

# An Analytical Study of Rubber Skillfulness Growth in Indian Rubber Industry

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## ABSTRACT

National Rubber Policy (NRP) envisages a well-developed value-chain of environmentally sustainable and globally competitive rubber industry, comprising natural and other forms of rubber and products thereof and ancillary sectors, capable of supplying materials and products of international standards to domestic and world markets, with focus on welfare of the entire stakeholder community and national economic progress. Indian rubber industry is characterized by the co-existence of a well-established rubber production sector and a fast growing rubber products manufacturing and consuming sector. The Rubber Industry value chain begins from NR plantations and ends with a huge range of dry rubber and latex based products. Historically, NR was a regulated commodity with strong tariff protection and domestic market regulations. The key factors which have contributed to the growth of Indian rubber industry are positive intervention of institutional agencies aiming at self-sufficiency and import substitution. India is the 4th largest producer and 2nd largest consumer of natural rubber in the world. The rubber industry comprise of tyre and non-tyre industries with a turnover of Rs.63,000 crore in 2011-12 with a CAGR of 10% for last 3 years. The Indian rubber industry consists of around 5,500 units<sup>1</sup> and is dotted with the presence of several small and tiny units. To ensure availability of skilled human resources to rubber industry, the Rubber Skill Development Council (RSDC) has been formed as a focused national level skill promoting entity under the aegis of National Skill Development Corporation (NSDC).

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## 1. Introduction

Natural rubber is a critical and strategic industrial raw material and will remain so in the foreseeable future. Natural rubber is grown primarily in landholdings that are owned by small growers. Majority of rubber processing is also done in a decentralised manner in small farms. Therefore, notwithstanding the status of NR being a crucial industrial raw material, the possibility of treating NR as an agricultural product for all practical and legal purposes and income from rubber production as agricultural income would be explored in consultation with the Ministry of Agriculture & Farmers Welfare and Department of Revenue. Different stakeholders have pointed out that NR, being an industrial raw material or not included under the Agreement on Agriculture (AoA) of the WTO, has nothing inconsistent with its status as an agricultural product for domestic policies. Self-sufficiency had been the main focus of development plans in NR sector till the last decade. Though importance of self-sufficiency cannot be reduced, competitiveness and sustainability have to be considered while setting up goals and formulating strategies pertaining to Rubber production in the country. NR consumption in the country in 2030 is projected at around 2.00 million tonne. It is envisaged that the domestic production is able to meet at least 75% of the NR requirement in 2030. In order to attain the projected production, average annual new planting and replanting would be to the tune of at least 8,000 ha and 10,000 ha respectively. Efforts would be made to get all the available mature area under rubber tapped.

All India Rubber Industries Association (AIRIA) and Automobile Tyre Manufacturers' Association (ATMA), under the aegis of National Skill Development Corporation (NSDC). The objectives of RSDC encompasses:-

- ♣ Standardization of job roles / skill types through development of National Occupation Standards (NOS)
- ♣ Identification of critical job roles where major skill gap exists
- ♣ Develop standards and assessment tools
- ♣ Capacity building of the Rubber education and training system
- ♣ Build affiliation and accreditation process for trainees
- ♣ Certification and examination of trainees
- ♣ Enable maximum employment of RSDC certified personnel
- ♣ Establish well structured, sector specific labour market information system (LMIS)

Given this background, ICRA Management Consulting Services Limited (IMaCS) has been appointed by Rubber Skill Development Council (RSDC) to conduct a study on Skill Gap Analysis across the Sub-segments (Tyre and Non-tyre)<sup>2</sup> for Selected States namely Maharashtra, Kerala, Tamil Nadu, and Punjab for Rubber Industry.

### Area expansion

Plantation of Rubber in traditional rubber growing regions comprising Kerala and Tamil Nadu has reached near saturation. However, in the non-traditional rubber growing regions, especially in the North Eastern States there is ample scope for increase in area under rubber cultivation. As per the present estimates, more than 500,000 ha. of area is available for plantation in non-traditional areas. However, food security, forest and biodiversity conservation, edaphic & climate conditions and other socio-economic factors will have to be given due consideration for identifying suitable areas for rubber cultivation. Extension services coupled with financial

assistance is vital in motivating growers to take up rubber cultivation. Adequate planting subsidy would be given for incentivizing rubber plantation. Priority would be given to marginal and small growers belonging to the resource poor communities. Use of modern technology in planning and implementation in areas such as assessment of potentially suitable areas for cultivation, advisories to rubber growers and provision of extension services, etc. would be promoted. Monitoring and outcome assessment would be regularly carried out using Information & Communication Technology (ICT) enabled tools. Another very important aspect is the institutional makeover, including infrastructure support of the Rubber Board in the non-traditional regions, to evolve an integrated approach towards development of rubber along with promotion of other farm livelihood and rubber integrated agro-forestry systems. Rubber based integrated farming systems would be developed taking into consideration location-specific factors. Such trials have been taken up in major rubber producing countries including Thailand and Malaysia, though adoption rate is not considerable. Efforts would be made for better networking and collaborations between the various line departments of the State and the Central government to make rubber plantations successful in the non-traditional areas.

#### Replanting of senile rubber areas

The share of rubber plantations in the highest age group of above 20 years is around 20% in the country based on historical planting trends, extending to around 1,60,000 ha. Out of this, around 30,000 ha needs to be replanted immediately to

maintain age composition due to delay in replanting. The remaining rubber plantations will have to be replanted during the next decade. Apart from age of the trees, realised yield, tapping intensity followed and prices of rubber and rubber wood influence replanting. The focus in traditional regions would therefore be on systematic replanting of senile plantations with high yielding and disease resistant varieties. The extent of replanting would be increased in non-traditional regions in future. The annual replanting would be more than 10,000 ha in a long term perspective. In order to promote plantation and replantation, the pattern of assistance provided by the existing schemes would be reviewed from time to time.

#### 2. Global Rubber Industry

Rubber has been used across the world from time immemorial. From humble beginnings of use as an eraser (suggested by noted explorer Magellan), today rubber is used across various industries like auto, aviation, healthcare, etc which drive the economy. With origins in Brazil, today rubber in its natural and synthetic forms is used globally. The rubber industry across the globe has majority of its production concentrated in the Asian continent, particularly in Thailand, Malaysia, India and China. The table below showcases the global Natural Rubber (NR) production. Thailand is the top natural rubber producing country. The critical reason attributed to Thailand's dynamic performance in rubber is the enhanced R&D efforts to improve the plantation level productivity.

**Table 1: World natural rubber production**

	('000 tonnes)					Growth ( per cent)		
	2008	2009	2010	2011	2012F	2010	2011	2012F
<b>Thailand</b>	3,090	3,164	3,252	3,394	3,530	2.8	4.4	4.0
<b>Indonesia</b>	2,751	2,440	2,736	2,982	3,101	12.1	9.0	4.0
<b>Malaysia</b>	1072	857	939	996	1,059	9.6	6.1	6.3
<b>India</b>	881	820	851	890	929	3.8	4.6	4.4
<b>Vietnam</b>	660	711	752	812	840	5.8	8.0	3.4
<b>China</b>	560	644	665	707	738	3.3	6.3	4.4
<b>Côte d'Ivoire</b>	194	203	227	234	243	11.8	3.1	3.8
<b>Brazil</b>	123	129	132	135	140	2.3	2.3	3.7
<b>Others</b>	797	721	845	825	855	17.2	-2.4	3.6
<b>World</b>	<b>10,128</b>	<b>9,690</b>	<b>10,399</b>	<b>10,974</b>	<b>11,434</b>	<b>7.3</b>	<b>5.5</b>	<b>4.2</b>

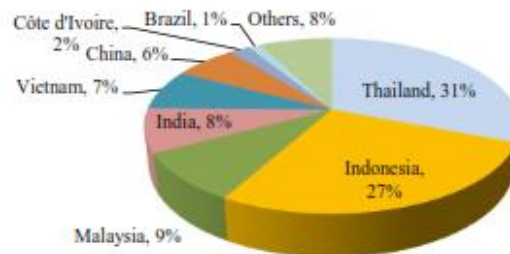


Figure 1: World Rubber Production by countries (as proportion of 2012)

The production chart depicted shows Thailand and Indonesia together contributing about 58 per cent to the global production, as of 2012. The hospitable climate and the focus on improving the plantation productivity have led to these results.

### 3. India Natural Rubber Production Scenario

In India, the yielding area in India was expected to expand during 2012-13. Around 24,300 hectares of trees were planted during 2005 and a small portion of 29,900 hectares of trees were planted in 2006. These will come under tapping during 2012. However 15,000 hectares under rubber trees will be uprooted for replanting. Apart from this, a small extent of yielding trees in the traditional region is expected to be discarded for other land-uses. The production from low-yielding non-traditional areas would also be looking up. Production of NR in India grew by just 2 per cent in 2012. Heavy rains in the country's main rubber-producing areas disrupted production, as did farmers' concerns over low prices. India's production peaks

in the final months of the calendar year, and in December 2012 production was up by nearly 18 per cent month on month. Medium-term prospects for Indian rubber production are promising, partly because the government is committed to expanding the country's rubber-producing capacity. By the end of the 12th Five Year Plan in March 2017, it hopes to bring an additional 60,000 ha under cultivation. With the analysis on the global natural rubber production and trends, the report will next focus on the consumption trends.

### Global Rubber Consumption

The global consumption trends have shown a 3.1 per cent growth from 2008-2012. While China has the production of about 6 per cent of the global production for 2012, the consumption pattern reveals that it accounts for about 33 per cent of the consumption for 2012. India's consumption of rubber has increased from 881,000 tonnes in 2008 to 995,000 tonnes in 2012.

Table 2: World Natural Rubber Consumption

Countries	Consumption in '000 tonnes					Growth ( per cent)		
	2008	2009	2010	2011	2012F	2010	2011	2012F
China	2,947	3,384	3,646	3,603	3,729	7.7	-1.2	3.5
India	881	905	944	957	995	4.3	1.4	4.0
Japan	878	636	750	765	784	17.9	2.0	2.5
Other Asia	2,126	2,061	2,292	2,298	2,390	11.2	0.3	4.0
EU	1,257	829	1,132	1,215	1,203	36.6	7.3	-1.0
Other Europe	229	177	228	250	264	28.8	9.6	5.6
North America	1,179	790	1,071	1,165	1,183	35.6	8.8	1.5
Latin America	584	488	613	582	616	25.6	-5.1	5.8
Africa	126	94	101	89	94	7.4	-11.9	5.6
World	10,171	9,330	10,778	10,924	11,259	15.5	1.4	3.1%

### 4. Rubber Processing

Ribbed Smoked Sheets (RSS) has been the strength of Indian NR sector and is largely preferred by rubber growers due to the relatively high farm gate price it fetches. However, the quality of sheet rubber, processed by around a million small

and marginal farmers is often inconsistent. Global composition of processed forms of NR is dominated by block rubber on account of its consistency in properties and low cost of production. In the Indian context, in view of the labour shortage in traditional rubber growing regions leading to escalation in production cost of sheet rubber and block rubber being

preferred by the consumers/manufacturers leading to 80% of import being block rubber at present, there is a need for a shift in approaching rubber processing from predominately sheet rubber and promoting block rubber in the country. However, in view of the existing huge processing infrastructure of sheet rubber with smallholders at farm level comprising rubber rollers and smokehouses which has been established over decades for processing sheet rubber, this transition/shift in processing should be gradual and systematic. The existing practice of visual grading of rubber sheets would be replaced with more scientific and automated systems of grading. This will enable the rubber growers to get the maximum price by way of avoiding the discrepancies in terms of 'downgrading' of rubber sheets in the present visual grading system. Further, in order to ensure quality and standardisation of sheets, Group Processing Centres (GPC)/Community processing centres would be promoted with facilities for processing latex, effluent treatment, biogas, etc. Latex/sheet/scrap collection through RPS/SHGs would be supported technically and financially. This will facilitate fetching of better price by avoiding intermediaries. Proper awareness among growers and skill development for processing is also the need of the hour. Processing block rubber from latex coagulum would also be promoted simultaneously.

## 5. Rubber Production In India

Rubber is traditionally grown in India in the hinterlands of the South West Coast comprising of the state of Kerala and adjoining Kanyakumari District of Tamil Nadu (TN). Kerala is the single largest rubber producing state in India accounting for 91 per cent of total NR production. Kerala and TN are considered to be the traditional rubber growing regions in the country. In recent years, among non-traditional region, Tripura and Assam have witnessed growing production of NR. In Kerala and TN, the tract is now reaching a level of saturation for rubber cultivation and the scope of further expansion of the crop is very much limited. Considering this fact, the expansion of rubber cultivation, which is of prime importance for setting up

rubber production, has to take place mainly in non-traditional areas. Non-traditional areas so far identified as almost fully or marginally suitable for rubber cultivation are Arunachal Pradesh, Assam, Manipur, and lower reaches of hills of Meghalaya, Mizoram, Nagaland and Tripura excluding the other state of India. Although the North Eastern Region lies far outside the traditional rubber growing zone, the agro-climatic conditions obtained here are unique in as much as near tropical features are experienced in most parts owing to low elevations, exposure to monsoons and other moderating influences. The positive results obtained from trial plantations undertaken in early 1960s in the then undivided Assam and Tripura, commercial scale plantations were raised by Government Forest and Soil Conservation Departments. Public Sector Corporations set up later joined rubber planting endeavours on extensive scales. Thus while in Assam and Tripura, Public Sector Corporations are leading in the rubber plantation sector, in Meghalaya, Manipur, Mizoram and Arunachal Pradesh the role has played by the State Forest and Soil Conservation Departments. Individual growers are also contributing to fast growth of rubber cultivation in this region. Rubber has been identified as one of the thrust areas in Tripura, in view of its suitability to the terrain and the acceptability amongst the people. Studies have shown that about 100,000 hectares of area in the state can be brought under rubber plantation. The area under rubber cultivation at present has increased from 27,000 ha in FY2001 to 50,070 ha in 2009-10, which is the second largest, after Kerala. Including Assam and other states, acreage in the North East has increased from 46,885 ha in 2000-01 to 88,865 ha in 2009. The yield per hectare and the quality of rubber are also comparable to Kerala's plantations. In fact, Tripura is now considered the "Second Rubber Capital of India" by the Rubber Board. The below table showcases the total rubber production in India across natural, synthetic and reclaim rubber. The NR has grown at a rate of 3 per cent, while SR and RR have grown at a rate of 4 per cent and 5 percent respectively.

**Table 3: Rubber production in India**

Year	Natural	Synthetic	Reclaim	Total
2001-02	631,400	69,653	63,550	764,603
2002-03	649,435	80,401	67,385	797,221
2003-04	711,650	88,366	70,990	871,006
2004-05	749,665	94,209	73,060	916,934
2005-06	802,625	97,634	76,645	976,904
2006-07	852,895	99,513	78,495	1,030,903
2007-08	825,345	101,265	83,075	1,009,685
2008-09	864,500	96,739	86,390	1,047,629
2009-10	831,400	106,743	93,535	1,031,678
2010-11	861,950	110,340	99,960	1,072,250
2011-12*	903,700	110,599	103,565	1,117,864
CAGR	3%	4%	5%	4%

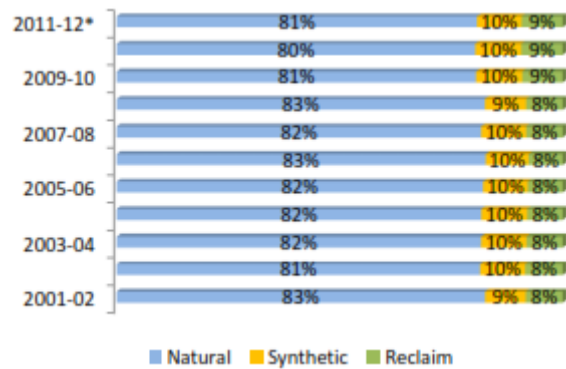


Figure 2: Percentage contribution of rubber production

The state-wise area in hectares under rubber shows the domination of Kerala to the national tally. The rise in the

hectare area under Tripura justifies the sobriquet of second rubber capital of India.

Table 4: State-wise rubber plantation in India

State	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Andaman and Nicobar	960	960	962	843	762	729	729	880	878	879	NA
Andhra Pradesh	109	109	124	124	107	111	111	180	1,103	NA	NA
Arunachal Pradesh	323	372	379	416	423	446	438	720	1,200	NA	NA
Assam	12,806	13,208	13,841	14,057	14,848	15,890	18,225	23,705	28,102	32,659	38,090
Bihar	-	-	-	-	-	-	-	-	-	-	-
Delhi	-	-	-	-	-	-	-	-	-	-	-
Goa	843	870	755	761	704	772	986	1,010	1,017	1,081	1,125
Gujarat	-	-	-	-	-	-	-	-	-	-	-
Haryana	-	-	-	-	-	-	-	-	-	-	-
Karnataka	20,017	20,294	20,460	21,189	23,153	26,035	28,830	32,415	34,777	38,110	41,588
Kerala	475,039	476,047	479,602	485,610	493,800	502,740	512,045	517,475	525,408	554,228	539,565
Madhya Pradesh	-	-	-	-	-	-	-	-	-	-	-
Maharashtra	165	200	182	152	149	171	373	650	858	1,173	1,513
Manipur	1,698	1,708	1,773	1,786	1,829	1,859	1,914	2,380	2,723	NA	NA
Meghalaya	4,354	4,586	4,758	4,834	5,000	5,331	6,830	7,740	9,196	10,584	11,875
Mizoram	619	696	709	498	507	525	551	735	908	NA	NA
Nagaland	2,024	2,087	2,091	2,184	2,274	2,486	2,697	3,515	4,141	NA	NA
Orissa	517	552	480	456	465	500	528	570	657	NA	NA
Pondicherry	-	-	-	-	-	-	-	-	-	-	-
Punjab	-	-	-	-	-	-	-	-	-	-	-
Rajasthan	-	-	-	-	-	-	-	-	-	-	-
Tamil Nadu	18,704	18,631	18,633	18,642	18,815	19,233	19,410	19,355	19,545	19,767	19,790
Tripura	27,947	28,853	30,770	32,065	34,189	37,846	41,165	50,070	55,415	59,285	64,480
Uttar Pradesh	-	-	-	-	-	-	-	-	-	-	-
West Bengal	430	494	461	473	523	526	548	580	587	NA	NA
Others	-	-	-	-	-	-	-	-	-	13,794	16,754
<b>Total</b>	<b>566,555</b>	<b>569,667</b>	<b>575,980</b>	<b>584,090</b>	<b>597,610</b>	<b>615,200</b>	<b>635,400</b>	<b>661,980</b>	<b>686,515</b>	<b>711,560</b>	<b>734,780</b>

## 6. Rubber Consumption And Export Of Rubber Products

Rubber consumption is the direct indicator of rubber based industrialisation. Though India is the second largest consumer of NR in the world, per capita consumption of rubber as a whole is just around 1.2 kg as compared to 6.5 kg in China and the global average rubber consumption of 3.6 kg. End product range of rubber covers more than 50,000 items, which are used far and wide in various industries like transport, health, households, sports, entertainment etc. Consumption of rubber shall be promoted for the overall development of the rubber industry value chain. Demand for tyres originates from the vehicle/automobile manufacturers for fitment on new vehicles (OEM supplies), vehicle population which is already on the road (replacement or aftermarket) as well as export. In some categories like passenger cars, motorcycle tyres, etc. the share of OEMs is more than 50% of total supplies. The future potential can be gauged from the present low automobile penetration in India. Growth in production and fitment of tyres is directly linked to the growth in GDP, particularly growth in infrastructure (for commercial tyres) and income levels (for passenger tyres). Tyre sector is poised to record notable growth in near future contributed by increase in GDP and export prospects. General rubber goods sector is dominated by Micro Small and Medium Enterprises (MSME). However, the versatility of these products, their potential in terms of huge domestic and external markets and relatively high employment potential are to be considered in according high policy priorities to the sector. General rubber goods sector also requires special attention with regard to research and development activities, technology upgradation and transfer, machinery import, export promotion, branding, quality enhancement, skill development etc. Promotional activities in rubber product manufacturing are mainly undertaken by Ministry of MSME, Department for Promotion of Industry and Internal Trade (DPIIT) and Industries Departments of state governments. There is no designated national level agency to assist rubber products manufacturing sector. A Rubber Industry Development Plan may be formulated in consultation with other relevant Ministries/Departments and Rubber Board. Initiatives of grower forums in manufacturing value added rubber products will be supported.

Rubber Parks are areas publicly procured, zoned and planned for the purpose of rubber based industrial development wherein infrastructure and common facilities are provided and single windows for clearances are established. Development of Rubber Parks as processing hubs would be promoted in the private sector or under PPP mode. Several studies have highlighted significant advantages of rubberised roads over normal roads and it is inferred that though there is a marginal increase in the initial cost, periodic maintenance of these roads can be reduced by 35% compared to that of the bituminous roads. NR latex and crumb powder made from

end-of-life tyres can be used for modification of asphalt for road rubberisation. Promotion of Road Rubberisation would have twin advantages of boosting rubber consumption and infrastructure durability in the long run. An independent Rubber Products Export Promotion Council could be considered to be constituted in order to address the export related issues of the Rubber Products Sector (both tyres and General rubber goods) and also to specifically handhold the manufacturers belonging to MSME sector which is highly essential in the present scenario. Further, export oriented clusters would be identified and specific strategies would be framed for giving the focussed boost in exports.

## 7. Commercial Utilisation Of Rubber Wood

Increasing demand for timber and timber products, declining supply of timber from conventional sources and growing concern for environmental conservation etc. has propelled the search for alternative sources of timber. In this context, rubber wood can emerge as a potential alternative because of its distinct advantages of being a sustainable and renewable source and its amenability to versatile industrial applications. Specific action plan for promotion of commercial utilisation of Rubber wood as an alternative source of timber would be prepared with due importance for small dimension technology. However, harmonisation with relevant legal provisions under Forest Acts and Rules has to be done to prevent legal hitches in harvesting, transit and marketing of rubber wood.

## 8. Conclusion

RSDC has been constituted under the aegis of National Skill Development Corporation (NSDC), in collaboration with All India Rubber Industries Association (AIRIA) and Automotive Tyre Manufacturers Association (ATMA), with the aim to identify and fulfill skill development needs in the Rubber sector. The RSDC will encourage the industry to employ skilled and certified manpower. It will create a dynamic LMIS to keep track of the labour market skill gaps, frame Occupational Standards, facilitate development of practical and high quality training content, ensure adequate availability of faculty through Train The Trainer initiatives, build accreditation and certification mechanisms and encourage capacity building through private sector participation. In the process, RSDC will indulge in preparing a catalogue of skill sets, range and depth of skills to facilitate individuals to choose from. RSDC has been registered as a Section 25 company. The purpose of RSDC is to ensure the generation of skilled manpower in both the tyre and the non-tyre sectors, provide employment opportunities to youth across the nation, create career paths in roles existing within the unorganized and organized segments of the rubber industry and ensure active participation of the industry in absorption of skilled manpower generated through RSDC.

## References

1. Beilen JB, Poirier Y (2007) Establishment o new crops for the production of natural rubber. Trends Biotechnol 25: 522–529
2. Crement-Demange A, Priyadarshan PM, Thuy Hoa TT, Venkatachalam P (2007) Hevea Rubber Breeding and Genetics. Plant Breed Rev 29: 177–283

3. Davies W (1997) The rubber industry's biological nightmare. *Fortune* 136: 86
4. Guen VL, Guyot J, Reis Mattos CR, Seguin M, Garcia D (2008) Long lasting rubber tree resistance to *Microcyclusulei* characterized by reduced conidial emission and absence of telomorph. *Crop protection* 27: 1498–1503
5. KumariJayashree P, Thomas V, Saraswathyamma CK, Thulaseedharan A (2001) Optimization of parameters affecting somatic embryogenesis in *Heveabrasiliensis*. *J Nat Rubber Res* 14: 20–29
6. Lespinasse D, Grivet L, Troispoux V, Rodier-Goud M, Pinard F, Seguin M (2000) Identification of QTLs involved in the resistance to South American Leaf Blight (*Microcyclusulei*) in the rubber tree. *TheorAppl Genet* 100: 975–984
7. Lespinasse D, Rodier-Goud M, Grivet L, Leconte A, Legnate H, Seguin M (2000) A saturated genetic linkage map of rubber tree (*Heveaspp*) based on RFLP, AFLP, microsatellite and isozyme markers. *TheorAppl Genet* 100: 127–138
8. Metcalfe CR (1966) Distribution of latex in the plant kingdom. *Econ Bot* 21: 115–127
9. Montoro P, Rattana W, Pujade-Renaud V, Michaux-Ferriere N, Monkolsook Y, Kanthapura R, Adunsadthapong S (2003) Production of *Heveabrasiliensis* transgenic embryogenic callus lines by *Agrobacterium tumefaciens*: Role of calcium. *Plant Cell Rep* 21: 1095–1102.
10. Mooibroek H, Cornish K (2000) Alternative sources of natural rubber. *Applmicrobiol and biotechnol* 53: 355–365
11. Priyadarshan PM, Crement-Demange A (2004) Breeding *Hevea* rubber: Formal and molecular genetics. In: Hall JC, Dunlap JC, and Friedmann T (ed), *Advances in genetics*. Elsevier Academic Press, Amsterdam, pp 51–115
12. Senyuan G (1990) *Hevea* breeding and selection for cold resistance and high yield in China. *Proc IRRDB Symp*, Oct5-6, Kunming, China, International Rubber Research and Development Board, Brickendonbury, pp 154–164
13. Takahashi S, Koyama T (2006) Structure and function of cis-prenyl chain elongation enzymes. *Chem Rec* 6: 194–205