CONCEPT OF CLONE BLENDS : MONOCULTURE Vs. MULTICLONE PLANTING

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In recent years development and wide spread cultivation of a few improved varieties have, within a short period, reduced the number of commercial cultivars in the case of many major crops. *Hevea brasiliensis*, the para rubber tree, is no exception to this.

Fig. 1 RRII 105 *

Monoculture of high yielding varieties of any agricultural crop in a geographical area has the potential danger of narrowing down the genetic variability. The practice of continuous planting of any single cultivar promotes genetic changes in major pests and pathogen. Pests and diseases of minor nature are likely to assume major significance. Such changes in disease and pest epidemics make control operation difficult and less effective. Bitter experience did occur in the past and some of the specific examples include :

1) Irish famine of the 1940's due to damage to potato crop by *Phytophthora infestans*,

2) Bengal famine of 1943 associated with brown spot disease of rice,

3) Break down of rust resistance in Kalyan Sona wheat in SE Asia during 1973-'74,

4) Coffee rust in Sri Lanka which caused a shift to tea production,

5) the disastrous southern corn leaf blight epidemy of the USA in the early 1970's and

6) the rapid shift from the rice brown plant hopper biotype 1 to biotype 2 during 1974-'76 when large areas in Philippines and Indonesia were planted with a few semi-dwarf rice varieties.

GENETIC ADVANCE

In *Hevea*, genetic improvement has resulted in substantial increase in productivity from around 250 Kg^{-ha-yr} for the original material to over 2500 Kg^{-ha-yr} for recent clones. Though the early phases of selection could achieve substantial improvement in yield over the original Wickham material, a slow down of genetic advance is evident in the recent breeding phases. One of the reasons that can be attributed to

Fig. 2 RRIM 600

this is a narrowing down of the genetic variability in the breeding pool exploited from time to time. The original genetic base of *Hevea* in the East is very narrow, limited to 20-22 seedlings collected from a minuscule of the gene- tic range at Amazonian river basin in Brazil. Budgrafting, an established commercial practice of clonal propagation in *Hevea* results in uniform plantations. This practice however, has resulted in the non-conservation of natural genetic variability available in seedling populations. The cyclical generation wise assortative mating adopted in *Hevea*, where, the best clones in one gene-ration are used as parents for the next cycle of breeding, has also restricted the number of high

* Clones (Fig. 1 to Fig. 11) two years after planting.

yielding clones, most of which have originated from a few dominant parents. Thus, at present, extensive areas are cultivated with a very few high yielding clones which are more or less closely related.

In *Hevea*, recent reports indicate instances of less serious diseases becoming more severe. The most serious problem reported is severe incidence of *Corynospora* leaf disease observed from 1985

Fig. 3 PB 235

onwards affecting clones RRIC 103, KRS 21 and RRIM 725 in Sri Lanka. As a result RRIC 103, one of the most popular high yielders planted extensively had to be withdrawn from the planting recommendation and extensive areas under this clone were replanted in Sri Lanka. A new anthracnose caused by *Fusicoccum* reported during 1987 in Malaysia, a minor disease of *Guignardia* observed intermittently in Malaysian estates since 1982 affecting clones like PB 217, PB 235 and PB 260 and incidence of target leaf spot in Malaysia are some examples which deserve attention. In the case of the emergence of a virulent strain of a particular pathogen in a favourable environmental condition, the disease will spread, and cause serious damage, if monoculture is adopted.

MAJOR CONTRIBUTION

In India, the high yielding clone RRII 105 was released for commercial planting in 1980. This clone, very popular in the traditional rubber growing tract, performs very well and has recorded the highest commercial yield in comparison with other high yielders. A good share of the yield increase during the recent years can be attributed to this clone. An analysis of the use of planting materials reveals that RRII 105 has been increasingly used since its release, especially by the small holders, who account for more than 80% of the area under rubber. During recent years, around 90% of the planted area is under this clone. If this trend is continued, it can lead to serious consequences resultant of monoculture. Although there is no alarming situation yet, the need for preventing such a possible danger assumes much significance.

Considering the gravity of the situation, RRII has proposed a strategy for encouraging multiclone planting. With a view to reducing the proportion of RRII 105 in future planting programmes the Rubber Board now recommends a multiclone planting of different selected clones.

These clones, selected based on available data from India and/ or abroad, are included in three different categories depending on the stage of evaluation. Materials included under Category I will continue to be those approved for large scale planting but should not exceed 50% of the total area of planting in any estate/holding. According to 1991 recommendation only RRII 105 is included in category I for traditional area. Category II includes six clones, which in combination of three or more can be planted upto 50% of the area. Category III materials are recommended for planting only upto 15% in aggregate of the total area of any estate/holding. The different materials are recommended as follows :

Steps have already been taken to popularise these clones with a view to making the planting materials available to planters. Experiments have been initiated for identification of suitable clonal blends and for evaluation of the performance of different clone combinations in comparison to monoclone population of RRII 105. Based on the availability of more data from time to time, both from experiments and from

Fig. 4 PB 217

Category	Materials recommended	Remarks
I	RRII 105 (also RRII 600-& GT 1 for non-traditional area)	Should not exceed 50% of the total area.
II	RRIM 600 GT 1 PB 28/59 PB 217 PB 235 RRIM 703	Combination of three or more clones for planting upto 50% of the area
III	a) RRII 5, PCK 1, PCK 2, PB 260, PB 280 and PB 311 b) Tjir 1, PB 86, G1 1 , PR 107, RRIM 605, 623, 628, 701, PB 6/9, PB 5/51, RRII 118, 203 and 208 and polyclonal seeds from approved sources. c) Other old or new promising clones specially approved by the Chairman, Rubber Board.	Planting not to exceed 15% in aggregate

commercial trials the recommendations will have to be modified/updated.

Diversity within the crop will counter balance the epidemic prone situation associated with continuous monoculture. This will also provide potential for further genetic improvement. There is no doubt that clone blends of diverse genetic material will offer better protection to the plantation industry from possible disasters in future.

Fig. 5 RRIM 703

SHORT NOTES ON CLONES

1. RRII 105 (Parentage : Tjir 1 x G1 1)

A promising clone developed by the Rubber Research Institute of India. Mean yield in large scale trial over first five and ten years is 65.57 and 66.71 $g^{-tree-tap}$ respectively. Commercial yield over five and ten years is 1450 and 1555 kg^{-ha-yr}. Trunk tall and straight; branching good; canopy dense; crown restricted to the top; foliage dark green with glossy leaves. Vigour before and after tapping average; virgin and renewed bark thickness above average.

Fig. 6 PCK 1

This clone has fair degree of tolerance to abnormal leaf fall disease under normal prophylactic measures; susceptible to pink; fairly tolerant to yield depression during drought; S/2 d/3 system of tapping is preferable as susceptibility to brown bast is reported from many holdings. Latex colour white and d.r.c. high.

2. RRIM 600 (Tjir 1 x PB 86)

A popular high yielding clone developed by the Rubber Research Institute of Malaysia. Average commercial yield over first five, ten and fourteen years in India is 1129, 1327 and 1387 kg^{-ha-yr}. Experimental yield in large scale trial over first five, ten and 15 years is 48.0, 52.3 and 52.6 $g^{-tree-tap}$ respectively. Experimental yield in large scale trial in Malaysia over first five, ten and fifteen years is 1540, 1990 and 2199 kg^{-ha-yr}. Summer yield is high. Young plants show spindly growth and late branching. Trunk is tall and

Fig. 7 PCK 2

straight, canopy broom shaped and narrow with moderate heavy branches, foliage sparse and small yellowish green leaves. Though girth at opening is low, girth increment on tapping is high. Similarly virgin bark thickness is low and thickness of renewed bark over five years is high.

The clone is highly susceptible to *Phytophthora* leaf fall; incidence of pink medium; *Oidium* mild; incidence of wind damage and brown bast mild. Latex colour white and d.r.c. medium, latex unsuitable for concentration.

3. GT 1 (Primary Clone)

A high yielding clone developed in Indonesia by way of mother tree or ortet selection. Commercial yield in India over the first five, ten and 13 years is 1019, 1329 and 1400 kg-ha-yr. Experimental yield in large scale trial in Malaysia over five, ten and 15 years is 1300, 1727 and 1723 kg-ha-yr respectively. Summer yield is very high.

Trunk upright and slightly kinked, branching habit variable; canopy narrow, open and globular; dense, dark green leaves. Girth at opening and girth increment on tapping medium; virgin bark thickness medium and thickness of renewed bark over five years is low.

This clone shows good tolerance of pink disease, and brown bast. Incidence of *Phytophthora* mild to medium; wind damage low and *Oidium* medium to severe. Withstands higher intensities of tapping, latex colour white, d.r.c. medium.

4. PB 28/59 (Primary clone)

A high yielding Prang Basar clone. Commercial yield in India over first five, ten and 13 years is 1227, 1451 and 1423 kg-ha-yr respectively. In Malaysia, large scale trial yield over first five, ten and 12 years is 1780, 1986 and 2023 kg-ha-yr respectively. Summer yield medium.

Trunk is fluted and crooked, sometimes showing a leaning tendancy, low branching, moderate to heavy branches, Girth at opening medium and girth increment on tapping low; thickness of virgin bark low and that of five years renewed bark high. The incidence of *Phytophthora*, *Oidium* pink and brown bast high; wind damage medium.

5. PB 217 (PB 5/51 X PB 6/9)

A Prang Basar hybrid clone, showing rising yield trend. Commercial yield in India over first five and ten years is 1001 and 1257 kg-ha-yr respectively. Experimental yield in large scale trial over first five, ten and fifteen years is 38.0, 56.8 and 62.4 g-tree-tap respectively. Estimated yield in large scale trial in Malaysia over five, ten and fifteen years is 1220, 1675 and 1778 kg-ha-yr respectively. Summer yield is very high.

Trunk is tall and straight. Canopy high with dense foliage and usually light branches. Medium girth at opening with high girth increment on tapping. Thickness of virgin bark low and that of renewed bark over five years medium.

Incidence of *Phytophthora* leaf fall is mild in India, but it is reported to be very severe in Malaysia. *Oidium* and pink severe; wind damage very low and brown bast mild. Latex colour light yellow and d.r.c medium.

Fig. 8 RRII 5

6. PB 235 (PB 5/51 X PB S.78)
A high yielding hybrid clone developed by Prang Basar Institute in Malaysia. Average commercial yield for first five and ten years in India is 1095 and 1232 kg-ha-yr respectively. In Malaysia, experimental yield in large scale trial over first five, ten and fifteen years is reported to be 1964, 2273 and 2485 kg-ha-yr respectively. Summer yield medium.

Vigorous clone, trunk very tall and straight with long, light branches. Spreading canopy and dense foliage, Girth at opening very high, Girth increment on tapping medium; thickness of virgin bark medium and that of renewed bark over five years low.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wild damage high. This clone is susceptible to brown bast. Latex colour is pale yellow and d.r.c. very high.

7. RRIM 703 (RRIM 600 X RRIM 500)

A high yielding hybrid clone developed by the Rubber Research Institute of Malaysia. In India, block trial yield in one location over first five years of tapping is 1424 kg^{-ha-yr} and yield in large scale trial over five years is 45 g-tree-tap. In Malaysia, large scale trial yield over first five, ten and thirteen years of tapping is 1828, 1847 and 1736 kg^{-ha-yr} respectively. Summer yield low.

Trunk is upright and slightly kinked, canopy open and narrow, branches few and heavy. Girth at opening medium while girth increment on tapping is low. Thickness of virgin bark high and that of renewed bark over five years medium.

This clone has recorded severe incidence of *Phytophthora* in India but medium in Malaysia ; Pink severe, *Oidium* mild; incidence of wind damage and brown bast high. Latex light yellow in colour with medium d.r.c.

8. RRII 5 (Primary clone)

A primary clone developed in India. Experimental yield in one large scale trial in India over first five, ten and sixteen years is 56.2, 70.3 and 76.4 g$^{-tree-tap}$ respectively. Summer yield high.

Trunk is straight and terete; heavy oval canopy; low branching with several branches arising at acute angles; foliage dense. Girth at opening very high with medium girth increment on tapping. Thickness of virgin bark and that of five year renewed bark high.

Incidence of *Phytophthora* and *Oidium* medium to severe; pink mild, wind damage low and brown best severe. Latex colour pale yellow and d.r.c. high.

9. PCK 1 (Tjir 1 x PR 107)

This clone is only in the early years of tapping. Promising yield trend. Trunk is tall and straight; branches spreading with light side branches and dense foliage. Girth

Fig. 9 PB 260

at opening high; medium girth increment on tapping. Thickness of virgin bark high and that of five year renewed bark medium.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wind damage low and brown bast medium. Colour of latex pale yellow and d.r.c. high.

10. PCK 2 (Tjir 1 x PR 107)

This clone also is only in the early years of tapping; promising yield trend.

Canopy spreading and 'V' shaped with dense foliage, many light and low branches. Girth at opening, and girth increment on tapping medium; thickness of virgin bark and that of five year renewed bark medium.

Incidence of *Phytophthora* pink and *Oidium* medium; wind damage very low and brown bast medium. Latex colour is pale yellow, high Dr. C.

11. PB 260 (PB 5/51xPB49) 1xPB49)

A vigorous and high yielding hybrid clone developed by the Prang Basar Institute. In India, this clone is only in the early years of tapping; promising yield trend. In Malaysia, yield in large scale trial over first five, ten and twelve years of tapping is 1880, 2168 and kg-ha-yr. Summer yield high.

Trunk is slightly kinked and fluted, dense canopy, foliage thick; balanced branching with light spreading branches. Girth at opening high and girth increment on tapping medium. Thickness of virgin bark and that of five year renewed bark low.

Incidence of *Phytophthora* medium; pink mild; *Oidium* mild-medium; wind damage medium; brown bast severe. Latex light yellow in colour with high d.r.c.

12. PB 280 (Primary clone)

A Prang Basar primary clone. In India, this clone is only being evaluated. In Malaysia, yield in

Fig. 10 PB 280

large scale trial over first five, ten and 13 years is 1740, 2003 and 2006 kg-ha-yr respectively. Summer yield high. Girth at opening and girth increment on tapping medium; thickness of virgin and renewed (five years renewal) bark very high.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wind damage severe and brown bast mild. Latex light yellow in colour, d.r.c. very high.

13. PB 311 (RRIM 600 x PB 235)

An advanced generation hybrid clone bred by prang Basar Institute. This clone is only in the early years of tapping in India. Promising yield tread. In Malaysia yield in large scale trial over first three years is 1580 kg-ha-yr. Summer yield high.

The trunk is sometimes leaning. Canopy heavy and foliage dense. Girth at opening medium and girth increment on tapping high; thickness of virgin bark low and that of five years renewed bark medium. According to report from Malaysia, wind damage very high; incidence of pink and *Oidium* medium; brown bast mild; latex colour light yellow.

14. Tjir 1 (Primary clone)

A primary clone developed in Indonesia, heavy crown liable to wind damage. Average commercial yield in India over 15 years is 978 kg-ha-yr. Highly susceptible to *Phytophthora*, *Oidium* and pink diseases; latex yellow.

15. PB 86 (Primary clone)

A Malaysian primary clone. Commercial yield in India over 15 years is 1127 kg-ha-yr Resistant to wind damage, suitable for exposed areas; prolific seeder; highly susceptible to *Phytophthora* leaf fall and shoot rot. Good performance in kanyakumari district.

16. GI 1 (Primary clone)

A Malaysian primary clone; vigour below average, canopy healthy with characteristic glossy leaves. Average commercial yield over 15 years is 1145 kg-ha-yr; resistant to wind damage; good performance in areas of high water table; susceptible to brown bast.

17. PR 107 (Primary clone)

An Indonesian primary clone; sturdy, vigour average, good girth increment on tapping. Though a slow starter, shows rising yield trend. Average commercial yield over 15 years is 1043 kg-ha-yr; withstands higher intensities of tapping; resistant to wind damage, susceptible to *Phytophthora*.

18. RRIM 605 (PB 86 x Pil B 84)

Growth average. Average commercial yield over 15 years is 1226 kg-ha-yr.

19. RRIM 623 (PB 49xPil B 84)

A vigorous clone with rising yield trend. Average commercial yield over 15 years is 1178 kg -ha-yr. Susceptible to wind damage, abnormal leaf fall and pink diseases.

20. RRIM 628 (Tjir 1xRRIM 527)

Vigour medium before tapping and low after tapping. Average commercial yield over 10 years is 1096 kg-ha-yr. Summer yield poor; incidence of *Phytophthora* leaf fall and wind damage poor, brown bast severe.

Fig. PB 311

21. RRIM 701 (44/553xRRIM 501)

Vigour high in the early years,girth increment on tapping medium. Average commercial yield over 10 years is 1139 kg-ha-yr. Susceptibe to pink , powdery mildew and wind damage.

22. PB 6/9 (PB 24xPB 28)

Trunk some what crooked, canopy light. The average commercial yield over 15 yeas is 1151kg-ha-yr.

23. PB 5/51 (PB 56xPB 24)

Stem straight and upright, balanced canopy; virgin bark thickness medium and renewed bark thickness low. Commercial yield over 10 years is 1314 kg-ha-yr. Summer yield good. Incidence of *Phytophthora* leaf fall medium; pink, *Oidium* and brown bast high; resistance to wind damage high.

24. RRII 118 (Mil 3/2xHil 28)

A very vigorous clone, trunk tall and stout, canopy dense, crown balanced. Mean commercial yield over six years is 1117 kg-ha-yr. Incidence of diseases and brown bast average.

25 RRII 203 (PB 86x Mil 3/2)

A very vigorous clone, trunk straight and tall, rather robust, balanced crown. Thickness of virgin and renewed bark medium. Average commercial yield over five years is 1142 kg-ha-yr. Latex coagulum show black discolouration, which ,however, does not affect the quality of rubber. Average tolerance to diseases.

26. RRII 208 (Mil 3/2 x AVROS 255)

Average commercial yield over six years is 122 kg-ha-yr. Highly susceptible to shoot rot; medium tolerance to other diseases.

Rubber Seed Oil

Studies undertaken in the RRII show that an average of 150 Kgs of useful seeds are available from 1ha. of mature plantation. At present we have 3,00,000 ha. of mature area and an estimated production of 45,000 tonnes of rubber seeds per annum. About 10% of the production is used for raising stock materials in the plantations. Under commercial conditions, the oil recovery is around 12 to 16% of the total weight of the seed. Normally, about 4,000 tonnes of rubber seed oil is processed per annum. During 1990 - 91 the rubber seeds are being procured at the rate of around Re. 1/- per Kg. The production of rubber seed oil is concentrated in Virudhunagar due to favourable weather conditions and unutilised capacity in the oil mills sector. The present market price of rubber seed oil is Rs. 15/- per Kg.

Usually the rotary(Chakku) machine is used for extraction. The extraction process involves the installation of a pair of rotary machines. The oil recovery under commercial conditions is around 35% of the weight of the kernal.

Rubber seed is mainly used for manufacturing imferior quality washing soaps. A small quantity is also used in the paint, varnish and leather industries. It is widely suspected that rubber seed oil is being used for adultering coconut oil as reporated by smt. Surekha Sule in the 'Economic Times' (30-9-1983)-: "Informed sources feel that there is a strong possibility of rubber seed oil being used for adulteration purposes. The Government should lay down the specifications of the oil for use in various industries as is done for vanaspati industries".

Rubber seed oil is a non-edible oil. The presence of "hydrocyanic acid" and other elements makes it harmful to health. It is possible to find out whether coconut oil is adultered through simple lab tests . But the presence of rubber seed oil cannot be identified easilly. It requires more reference and lab tests to investigate and find out a methodology for the same. Rubber seed oil is easily mixable with other oils . Hence it is felt that the dealers of coconut oil are the main adelterators.

Properties of rubber seed oil

Rubber seed oil is light yellow in colour and free from deposits on standing. It is a semi-drying oil with the following chemical properties.

Acid Value	4 — 40
Saponification Value	190 — 195
Iodine value	132 — 141
Hydroxyl value	12 — 32
Unsaponification (%)	0.5 — 1.0
Refractive index 40°C	1.466 — 1.469
Sp gravity 15 / 15°C	0.924 — 0.930
Titra (°C)	28 — 32

Fatty acid composition (%)	
Palmitic acid	11
Stearic acid	12
Arachidic acid	1
Oleic acid	17
Linoletic acid	35
Linolenic acid	24
	100