COMPARATIVE STUDY OF THE PERFORMANCE OF POLYBAG PLANTS VIS-a-VIS BUDDED STUMPS IN SMALL HOLDINGS OF KANNUR DISTRICT

BY

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1992

DECLARATION

I hereby declare that this dissertation entitled **"A comparative study of the performance of polybag plants vis-a-vis budded stumps in small holdings of Kannur District"** is a bonafied record of research work done by me during the course of research and that this has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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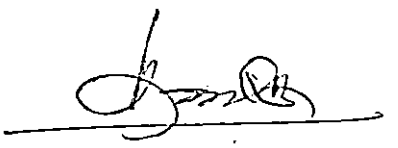

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CERTIFICATE

Certified that the dissertation entitled "A comparative study of the performance of polybag plants vis-a-vis budded stumps in small holdings of Kannur District" is a record of research work done independently by **Sri.M. RAMACHANDRAN** under our guidance and supervision, and that it has not previously formed the basis of the award of any degree or diploma to him.

We, the undersigned Members of the Advisory Committee of **Sri.M. RAMACHANDRAN** a candidate for the Post Graduate Diploma in Natural Rubber Production agree that the dissertation entitled "A comparative study of the performance of polybag plants vis-a-vis budded stumps in small holdings of Kannur District" may be submitted by Sri.M. RAMACHANDRAN in partial fulfilment of the requirement for the Diploma.

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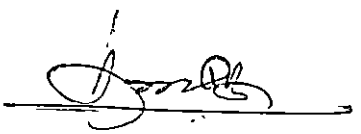

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1. INTRODUCTION

The para rubber tree (Hevea brasiliensis Muell. Arg.) is the only one under commercial exploitation among the 12,500 species of rubber yielding plants. The tree has a comparatively long gestation period of 5-7 years which account for nearly one fifth to one fourth of the economic life span of the crop. This period is even prolonged by one or two years when the management is poor. In India, small farmers account for 93 per cent of the area under this crop. The economic conditions of our small and marginal farmers are not sound to wait for long for getting returns from the crop. In plantation sector also, this crop has to compete in the domestic market and hence attempts for reducing the cost of production is confronted by the long gestation period. More over, in the years to come, natural rubber in India will have to be more competative in the international market too. It is therefore very evident that one of the most important aspects in plantation-management is the reduction of unproductive phase so that early return from investment is ensured (Potty et al., 1991). Apart from the optimum agromanagement practices, the selection of correct planting material assume great importance in reducing the pre-bearing period. Conventional technique of planting was the use of bare rooted brown budded stumps which takes nearly three to four months for establishment. Field experiments were started in India as early as 1976 and the the results indicated the advantage of using advanced planting

materials like plants raised in polythene containers (Potty, 1983). Encouraged by the experimental findings, the Rubber Board popularised the use of polybag plants and also extended financial assistance to small growers for this purpose. This practice has now become so popular that almost all small farmers resort to this planting material. However, Potty et al. (1991) found that in Tripura budded stumps also performed equally well when best agromanagement practices were followed. The above authors warned that this findings are to be viewed with caution and a proper assessment of the technique should be made under the situations of small growers. In the present study the performance of polybag plants and conventional budded stumps were compared in selected small holdings of Kannur District.

2. REVIEW OF LITERATURE

The comparatively long unproductive phase was recognised as a definite disincentive for investments in rubber including replanting with high yielding cultivars. Attempts have been made from early sixtees to reduce the immaturity period (Pushparajah and Haridas, 1977). Earlier approaches were mainly through the use of fertilizers, maintenance of leguminous covers, plant protection and early branch induction (Mainstone, 1962; Watson, 1963).

Pushparajah and Chellappah (1969) showed that by introducing leguminous covers the period of immaturity can be reduced from 78 to 80 months under non-leguminous covers to 60 months under legume covers. This practice was shown to be more economical also (Ti et al., 1971). Split application of fertilizers, increasing the doze and frequency of application etc. were found to contribute towards reduction in immaturity period (Sivanadyan et al., 1973). Early branch induction has been suggested as one of the horticultural manipulations towards shortening the immaturity period of rubber (Yoon, 1973). The importance of branch induction is more relevant in case of clones which have a tendency of tall and spindy growth. The effect of early branching is through more leaf area so as to increase the rate of photosynthesis and thereby production of more assimilate for girthing.

For the purpose of cloning, brown budding was practised in rubber since 1950. This technique resulted in wastefull growth of the stock seedlings for a larger period prior to budding. Hurov (1961) introduced budding on green tissues which enabled earlier budding, before the stock seedlings grew to the required girth for brown budding. Such green buddings were found to sprout and grow quickly, and it reduced the immaturity period by 3 to 4 months when compared to field budded rubber. The technique of green budding have been standardised and demonstrated by many workers (Gener, 1966; Leong and Yoon, 1979).

Planting of budded stumps in containers and later transplanting to the field was attempted by various workers. Use of bamboo baskets as containers was reported by Dijkman, 1951. Tinley (1960) further showed that budded materials can be transplanted in polythene bags and re-transplanted in the field which resulted in a further reduction of immaturity period. Stevans quoted by Sivanadyan et al. (1976) used materials 18 months old stumped buddings and showed that the immaturity period in the field could be reduced by one year. Shepherd (1967) tested various techniques of field establishment and later showed that the stumped buddings of various clones like PB 5/51 could be brought into tapping in about 46 months.

Yoon (1973) reported that for stumped buddings, use of lime to white wash the stem would reduce casualities. Sivanadyan et al. (1973) in their preliminary reports revealed that by

agronomic manipulations, stumped buddings could be useful as advanced planting material. They also showed that plants raised in polybags could also be useful for field establishment to reduce immaturity period.

Abraham (1983) showed that the stumped buddings can be brought into tapping in about $4\frac{1}{2}$ to 5 years. He opined that this techniques may be suitable only for southern districts where rainfall is more distributed. Potty (1983) reported that the success of planting of stumped buddings would depend upon the climate that followed after planting which is quite unpredicable and hence, always a risk factor to prevail in resorting this techniques.

Soil core buddings, where a budded and established plant from the soil core nursery is transplanted with an intact core of soil with an undisturbed root system was tried. Nor et al. (1982) quoted by Webster (1989) reported that soil core buddings with 2-4 whorls of leaves have done as well as stumped buddings in some trials but have given poor results in others. The variation is possible being the soil type. Soil core buddings are not much used for larger plantings now a days (Webster, 1989), obviously due to the handling difficulties.

Relative advantage of planting budded stumps raised in polybags has been demonstrated by many workers. In South India Potty (1983) reported that polybag plants attained a girth of 53.4 cm

in 6½ years while conventional budded stumps attained only 47.2 cm. The performance of stumped buddings was not encouraging as they attained only 43.1 cm. The percentage of tappable trees was 73.3 in among plants raised in polythene bags while it was only 40 per cent in conventional budded stumps and stumped buddings. Seed-at-stake planting followed by field budding resulted in poor performance. However, Abraham (1983) have observed difference in girth of plants raised in polythene bags narrowed down as the years progress. In one of the fields the annual girth increments were 3.1 cm, 4.9 cm, 7.0 cm and 4.4 cm during Ist four years respectively.

At the end of 3½ years, plants raised in polythene bags recorded 25.26 cm compared to 23.34 cm in conventional budded stumps. In another field the difference in the girth between the polybag plants and budded stumps were 4.81 cm as against 1.92 cm in the field mentioned earlier. These results suggest that under well managed situations, the advantage of polybag plants on girth of trees could be marginal. However, advantage of fairly uniform stand and very low percentage of mortality rate in the field could more than compensate the extra cost. The average cost of polybag plants ex-nursery was reported to be Rs.6.6 in 1984 and currently is around Rs.10/-. Under conditions in North East India where stress situation are prevailing and the growers are illetrate and inexperienced in rubber cultivation, comparative performance of

different planting materials have been reported by Potty et al. (1991). It was observed that in girth increment 14 months old large size polybag plants were superior to various types of budded stumps and small polybag plants of 2 months age. From the establishment point of view the best performance was for 2 months old polybag plants. Casuality was relatively higher for the 14 months old plants which was due to planting shock due to the lack of practical experience to handle the large size plants. It was also observed that especially under best management conditions,, to avoid casualities in the begining, stumped budding also could be used as successfully as polybag plants.

In a study of comparative merits of different planting techniques, Shepherd (1967) observed that budded stumps raised in polybags recorded higher girth at 32 months age. Similar results have been reported by Sivanadyan et al. (1973) who observed that while budded stumps took 69 months to attain maturity, large polybag plants took 60 months in Malaysia. Large polybag plants were also reported to be the best planting materials in Malaysia (Sivanadyan et al., 1976; Webster, 1989). Immaturity period of small polybag plants was only 59 months compared to field budded plants which had 67 months of immaturity. Pushparajah and Haridas (1977) have also reported the same trend in Malaysia. Yoon (1973) observed that plants from the conventional brown budded stumps were benefited by artificial branch induction in terms of girth

increment. However for the large sized polybag plants, the transplanting shock itself is sufficient to reduce side shoots at a hight of six feet and therefore branch induction may not be necessary in polybag plants.

The economics of shortening the unproductive phase has been studied by several workers [Barlow and Ng (1966), Lim et al. (1973), R.R.I.M. (1974) Chong and Pee (1976)].

The best results in terms of shortening the immaturity period was obtained by planting stumped budding. From the yield of Ist five years tapping, the discented revenue over the first nine years was made up. The second best planting material was found to be the large size polybag plants (Shepherd et al., 1974; Sivanadyan et al., 1976; Pushparajah and Haridas, 1977).

Plate 1. Bare rooted brown budded stump ready for planting

170322

Plate 2. Polybagged plant with 3 whorls of leaf

3. MATERIALS AND METHODS

In order to assess the comparative performance of polybag plants and budded stumps a case study was conducted in Kannur District. Among the various type of materials used for planting, bare rooted brown budded stumps (Plate 1) and budded stumps raised in polybag (Plate 2) are being mainly adopted by planters in India. Therefore the study was restricted to these material. The case study was made by collecting relevant information from the subsidy files available at the Rubber Board Regional Office, Thalassery. A total number of 160 files were screened covering 80 cases each under stump planting and brown budded stumps raised in polybags having a size of 55 x 25 cm. The details of the holdings selected for the study is given in Appendix-I. In these cases plantings were carried out in 1983 and 1984. The study was restricted to 1983 and 1984 as in the years prior to 83 polybag planting was not popular. Similarly after 1984 stump planting was not much adopted by the small growers.

As far as possible, units under comparable conditions were selected for both the planting material. Relevant informations on the year of planting, area, size of polybag used, date of planting in polybag, date of planting in main field, height and number of whorls of leaves of polybag plants, cultural operations attended to, were recorded to ascertain the uniformity of conditions.

The details regarding;

Type of planting material

Annual growth performance commencing from the 2nd year to the 7th year

Casualities observed

Number of tappable trees at the end of 7th year etc. were also collected based on a pre-prepared questionnaire (Appendix-II)

Five cases each under stump planting and polybag planting were inspected in the field during May 1992 to evaluate the present condition and to confirm the performance. The data collected were tabulated and presented.

4. RESULTS AND DISCUSSION

From the case study made with reference to the replanting and new planting subsidy files at Rubber Board's Regional Office, Thalassery and field visit to selected holdings, the following results were obtained.

4.1 Casualities one year after planting

The mortality rate observed for polybag plants and budded stumps is presented in Table 1. The results indicate that the establishment rate for polybag plantings is substantially high. The percentage casuality recorded, one year after planting, in polybag area was only 2.58 and 1.81 as against 15.37 to 14.82 for budded stumps in 1983 and 1984 plantings respectively.

Kannur District being a drought prone area in the state of Kerala, establishment rate of plants during the first year itself is a problem. The rainfall pattern is different from the southern district like Kottayam (Kerala) or Kulasekaram (Tamil Nadu). Rainfall pattern of Kottayam, Kulasekaram and Kannur is shown in Fig.1. North East monsoon is relatively feeble in north Kerala and hence dryspell is much prolonged. Rainfall data for Kannur District for the last 5 years is given in Appendix III. In budded stump plantings casualities were found to be very high and this necessitated vacancy filling during 2nd and subsequent years. This high rate of casualities observed not only resulted in an additional expenditure to the growers but

Table 1. Percentage of casualities one year after planting for budded stumps and polybag plants

Year	No. of units	Area in hectares	Number planted	Number surveyed	Casuality percentage
Budded stump					
1983	39	24.30	12150	10282	15.37
1984	41	18.93	9465	8062	14.82
Polybag					
1983	30	24.32	12160	11840	2.58
1984	42	32.30	16150	15757	1.81

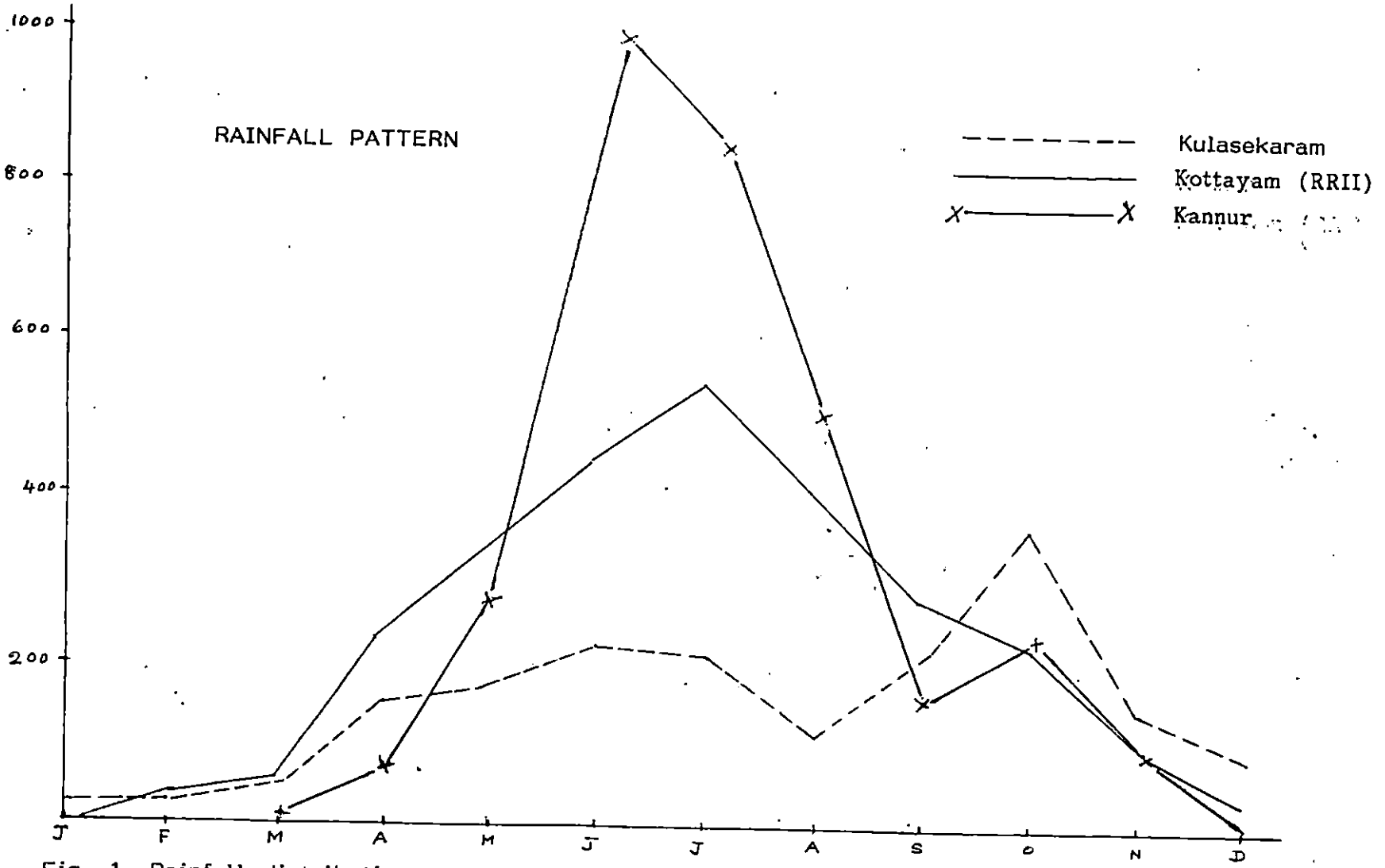

Fig. 1. Rainfall distribution pattern in different locations in the main rubber growing tract (Kerala and Tamil Nadu)

also in lack of uniformity. Heterogenous nature of plants due to vacancy among plants filling lasts almost throughout the immaturity period of the plantation and delays commencement of tapping.

The higher percentage of establishment (low casuality rate) obtained for polybag plants is due to the well developed root system which can tide over adverse climatic condition, especially under conditions in North Kerala region where north eastern monsoon is feeble. However, where there is a well distributed rainfall pattern, the budded stumps may not have this disadvantages. Such a finding was reported by Potty et al. (1991); wherein budded stumps performed equally well when best management was provided.

4.2 Girth and girth increment

Girth of plants at the end of seven years was almost comparable in 1983 planting in both the planting materials (Table 2). The girth difference was only 1.6 cm in 1983 planting. The mean difference between the two plantings were found to narrow down as the years progress from 4.1 cm in the 3rd year to 1.6 cm in the 7th year in 1983 planting and from 4.1 cm to 2.26 cm in the 1984 planting (Fig.2). This revealed that the budded stumps once established would grow fast to make up for the loss in growth. In 1984 plantings, polybag plants recorded higher girth and were having 2.26 cm more than budded stump planting. This could be attributed to the relatively more percentage of polybag plants with more than three whorls in 1984 planting (Table 3).

Table 2. Mean girth in cm at 125 cm height from Ist to 7th years after planting

Years after planting	1983			1984		
	Mean girth (cm)		Mean difference cm	Mean girth (cm)		Mean difference cm
	BS	PB		BS	PB	
1	-	-	-	-	-	-
2	-	13.20	-	-	12.85	-
3	12.80	16.90	4.10	12.80	16.90	4.10
4	20.00	22.80	2.80	19.50	22.55	3.05
5	27.60	29.60	2.60	26.20	29.52	3.32
6	35.60	37.80	2.20	34.55	38.42	3.87
7	43.30	44.90	1.60	42.90	45.60	2.26

BS - budded stumps
PB - polybag plants

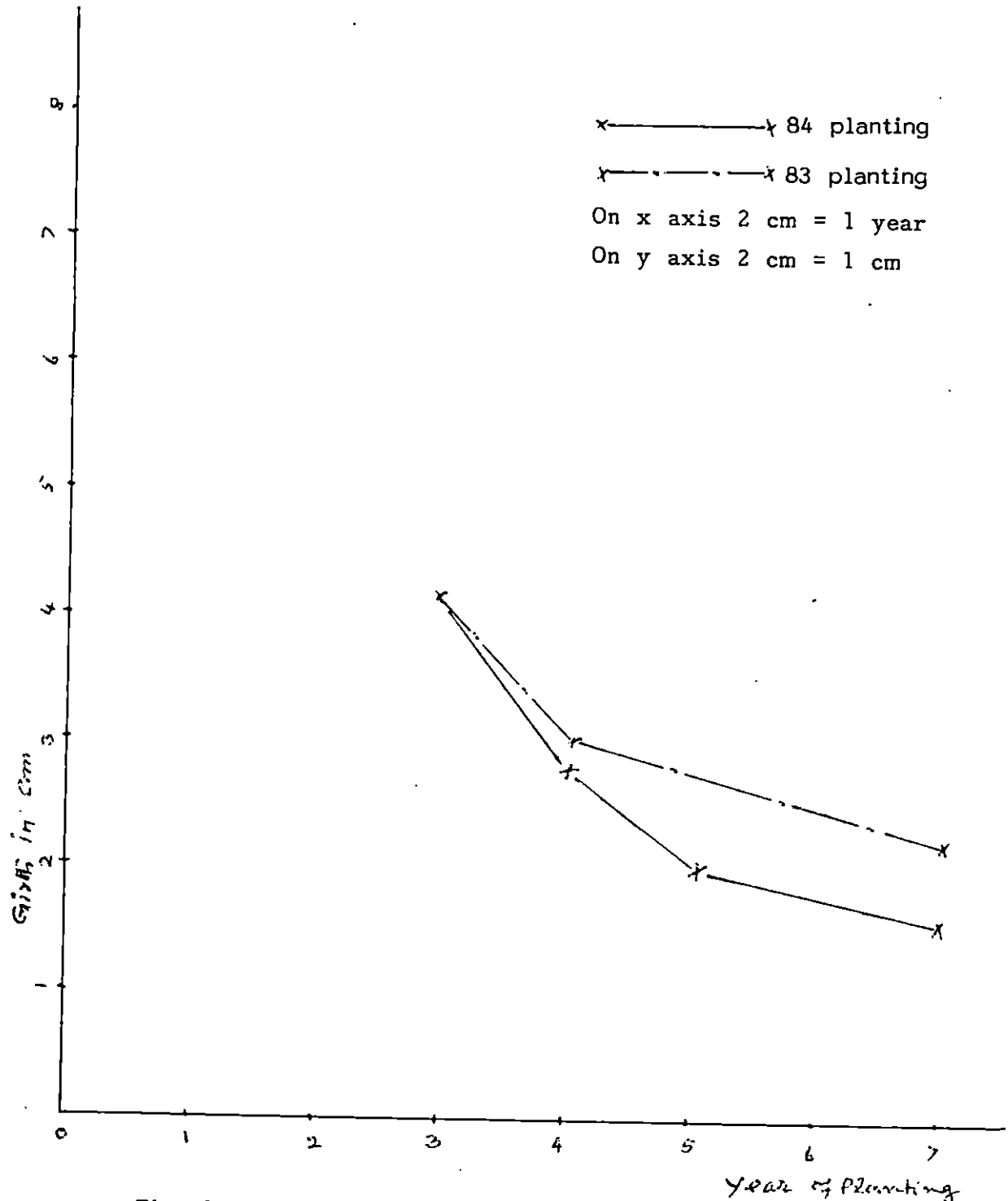

Fig. 2. Mean girth difference from 3rd to 7th year

Table 3. Mean number of whorls for the polybag plants at the time of planting

Growth stage	1983	1984
1 to 2 whorls	5 %	-
2 to 3 whorls	60 %	55 %
above 3 whorls	35 %	45 %

Since the polybag plants have an extra growth period in the nursery it is expected that girth of plants in polybag plants at the end of 6th year would be on par with the girth of plants at the 7th year in budded stump and thereby reduction in immaturity period. The present findings does not give any indication on this aspect. The results reported herein are in full agreement with the observations of Potty et al. (1991) from a field trial conducted in North-East India.

Comparison of annual girth increment from third to seventh year in plants raised from polybag and budded stumps revealed that budded stumps had relatively higher rate of girthing in the initial years while the rate of girthing was gradual in the case of polybag plants (Table 4). However, in later years both the plantings recorded comparable rate of girthing (Fig. 3 and 4).

Usually small farmers buy polybag plants and get them transported for planting in their holding which may result in shock during handling. Moreover in general it is seen that very vigorously growing stock seedlings are used for first round budding and utilised for field planting and less vigorous ones in subsequent budding and are used for the purpose of polybagging. Initial slow growth of polybag plants could be attributed to this.

4.3 Percentage of tappability attained

The percentage of tappability at the end of 7 years were

Table 4. Mean girth increment from 3rd to 7th year

Year after planting	Mean girth increment (cm)			
	1983		1984	
	BS	PB	BS	PB
3	-	3.7	-	4.05
4	7.2	5.9	6.7	5.65
5	7.6	6.8	6.7	6.97
6	8.6	8.2	8.35	8.90
7	7.7	7.1	8.35	7.18

BS - budded stumps
PB - polybag plants

1983 planting x——————x Polybag

1983 planting x—·—·—·—·—x Budded stump

On x axis 2 cm = 1 year

On y axis 2 cm = 1 cm

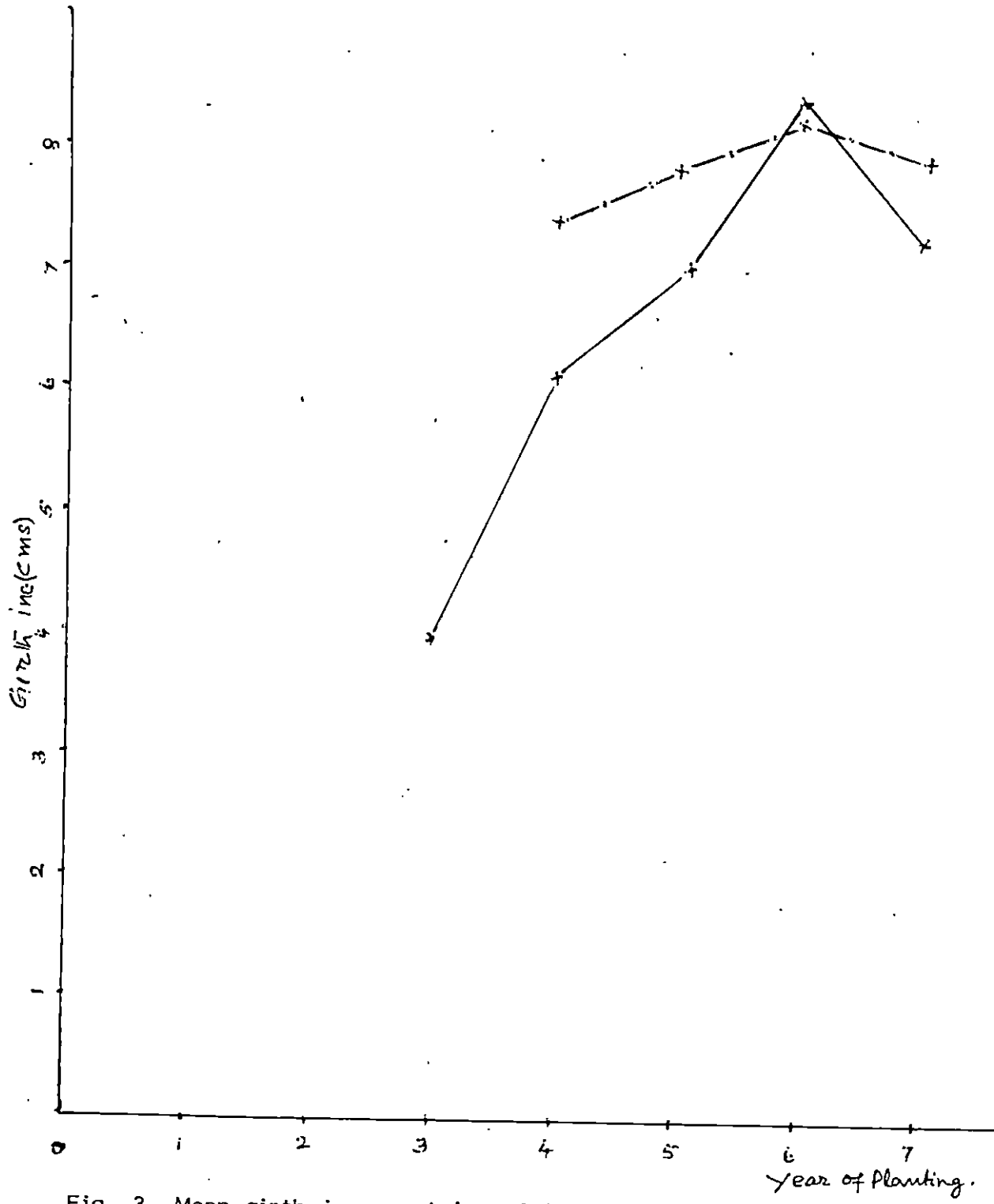

Fig. 3. Mean girth increment in polybag plants and budded stumps

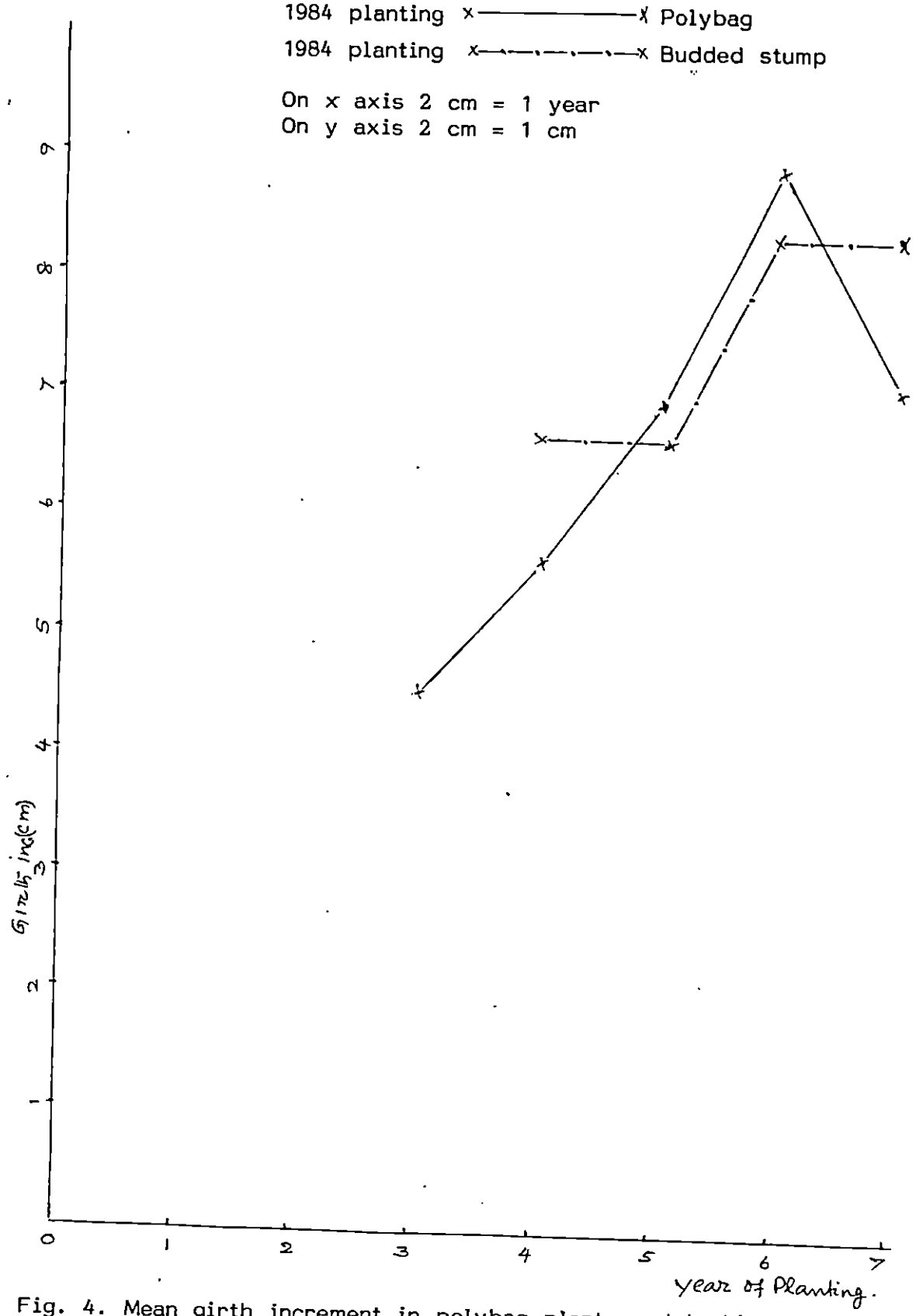

Fig. 4. Mean girth increment in polybag plants and budded stumps

collected and classified into different categories (Tables 5 and 6). The frequency of cases for lower percentage of tappability upto 30 per cent was more for budded stumps and the polybag plants recorded more frequency for tapping classes of 30 and above. This showed that trees attain more percentage of tappability in the case of polybag plantings. In 1983 planting 63 percentage of cases had above 50 per cent tappability in polybag plants while it was much less (20 per cent) in budded stump planting. The corresponding figures were 68 and 31 per cent in 1984 planting for polybag plants and budded stumps. This data clearly shows that planting polybag plants resulted in attaining higher percentage of tappability in the 7th year.

Even though the difference in girth of polybag plants and budded stump plants were marginal at 7th year after planting, the higher percentage of tappability is due to the uniformity in establishment of the polybag plants during the first year itself.

The ultimate aim in managing a rubber plantation is to bring more trees under tapping in the shortest time period and polybag planting was found to achieve this goal to some extent even though the girth at tappable stage was almost comparable under the two systems. The better establishment and uniformity of the trees was another added advantage for polybag planting. These advantages may compensate the extra cost involved in preparing polybag plants. The additional incentive offered by the Board for using polybag plants is thus fully justified. This system had an added advantage for non

Table 5. Percentage of tappable trees at the 7th year of planting (1983 planting)

Percentage of plants attained tappability	Polybagged plant				Budded stump			
	No. of units	Area in ha	Total trees	Tappable trees	No. of units	Area in ha	Total trees	Tappable trees
10					2 (7.6)	1.82 (10.80)	910 (11.13)	91 (3.43)
10 to 19	6 (18.00)	6.17 (21.79)	3085 (21.27)	617 (10.40)	4 (15.38)	1.82 (10.80)	660 (8.07)	132 (4.97)
20-29	4 (12.12)	3.78 (13.35)	1890 (13.03)	567 (9.56)	10 (38.46)	7.31 (43.38)	3655 (44.70)	1096 (41.32)
30-39	2 (6.06)	1.34 (4.73)	670 (4.62)	268 (4.52)	5 (19.23)	2.82 (16.73)	1410 (17.24)	564 (21.26)
40-49	9 (27.27)	6.93 (24.47)	3465 (29.87)	1732 (29.22)	3 (11.53)	1.83 (10.86)	915 (11.19)	457 (17.23)
50 and above	12 (36.36)	10.09 (35.64)	5388 (37.16)	2743 (46.27)	2 (7.69)	1.25 (7.41)	625 (7.64)	312 (11.76)
Total	33	28.31	14498	5927	26	16.85	8175	2652

(The values in parentheses indicate percentage of the total)

Table 6. Percentage of tappable trees at the 7th year of planting (1984 planting)

Percentage of plants attained tappability	Polybagged plant				Budded stump			
	No. of units	Area in ha	Total trees	Tappable trees	No. of units	Area in ha	Total trees	Tappable trees
10 to 19	2 (6.25)	1.76 (6.40)	880 (6.40)	176 (2.81)	3 (9.37)	1.43 (9.98)	715 (9.98)	286 (10.42)
20-29	3 (9.37)	1.85 (6.73)	925 (6.73)	277 (4.43)	12 (37.50)	6.04 (42.17)	3020 (42.17)	906 (33.02)
30-39	5 (15.62)	3.51 (12.77)	1755 (12.77)	702 (11.24)	7 (21.87)	3.22 (22.48)	1610 (22.48)	644 (23.47)
40-49	6 (18.75)	4.11 (14.96)	2055 (14.96)	1027 (16.45)	6 (18.75)	2.14 (14.94)	1070 (14.94)	535 (19.50)
50 and above	16 (50.00)	16.24 (59.11)	8120 (65.04)	4060 (65.04)	4 (12.50)	1.49 (10.40)	745 (10.40)	372 (13.56)
Total	32	27.47	13735	6242	32	14.32	7160	2743

(Values in parentheses indicate the percentage of the total)

Plate 3. A general view of polybag plants established in the field

a) In the first year of planting

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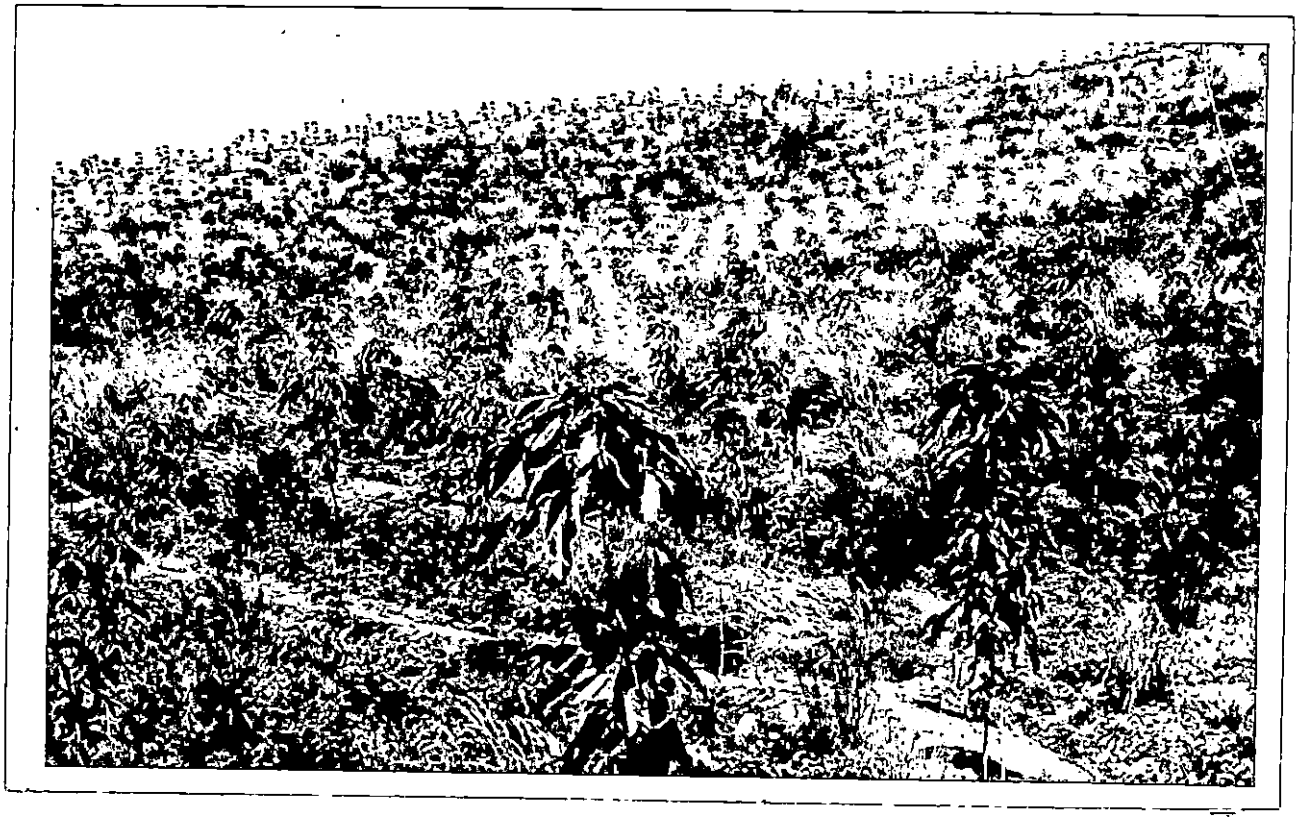

Plate 3. A general view of polybag plants established in the field

b) Two year after planting

traditional areas where this crop is new for the highly unskilled growers employing unskilled labour force. The high establishment rate and uniformity obtained for the polybag plants is evidenced in Plate 3 (a & b).

4.4 Variation in girth after attaining tappability

The data collected from the field during the 2nd week of May 1992, revealed that the trees of both budded stump and polybag planting after commencement of tapping did not show any significant difference with respect to the total girth attained (Table 7). Hence the performance of budded stumps and polybag plants were found to be on par.

Table 7. Variation in girth for polybag plants and budded stumps

Units	Polybag plant (girth in cms)		Budded stump (girth in cms)	
	1983	1984	1983	1984
1	56	56	55	51
2	56	55	52	52
3	55	55	53	52
4	56	56	55	53
5	53	52	58	51
Total	276	274	273	279
Mean	55.2	54.8	54.6	51.8

5. SUMMARY AND CONCLUSION

In order to compare the field performance of polybag plants with that of budded stump planting a case study was undertaken in Kannur district. The data required for the study was drawn from the subsidy files of Rubber Board Regional Office, Thalassery. Eighty cases each under the two types of planting were considered. The important observations emenated from the study are

1. Polybag plantings resulted in relatively low rate of casuality.
2. Budded stump planting after establishment showed a very high growth rate in the initial years of immaturity.
3. In the later years of immaturity polybag plants and budded stumps had comparable growth rate.
4. The mean girth difference between polybag and budded stump planting narrowed down as years progressed. After 7 years, growth of plants under both the systems were comparable.
5. Proportion of plants that attained tappable girth in 7 years were substantially high in polybag plantings.

Considering the main objective of shortening the immaturity period, by bringing more percentage of trees to tapping, use of polybag plants is justified.

Polybag planting being more expensive, it could be suggested in the areas where dry spell is extensive. In areas where distributed

rainfall is prevelent, budded stump planting may be undertaken in early June and polybag plants may be used for filling up of vacancies if any during September/October season itself. For this purpose small polybags are sufficient and polybagging of budded stumps is to be done simultaneously with field planting in early June. If this system is adopted cost of planting material can be considerably reduced and at the some time better establishment and uniformity could be attained during the Ist year of planting itself.

As the financial aspects of different planting materials and the monitory gains are not considered in this study; it may be further investigated.

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* Original not seen

APPENDIX-I

Details of holdings selected

1983 Polybag planting

1	Sri.Thomas Thanniyil	PD/TY/869-83A	0.69 ha
2	Sri.Jacob Nadakkel	PD/TY/68-83A	2.09 ha
3	Sri.M.M.Joseph Mohikunnel	PD/TY/278-83A	0.87 ha
4	Sri.M.D.Sebastian Kallarakal	PD/TY/281-83A	1.25 ha
5	Smt.K.M.Nirmala	PD/TY/32-83A	0.86 ha
6	Sri.Madhusoodanan Vazhunnavan	PD/TY/12-83A	0.30 ha
7	Sri.Kattakal Alykutty	PD/TY/46-83A	0.46 ha
8	S/s. Kuriakose & Thressia	PD/TY/22-83A	0.28 ha
9	Sri.Mlakuzhiyil Francis	PD/TY/35-83A	0.86 ha
10	Sri.V.K.George	PD/TY/34-83A	2.30 ha
11	Sri.K.J.Joseph	PD/TY/432-83A	0.56 ha
12	S/s/Viswanathan & Omana	PD/TY/1540-83A	0.20 ha
13	Smt.C.M.Mary	PD/TY/379-83A	2.25 ha
14	Sri.M.K.Peter	PD/TY/365-83A	0.41 ha
15	Sri.Kuttappan Kulangarayil	PD/TY/497-83A	0.23 ha
16	Sri.Mukalal Joseph	PD/TY/452-83A	0.20 ha
17	Sri.Mamoottil Joseph	PD/TY/443-83A	0.20 ha
18	Sri.A.P. Emmanual	PD/TY/401-83A	2.00 ha
19	Sri.Kunnathusseril Jose	PD/TY/462-83A	0.41 ha
20	Sri.V.V.Varghese & Alyamma	PD/TY/475-83A	0.33 ha
21	Smt.Monica Parathenal	PD/TY/478-83A	0.51 ha
22	Smt.Patheyedath Santha	PD/TY/16-83A	0.67 ha
23	Smt.Anni Thomas	PD/TY/1388-83A	0.38 ha
24	Sri.Thomas Anjilimoottil	PD/TY/1327-83A	0.32 ha

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25	Sri.Georgekutty Nadeyath	PD/TY/321-83A	1.97 ha
26	Sri.Karonnan Raju & Vijayan	PD/TY/320-83A	0.45 ha
27	Sri.Aanyapally Kumaran	PD/TY/362-83A	0.26 ha
28	Sri.Pilakkool Kuttoosan	PD/TY/1483-83A	0.31 ha
29	Sri.Kunhikrishnan Nambiar	PD/TY/307-83A	0.90 ha
30	Sri.K.P. Balagopalan	PD/TY/309-83A	0.33 ha
31	Sri.Nadakkel Joseph	PD/TY/67-83A	1.92 ha
32	Sri.Davassia, P.J.	PD/TY/38-83A	0.78 ha
33	Sri.Joseph, P.I.	PD/TY/37-83A	0.48 ha
34	Sri.Thomas, V.D.	PD/TY/23-83A	1.07 ha
35	Sri.Mandambeth Raghavan	PD/TY/48-83A	0.74 ha
36	Sri.Karimbileri Umbru	PD/TY/66-83A	0.56 ha
37	Sri.K.J. Jose	PD/TY/47-83A	0.24 ha
38	Sri.Mannathukaran Abraham	PD/TY/81-83A	0.90 ha
39	Sri.A.K.Chacko	PD/TY/409-83A	0.54 ha
40	Sri.Thyvalappil Kunhikannan	PD/TY/327-83A	0.31 ha

1983 Budded stump planting

1	Sri.N.V.Chandrasekharan	PD/TY/412-83A	0.89 ha
2	Sri.N.K.Mithran	PD/TY/407-83A	1.36 ha
3	Sri.Muthuplackal Xaviar	PD/TY/338-83A	0.59 ha
4	Sri.Mathew John Arumackal	PD/TY/328-83A	0.70 ha
5	Sri.Thommachan Mammoottil	PD/TY/467-83A	0.88 ha
6	Mother Superior S.H. Convent	PD/TY/306-83A	0.54 ha
7	Smt.Kandamparambil Alykutty	PD/TY/296-83A	0.20 ha

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8	Smt.Kallumkal Mariyakutty	PD/TY/480-83A	0.25 ha
9	Sri.Joseph Chacko Chirappath	PD/TY/474-83A	0.35 ha
10	Sri.Andayan Nanu	PD/TY/43-83A	0.25 ha
11	Sri.Kulathinkal Philipose	PD/TY/1546-83A	0.18 ha
12	Sri.P.P.Chacko	PD/TY/1537-83A	0.20 ha
13	Sri.K.A.Jose	PD/TY/1494-83A	0.40 ha
14	Smt.Vattaviripppil Mariyamma	PD/TY/361-83A	0.76
15	Sri.Paradiyil Scariya	PD/TY/358-83A	0.30 ha
16	Smt.Monokki Madhavi Amma	PD/TY/36-83A	0.45 ha
17	Sri.Kunnath Pankajakshan Nair	PD/TY/288-83A	0.56 ha
18	Sri.Varkey Karunkel	PD/TY/282-83A	0.83 ha
19	S/s.K.A.Mathai & Alyamma	PD/TY/868-83A	0.43 ha
20	Sri.Hareendran, P.K.	PD/TY/2856-83A	0.58 ha
21	Sri.Vadat Varkey Master	PD/TY/1340-83A	1.06 ha
22	Smt.Cheloran Santha	PD/TY/1346-83A	0.40 ha
23	Smt.M.P.Saradamma	PD/TY/133-83A	ha
24	Sri.A.K.Krishnan	PD/TY/1356-83A	0.69 ha
25	Smt.V.M.Kalliani Amma	PD/TY/1358-83A	0.69 ha
26	Sri.Thomas Puthuparambil	PD/TY/1417-83A	0.37 ha
27	Sri.Paul Mundayathuchundayil	PD/TY/1476-83	0.60 ha
28	Smt.Thressia Kundattil	PD/TY/1583-83A	0.30 ha
29	Sri.Valayangadan Bappu	PD/TY/410-83A	0.53 ha
30	Sri.P.M.Joseph	PD/TY/417-83A	0.33 ha
31	Sri.Joseph Puthenpurakel	PD/TY/53-83A	0.53 ha
32	Sri.Vattakunnel Narayanan	PD/TY/486-83A	0.31 ha

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33	Sri.Payyanadan Nanu	PD/TY/397-83A	0.20 ha
34	Sri.K.J.Chako	PD/TY/461-83A	1.41 ha
35	Sri.Thottathil Mathai	PD/TY/370-83A	0.90 ha
36	Smt.K.P. Devakey	PD/TY/374-83A	2.44 ha
37	Sri.E.C.Joseph	PD/TY/380-83A	0.35 ha
38	Sri.Mathew Edathinel	PD/TY/375-83A	1.04 ha
39	Sri.George Thomas Vilangupara	PD/TY/212-83A	0.72 ha
40	Sri.K.D.Ouseph Kavanamalil	PD/TY/379-83A	0.32 ha

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1984 Polybag planting

1	Sri.Kunnath Sathyanathan	PD/TY/74-84A	1.84 ha
2	Sri.K.Karunakaran Adiyodi	PD/TY/49-84A	1.53 ha
3	Sri.Madathinakathu Thomas	PD/TY/262-84A	0.55 ha
4	Smt.N.P.Mariyam	PD/TY/41-84A	1.90 ha
5	Sri.Vachali Kumaran	PD/TY/169-84A	0.63 ha
6	Smt.Annamma, K.V.	PD/TY/187-84A	0.52 ha
7	Sri.P.T.Chacko, Payyampallil	PD/TY/182-84A	0.33 ha
8	Sri.Thaikandiyil Dasan, Bhaskaran	PD/TY/25-84A	1.80 ha
9	Smt.Rosamma Chacko	PD/TY/183-84A	0.96 ha
10	Sr.Superior F.C. Convent	PD/TY/33-84A	0.36 ha
11	Sri.Jayakrishna Vazhunnavan	PD/TY/56-84A	1.86 ha
12	Smt.K.V.Subaida	PD/TY/15-84A	0.83 ha
13	Sri.V.M.Abdul Rehiman	PD/TY/243-84A	0.90 ha
14	Sri.Jose Mannamparambil	PD/TY/241-84	0.23 ha
15	Sri.Thomas Kadakathra	PD/TY/232-84A	1.11 ha
16	Sri.Devassia Chacko Vattamthottiyil	PD/TY/59-84A	0.63 ha
17	Thallevettil Narayanan	PD/TY/67-84A	0.32 ha
18	Sri.Poyilan Mohammed Haji	PD/TY/17-84A	0.75 ha
19	Sri.V.K.Joseph Vakachalil	PD/TY/29-84A	1.33 ha
20	Sri.Narikodan Nadu	PD/TY/77-84A	0.34 ha
21	Smt.Karonnan Parvathi Amma	PD/TY/193-84A	0.09 ha
22	Smt.Kakkodan Nalini	PD/TY/361-84A	0.39 ha
23	Mr Superior S.H. Convent	PD/TY/141-84A	0.40 ha

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24	Sri.Aryappally Krishnan	PD/TY/119-84A	0.42 ha
25	Smt.Pathanikal Narayani	PD/TY/413-84A	0.60 ha
26	Sri.Vengaparambil Joseph	PD/TY/104-84A	0.43 ha
27	Sri.Pallipravan Rayaroth Raghavan	PD/TY/212-84A	0.52 ha
28	Sri.Karonnan Padmanabhan	PD/TY/188-84A	0.73 ha
29	Sri.Karonnan Damodaran	PD/TY/192-84A	0.60 ha
30	Sri.Mariyakath Abraham	PD/TY/46-84A	0.56 ha
31	Smt.K.K.Karthiyani Amma	PD/TY/53-84A	0.60 ha
32	Sri.V.D.Devassia	PD/TY/54-84A	0.29 ha
33	Sri.Kokathu Joseph	PD/TY/19-84A	0.41 ha
34	Sri.Kizhakkayil Mathew	PD/TY/45-84A	1.44 ha
35	Sri.Palakkal Madathil Maheswaran Namboodiri	PD/TY/69-84A	1.37 ha
36	Sri.Theneloth Hameed	PD/TY/58-84A	1.82 ha
37	Sri.Payilan Mustafa	PD/TY/18-84A	0.48 ha
38	Sri.K.K.Ibrahimkutty Haji	PD/TY/295-84A	0.44 ha
39	Sri.M.V.Chacko	PD/TY/268-84A	0.63 ha
40	Sri.Vattikalath Joseph	PD/TY/70-84A	0.70 ha

1984 Budded stump planting

1	Sri.Kozhukunnel Kunhikrishnan Nambiar & Devaki Amma	PD/TY/240-84A	0.54 ha
2	Kum.Geetha, Chamakel	PD/TY/230-84A	0.69 ha
3	Sri.Kanhirathinkal Mathew	PD/TY/529-84	0.20 ha

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4	Sri.Joseph, M.J., Memana	PD/TY/584-84	0.39 ha
5	Sri.Thettathil Kumaran	PD/TY/1310-84	0.20 ha
6	Sri.Somadatha Marar, P.V.	PD/TY/1234-84	0.30 ha
7	Sri.Kamolkadan Chandu Nambiar	PD/TY/632-84	0.23 ha
8	Sri.Thomas Aamakkat	PD/TY/683-84	0.50 ha
9	Sri.Thomas, T.D.	PD/TY/1023-84	0.85 ha
10	Sri.M.J.Mathew Madathinakath	PD/TY/1094-84A	0.25 ha
11	Smt.Elsamma Padijarethe	PD/TY/171-84A	0.38 ha
12	Sri.Joseph Narimattathil	PD/TY/1413-84A	0.40 ha
13	Smt.Annamma Joseph, Kannampally	PD/TY/675-84A	0.29 ha
14	Sri.Sabastian, K.J.	PD/TY/555-84A	0.33 ha
15	Sri.A.Vasu, Ayelachi	PD/TY/362-84A	0.20 ha
16	Sri.K.J.Seariya	PD/TY/239-84A	0.41 ha
17	Sri.Mathai Moolechalil	PD/TY/660-84A	0.44 ha
18	Sri.Kunhambu Nair	PD/TY/1309-84A	0.29 ha
19	Smt.M.R.Sarojini		0.16 ha
20	Sri.Kurian Varkey	PD/TY/1229-84A	0.48 ha
21	Sri.Mathew Valliad	PD/TY/1207-84A	0.82 ha
22	Smt.Cicily Kuruvamplackal	PD/TY/1116-84A	0.24 ha
23	Sri.Mattathil Joseph	PD/TY/955-84A	0.34 ha
24	Sri.Parolil Govinda Pillai	PD/TY/920-84A	0.41 ha
25	Pathiya Parambil Usman	PD/TY/855-84A	0.65 ha
26	Sri.Kuriyil Akath Neriyan Aleona	PD/TY/852-84A	0.52 ha
27	Sri.Narayanan Nambiar	PD/TY/581-84A	0.89 ha
28	Sri.George Payampallil	PD/TY/620-84A	0.41 ha

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29	Smt.Kurichan Sobhakrishnan	PD/TY/552-84A	0.78 ha
30	Smt.Jessintha, Mutharath	PD/TY/522-84A	0.36 ha
31	Sri.John Kulambukath	PD/TY/540-84A	0.30 ha
32	Sri.Mathew Kochuvelikkaketh	PD/TY/547-84A	1.30 ha
33	Sri.Mathai Chandrankunnel	PD/TY/365-84A	0.30 ha
34	Sri.Abraham, V.A.	PD/TY/480-84A	0.51 ha
35	Sri.K.N.Chandrasekharan Nair	PD/TY/476-84A	0.71 ha
36	Sri.Varkey Vazhaplackal	PD/TY/467-84A	0.40 ha
37	Smt.Thankamma Kunnath	PD/TY/363-84A	0.32 ha
38	Sri.Koothanel Chacko	PD/TY/1729-84A	0.59 ha
39	Sri.K.V.Varkey	PD/TY/227-84A	0.72 ha
40	P.M Maheswaran Namboodiri	PD/TY/69-84A	0.45 ha

APPENDIX-II

QUESTIONNAIRE

1. Name of Grower :

2. Reg.No./Permit No. :

3. Year of Planting/Area :

4. Planting Material

   a) Polybag Plants (Green or Brown) :

   b) Budded stump :

5. Date of Planting in Polybag :

6. Size of Polybag :

7. Date of Planting in the field :

8. Size of Plant at the time of Planting (Height and No. whorls) :

9. Cultural operations attended to

   a) Spraying :

   b) Manuring (Qty. & Time) :

   c) Other practices :

10. Growth performance : Vacancy filled

    a) Girth/Height of Plant during Second year : Nos./variety

    b) Girth of Planting during 3 year :

    c) Girth of Planting during 4 year :

    d) Girth of Planting during 5 year :

    e) Girth of Planting during 6 year :

    f) Girth of Planting during 7 year :

11. Field evaluation

a) Type of Planting materials :

b) Clone Variety :

c) Growth stage :

d) Tapping system :

e) Girth increment after tapping :

APPENDIX-III

Rainfall data of Kannur District for the last 5 years (in mm)

Month	1987	1988	1989	1990	1991
Janurary	0.0	0.0	0.0	0.0	0.0
February	0.0	0.0	0.0	0.0	0.0
March	0.0	0.0	9.2	0.0	0.0
April	31.4	80.3	147.0	3.0	36.8
May	37.4	176.0	132.6	629.4	285.8
June	835.4	1073.0	1341.9	660.5	1041.9
July	387.4	1028.3	743.1	869.4	1311.4
August	408.4	532.5	465.1	523.7	651.6
September	156.8	343.1	194.8	124.8	58.8
October	112.8	49.4	284.6	496.2	365.9
November	179.6	98.1	121.6	72.8	43.5
December	84.5	0.0	0.0	0.6	0.0
Total	2233.3	3380.7	3439.9	3380.4	3795.7