major diseases of rubber; it is based mainly on current practice in Malaysia. The broadly satisfactory situation with regard to disease control in *Hevea* has only come about as the result of continuing research, both basic and applied, at a number of centres; such research must clearly continue, to improve existing procedures and to devise new ones. New strains of known pathogens, even new pathogens, have arisen and will doubtless continue to do so. *Hevea brasiliensis* has been more intensively researched than most other tropical crops; the present understanding of its pathology reflects this effort and augurs well for its future well-being.

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The monthly crop

Riotous or disorderly behaviour — misconduct. In the Industrial Court of Malaysia Case No. 157 of 1975 (Award No. 25/76) between National Union of Commercial Workers and American International Assurance Company Limited—the Court was asked to determine a dispute arising out of the issue of a warning letter to the Claimant, an Office Boy, who, over some misunderstanding in work, challenged his immediate superior to a fight outside the office. After office at 5.00 p.m. the Claimant accosted and pushed his immediate superior in the chest outside the office doors. The latter did not retaliate. At a domestic inquiry on the following day, the Chairman of the Union Office Committee took upon himself to settle the matter whereupon the Claimant apologised to his immediate superior and they shook hands. Subsequently the management took disciplinary action by issuing a warning letter to the Claimant, stating that "the Company cannot and will not tolerate any physical violence inflicted on a member of our staff in connection with work" and gave "final warning in that any further misbehaviour or negligence of responsibility on your part will result in the immediate termination of your employment." The Union, after failing to negotiate for withdrawal of the warning letter, resorted to picketing.

As to what constituted misconduct in such circumstances, the Court referred to Malhotra's Law of Industrial Disputes, 2nd Edition, Vol. 2 page 601 and 602: —

> "Acts which are subversive of discipline being of riotous and disorderly nature amongst the employees would constitute misconduct. Rowdy conduct in the course of working hours would constitute misconduct; *misbehaviour even outside working hours but within the precincts of a concern and directed towards an employee of that concern may, in certain cases, constitute misconduct.*"

and

> "*However, in certain cases, particularly where there are no standing orders, acts of riotous and disorderly behaviour committed even beyond the working hours and outside the premises of the establishment may also constitute misconduct provided that there is a rational connection of the act with the employment of the assailant and the victim.* But whether any such act will constitute misconduct justifying disciplinary action would depend upon the facts and circumstances of each case."

Having regard to the facts and circumstances of this case, the Court held that "there was no justification at all to picket on the punishment of the issue of a warning letter." The Court reproached the conduct of the union and "accordingly awards that the warning letter of the 8th September, 1975 issued by the Company to the Claimant should stand."

SECA News (April 1976).

The Malayan Nature Society is organising a Symposium on the "Role and Management of National Parks" July 24–25, 1976 at Penang.

Any members interested are requested to liaise with Dr. Khoo Khay Huat, Chairman, Symposium Sub-Committee MNS, School of Biological Sciences, University Sains Malaysia, Penang.

About how the cake is baked. Every country has its system of industrial relations each developed along the lines dictated by its historical background, economic, political and social structure.

Nevertheless every system has four common elements:

- Government
- employers
- employees

and in one form or another

- collective bargaining.

Organised society is the reconciliation between the conflict of interests which exist within it. It is when society fails to resolve these conflicts that the system breaks down.

Collective bargaining is the political system in industry and commerce whereby the conflict of interests is resolved. Therefore, when the system of collective bargaining is ineffective conflicts remain unresolved and industrial unrest results.

Traditional collective bargaining about wages and conditions of employment, or in other words the issues about 'sharing the cake', are taken for granted.

However, the issues now moving into the bargaining arena, such as manning levels, financial consideration, production control, coupled with disclosure of information, are about how the cake is baked.

These issues are seen by some as an attack on 'management prerogatives'. This is what the whole debate on expanding collective bargaining is all about, in a word—power.

However, if we are to progress as a nation we must all recognise that industrial society rests on a bed of conflict, in itself vital to a progressive nation, which only an effective system of collective bargaining, expanding into the area of running the industry, can resolve.

The more we persuade people to participate the more we create areas of potential conflict, and the more we need collective bargaining to resolve them.

Resolving conflict on the shop floor depends essentially on the relationships between management and shop stewards. Training shop stewards to help them deal effectively with this expanding responsibility is vital not only to them and the trade union movement but to industry as a whole.

The Industrial Society, London.

The Lower Perak Branch is organising a *Planters Ball* on 17th July, 1976 8.00 p.m. in aid of the **Society's Building Fund** at Lower Perak Club, Teluk Anson.

It promises to be an interesting evening and it is hoped all members in Lower Perak as well as Central Perak will give their moral and financial support by attending the function.

Please contact Encik Mohd. Jamzari Wasi of Ladang Seri Pelangi, 11¾ Milestone, Jalan Bidor, Teluk Anson.

"Sandy's Spice"

A. A. SANDOSHAM

Have you heard of the three medicos who were seated in the corridor outside the medical Conference Hall when a young attractive female passed by? The Orthopaedic surgeon turned to the others and asked, 'Don't you think she has rather attractive ankles?" "I didn't notice that but I thought she had a well-formed pelvis, one that should offer no difficulties during childbirth," observed the Obstetrician. They both turned to the third medico to arbitrate only to be told, "Don't ask me, I am just a Chest specialist! "

Pursuing this theme here are some definitions and attributes of some of our medical specialists: —

An *Opthalmologist* is an I—specialist and is apt to suffer from I—strain. He is a bit of a meteorologist because he can look into a girl's eyes and say 'whether'.

An *Obstetrician* makes a poor farmer because he believes in sowing tares (sewing tears) in another man's field. Someone overheard this conversation outside the Labour Ward. "At your cervix, madam." "I'm dilated to meet you, doctor."

A *Gynaecologist*, often called Goldfingers, works in an area where others normally play. He is a spreader of old wives' tales (tails) and goes about with a gold plated curette in his pocket scraping acquaintances.

A *Radiologist* who claims he can see through and through a girl misses a lot.

A *Psychiatrist* is just a nut cracker; he dives down deeper, stays down longer and brings up more dirt than anyone does.

A *Dermatologist* thinks beauty is but skin deep.

A *Proctologist* is one who is always trying to enlarge the circle of his friends. Many of his friends suffer from constipation—trying to push a square meal through a round hole.

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Social and Personal

EXAMINATION SUCCESSES

Elementary Bahasa Malaysia

14th April 1976

Norman Santa Maria — (Lower Perak)
Chua Keng Lim — (Selangor)
Oh Kim Chwee — (North Johore)
Ee Kim Wan — (South Johore)
Achuthan Nair — (Central Johore)
Liong Ting — (South Johore)

Advanced Bahasa Malaysia

14th April 1976

Mohd Saleh b Mohd Tahir — (West Pahang)

Awards of Associate Diploma

Tan Miang Hang — (North West Malaysia)

Birth

BALLARD: Stuart, Marion and Timothy Ballard welcome Robert Paul to the fold. Born Ilford, U.K. on 18th April, 1976.

On leave

4257 Thompson, J.A., c/o Wilson, 23 North Gyle Loan, Corstorphine, Edinburgh 12, Scotland.

Returned from leave

4230 Carruthers, H., Sungei Chinoh Estate, Trolak, Perak.

4057 Fullarton, F.M., Tanah Merah Estate, Port Dickson, Negri Sembilan.

2827 Grut, R.L., JP, c/o Hotel Majestic, Jalan Sultan Hishamuddin, Kuala Lumpur.

5573 Hay, D.W.E., Johore Labis Estate, Cha'ah, Johore.

4829 Zakaria bin Othman, Rancangan Sungei Manila, P.O. Box 1253, Sandakan, Sabah.

Change of address

6257 Alagappan, V., Kelan Estate, Kulai, Johore.

4250 Ahmad Zakaria bin Abu Kassim (Hj), PJK, Bikam Estate, Sungkai, Perak.

5059 Abdul Alim bin Abdul Satar, Ladang Tereh, P.O. Box 23, Kluang, Johore.

5894 Abdul Talib bin Kidam, Ban Heng Estate, Pagoh, Muar, Johore.

6432 Ang Ban Huat, 10 Parit Road, Bruas, Perak.

5768 Byers, D.S., Commonwealth Development Corpn, P.O. Box 494, Kuala Lumpur.

5068 Brown, D.A.LL., Guston, Chelwood Gate, Hayward Heath, RH17 7LP, England.

5782 Bridge, C.J.R., OBE, c/o I.B.R.D., Room A 500, 1818 H St. N.W., Washington D.C., U.S.A.

6299 Chee Lee Weng, Norseman Estate, Ulu Sapetang, Taiping, Perak.

6206 Chandran, M.L.R., BSC, AGRI., Kok Foh Estate, Bahau, Negri Sembilan.

4957 Choo Hong Kim, Swee Lam Estate, Kulai, Johore.

3652 Hoddinott, G.W., Old Bailiffs, South Cheriton, Templecombe, Somerset, England.

5281 Ibrahim b Mohd Amin, Layang Estate, P.O. Box 105, Layang Layang, Johore.

6090 Keoy Liong Kaeh, 1454 Pasir Pinji, Ipoh, Perak.

5968 Jayaraman, P., AISP, Rasak Estate, Batu Tiga, Selangor.

6227 Kamarudin b Abidin, Elmina Estate, Division 3, Sungei Buloh, Selangor.

6331 Khalid b Abdul Rahman, Raja Musa Estate, Kuala Selangor.

5116 Loh Kwan Peng, Bukit Mertajam Estate, Kulim, Kedah.

5750 Lee Lou Tack, Gadek Estate, Tampin, Negri Sembilan.

5165 Lee Shin Cheng, c/o Lam Soon Huat Sdn Bhd, KS 6, 4th Mile, Klang Road, Kuala Lumpur.

3935 Lewis, J.C., Faber Merlin Malaysia Bhd, P.O. Box 306, Kuala Lumpur.

5266 Lian Kwen Min, AISP, West Estate, Carey Island, Port Klang, Selangor.

4264 Menon, C.P., Bahagian Perladangan, RISDA, Wisma Central, Jalan Ampang, Kuala Lumpur.

5259 Mahamad Aljaffri (Syed), Barlow Boustead Estates Agency Sdn Bhd, P.O. Box 295, Kuala Lumpur.

6341 Ng Tain Teck, Sg. Manila Settlement Scheme, SLDB, P.O. Box 1253, Sandakan, Sabah.

5293 Perera, W.T., Bentong Estate, Bentong, Pahang.

6343 Raj, P. Teva, Sungei Senarut Estate, Batu Anam, Johore.

4605 Sankar, G.S., AISP, 7 Club Road, Chetpet, Madras 600031, India.

3592 Stevenson, I.T., DFC, CPM, 10 Danefield Avenue, Large, Ayrshire, KA30 8RU, U.K.

6370 Sin Chuan Eng, CEP Rengam Estate, Rengam, Johore.

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5108 Koh Tian Soo, Bahau Estate, Bahau, Negri Sembilan.

5322 Loo Kim Sing, AISP, Tangkah Estate, Tangkak, Johore.

6064 Tan Soon Huat, Rancangan Penempatan, Kimanis, Kota Kinabalu, Sabah.

6099 Zainal bin Mohd Yassin, Sungei Mahang Estate, Nilai, Negri Sembilan.

Culinary Treasure

ECLAIRS

For chout pastry:

¼ pint water
pinch of salt
1 dessertspoon sugar
2 oz. butter, cut up
4 oz. flour
4 eggs

For the filling:

½ pint milk
drop of vanilla essence
2½ tablespoons flour
6 oz. sugar
pinch of salt
4 eggs
2 oz. butter
2 oz. icing sugar

Method:

For pastry: Put salt, sugar, water and butter in a saucepan. Bring to boil, and when bubbling, remove from heat. Add the flour and beat well until the mixture is smooth. Return to the heat and cook the mixture, stirring constantly until it leaves the sides of the pan clean. Remove from heat, and beat in eggs, one at a time. Beat until mixture is very light. Spoon or pipe onto greased and floured baking trays into 3½ ins. long eclairs. Brush with a little beaten egg yolk. Cook in a moderate oven (375°F) for one hour until the eclairs are well risen and golden brown.

For filling: Boil milk and add vanilla essence. Mix flour, salt and eggs in a saucepan and add the milk, slowly, stirring well. Place the saucepan on the heat and stir well until mixture comes to the boil. Continue stirring for 2 minutes then remove from the heat and allow to cool. Mix together butter and icing sugar until light and fluffy. Add to the cooked filling and stir well. Slit the eclairs on one side and fill with the prepared filling.

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