INTERIM RESULTS ON PROFITABLE GUM PRODUCTION TRIALS

By BEN CHIKAMAI

1.0. INTRODUCTION.

It is gratifying to learn that Kenya is reaching self sufficiency in the production of gum rosin and turpentine. This is being made possible through the initiative of Rosin Kenya, a Chemical industry based in Nakuru. The company specialises in the manufacture of gum rosin and turpentine. It is the sole supplier of rosin to Pan African Papers Mills and all its turpentine is locally consumed by the Pharmaceutical industry; a tramendous saving of foreign exchange on the part of the country. Its main source of Oleoresin is from Pinus elliottii with limited supplies from P. radiata. The Oleoresin is obtained by tapping of live trees.

The effort by Rosin Kenya Limited deserves positive comment and encouragement by all those concerned. As mentioned earlier the initiative is saving the country badly needed foreign exchange through import substitution. It is utilising a resource that hitherto was untapped thereby generating revenue to the government through royalty and providing employment opportunities to the Kenyan population. Unfortunately, the industry still faces some difficulties in realising required production.

It was established in Nakuru with a view to utilising the vast resources of Pine plantations in the Rift Valley. However, the main plantations are of Pinus patula and P. radiata which are not good producers of Oleoresin. It has therefore been compelled to confine its tapping to plantations of Pinus elliottii in Machakos and Taita Taveta districts The distance to the industry is incredible resulting in high cost of transportation. The present area under P. elliottii is rather small and unlikely to sustain the long term requirements of the industry. The plantations are mainly found on the hills with difficult terrain conditions leading to increased extraction costs. Given that gum production is a new venture in the country, appropriate methods of field extraction to optimise on sustained yield are still being examined.

Because of the importance of the industry to the nations economy, concerted effort is called for to look into the solutions to the above problems. There is urgent need to critically examine alternative sources of Oleoresin from other Pine species and a long term objective of expanding the area under P. elliottii using high yielding clones. Fortunately, KEFRI has recognised this need and is undertaking a number of studies to solve some of the problems. It has already

developed a project to be financed through the National Council of Science and Technology (NCST) to examine the potential of the country in Oleoresin production from alternative sources. It has also entered into agreement with Rosin Kenya Limited to carry out research into profitable gum production methods. This project aims at developing packages that will lead to improved production of Oleoresin from the present resource for the industry and better management by the Forest department. In particular, it is designed to examine suitable extraction methods that will result in favourable volume of Oleoresin annually for a period of four years without or with minimum detrimental effects on tree growth and quality. A secondary objective is to look into the potential of P. carribbeae in Oleoresin production. The present paper reports first year results of the trial.

2.0. MATERIALS AND METHODS.

2.1. Study areas.

Trials on P. elliottii were established on two sites; Mbooni in Machakos and Ronge in Taita/Taveta districts. Studies into the potential of P. carribbeae for Oleoresin production was set up in Kwale district.

2.2. Methodology.

For each site, four experiments were laid out.

(a) Experiment 1 was established to examine effect of tree diameter

and crown to clear bole ratio on yield of Oleoresin - Four diameter classes (≤ 25 cm; 26-30 cm; 31-35 cm; ≥ 36 cm) were selected and ten trees randomly sampled to represent each diameter class. A face width of 7 cm was opened at the base of each tree. Streaking and application of acid is done after every seven days.

(b) Experiment 2 was established to examine influence of the number of working faces and sequence of operation on yield and growth. Thirty trees of diameter class 30-34 cm were randomly selected for the study. One 7 cm face width was opened on the first ten trees, two faces (front and back faces) on the next ten trees and two faces (adjacent) on the last ten trees. Streaking and application of acid is done after every seven days.

(c) Experiment three was established to examine influence of face width on yield and tree growth. Thirty trees of diameter class 30-34 cm were randomly selected. Two faces (front and back) were opened

simultaneously per tree as described below: Face width was 7 cm on the first ten trees, 9 cm on the next ten trees and 11 cm of the last ten trees. Streaking and application of acid paste was done as in the other experiments.

(d) Experiment 4 was established to examine influence of frequency of streaking and application of acid on yield of Oleoresin. Again thirty trees as in the other experiments were sampled. Two 7 cm faces (front and back) were opened per tree. Streaking and application of acid is done as described below; after seven days for first ten trees; fourteen days next ten trees and 21 days for last ten trees.

The second set of experiments are to examine the influence of species, site and seasons on yield and quality of the Oleoresin. The study was established at the end of May, 1989 and is to run for a period of four years. Production results are compiled monthly and field verification after every three months.

3.0. RESULTS AND DISCUSSION.

3.1. Results.

3.1.1. Effect of diameter and crown to Clear bole ratio on the yield of Oleoresin.

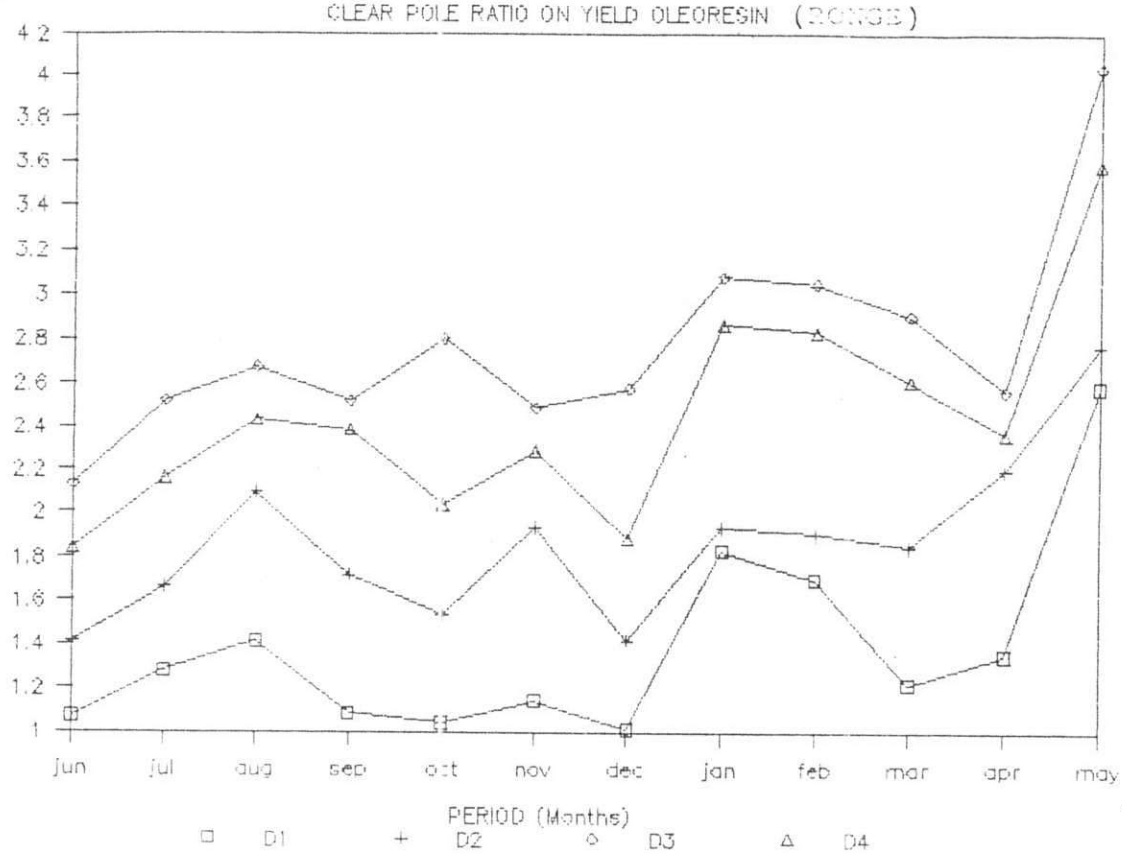
The results for Mbooni station were not available at the time of analysis. Report on Pinus elliottii presented in the text are therefore based on results from Ronge station. Yield data for a twelve months period are presented in table I and a schematic illustration on the production trend in Figure I. It is observed that trees with large diameters produced more Oleoresin compared with small diameter ones. Invariably, large trees had also well developed crowns covering more than 40% of the total height. A close examination of the table shows that highest yield was obtained from trees with diameters of 31-35 cm (D3) while lowest yield was from D1. This observation is further confirmed by illustration in Fig. 1. A one way analysis of variance performed showed that, at 0.05 level, yield for trees more than 31 cm (i.e. D3 and D4) was significantly

greater than those below 30 cm dbh (D1 and D2). However, the difference in yield between D1 and D2 or D3 and D4 was not significant.

Table I EFFECT OF TREE DIAMETER AND CROWN TO CLEAR POLE RATIO ON YIELD OF OLEORESIN

TREATMENT	MONTHS (kg)												RONGE:	
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
1-D1	1.078	1.282	1.416	1.089	1.047	1.146	1.018	1.829	1.694	1.220	1.351	2.584	16.75	1.40
1-D2	1.416	1.663	2.096	1.718	1.536	1.936	1.421	1.936	1.906	1.847	2.199	2.769	22.44	1.87
1-D3	2.129	2.523	2.673	2.523	2.804	2.492	2.579	3.088	3.053	2.906	2.568	4.042	32.48	2.71
1-D4	1.837	2.160	2.433	2.384	2.041	2.288	1.885	2.870	2.834	2.608	2.367	3.600	29.31	2.44

Fig. 1: EFFECT OF TREE DIAMETER AND CROWN TO CLEAR POLE RATIO ON YIELD OLEORESIN (RONGE)

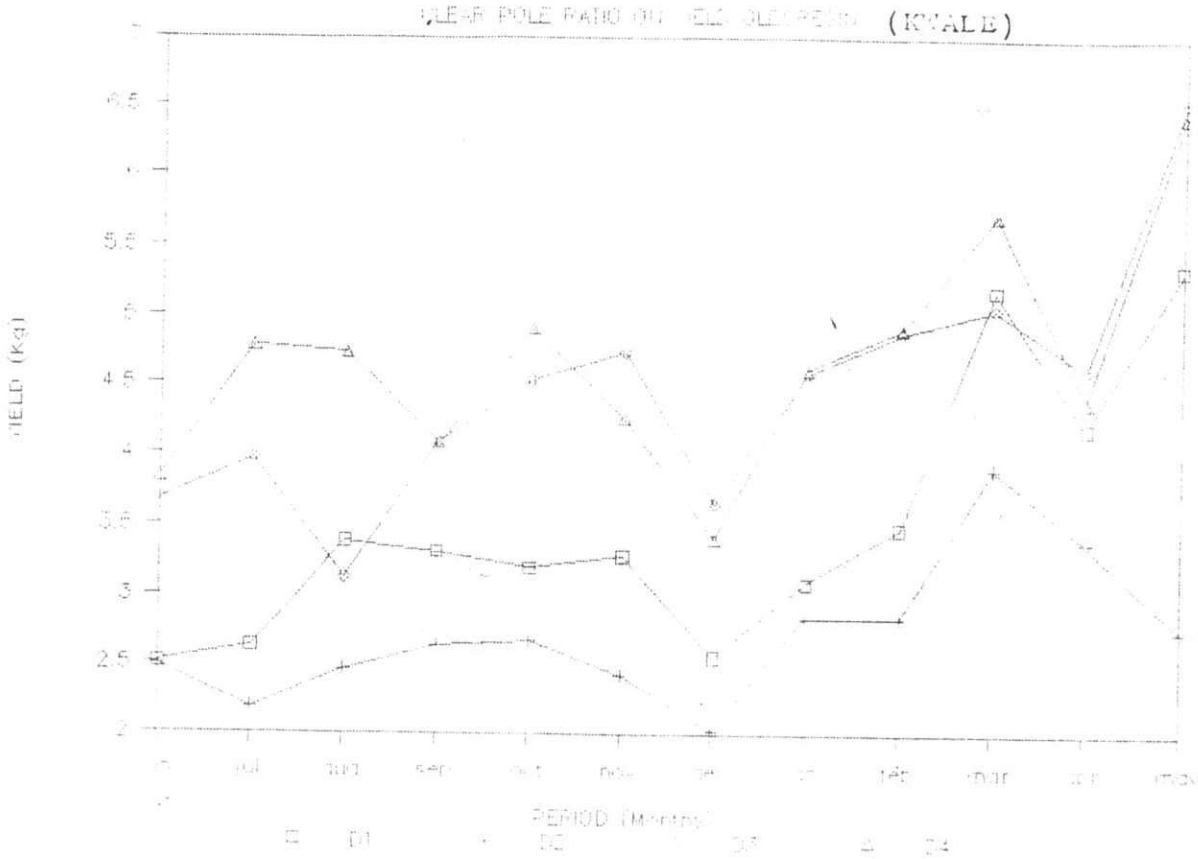


A more or less similar observation was obtained for P. carribbeae in Kwale. The results are presented in table II and schematic illustration in fig. 2. In this case however, maximum yield was obtained from D4 and minimum from D2. The analysis of variance showed a similar trend as was observed for P. elliottii in Ronge.

Table 2 EFFECT OF TREE DIAMETER AND CROWN TO CLEAR POLE RATIO ON YIELD OF OLEORESIN

TREATMENT	MONTHS (kg)												KWALE:	
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
1-D1	2.510	2.630	3.384	3.305	3.197	3.280	2.549	3.091	3.488	5.186	4.197	5.348	42.17	3.51
1-D2	2.488	2.192	2.454	2.632	2.659	2.426	2.022	2.844	2.838	3.906	3.400	2.750	32.61	2.72
1-D3	3.678	3.970	3.128	4.086	4.534	4.737	3.655	4.582	4.879	5.060	4.618	6.537	53.46	4.46
1-D4	3.838	4.775	4.726	4.084	4.906	4.256	3.407	4.609	4.911	5.725	4.387	6.440	56.06	4.67

Fig. 2 EFFECT OF TREE DIAMETER AND [illegible] ON [illegible] (KWALE)



3.1.2. Influence of number of working faces and sequence of operation on yield and growth.

Tables III and IV and figures 3 and 4 are the results from Ronge and Kwale respectively. The amount of oleoresin produced was lowest for one face and highest for two faces opened adjacent to one another. At 0.05 level of significance there was significant difference in yield among the three treatments in Ronge while in the case of Kwale significant difference in yield was observed only between single and table faces but not between double faces.

Results on effect of tapping on tree growth are yet to be analysed but at one year, this is not expected to be any significant.

Table III INFLUENCE OF WORKING FACES ON YIELD OF OLEORESIN AND GROWTH OF THE TREES

TREATMENT	MONTHS												RONCE:	
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
2-D1	1.343	1.574	1.609	1.567	1.314	1.315	1.211	1.174	1.742	1.728	1.869	3.389	19.84	1.65
2-D2	1.773	2.379	2.906	2.355	2.251	2.997	2.120	2.638	3.985	4.174	3.389	5.501	36.47	3.04
2-D3	3.949	3.811	6.012	5.022	4.412	5.478	4.810	5.020	5.419	6.215	5.816	7.676	63.62	5.30

Table IV INFLUENCE OF WORKING FACES ON YIELD OF OLEORESIN AND GROWTH OF THE TREES

TREATMENT	MONTHS												KWALE:	
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
2-D1	2.029	2.366	2.434	3.334	3.351	2.282	2.522	3.499	2.777	2.755	3.925	4.023	36.20	3.02
2-D2	3.403	3.549	4.727	5.972	6.743	6.025	5.101	6.900	5.767	7.962	6.099	7.900	70.15	5.85
2-D3	5.009	5.391	5.453	6.174	7.840	6.899	6.843	8.235	6.356	8.240	7.872	8.498	82.81	6.90

Fig. 3 INFLUENCE OF WORKING FACES ON YIELD OLEORESIN (KG/HA)

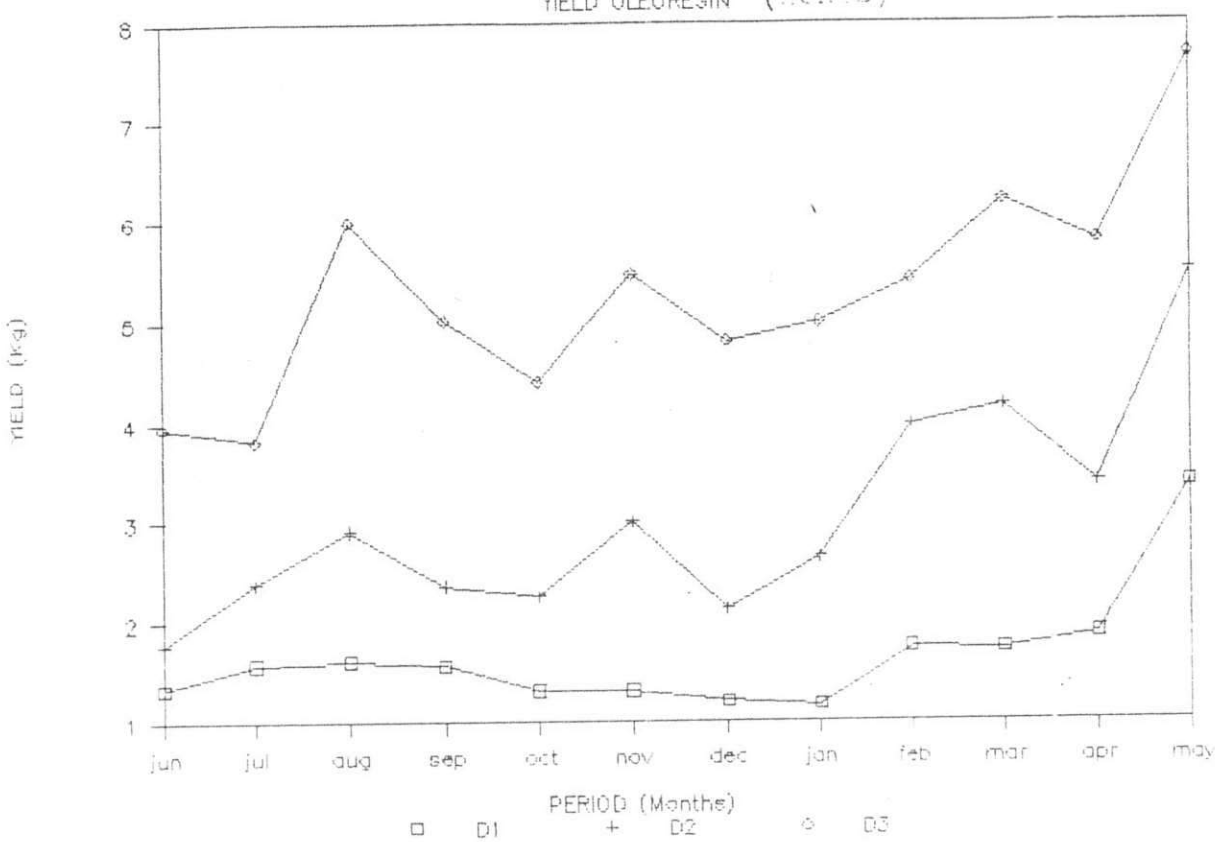
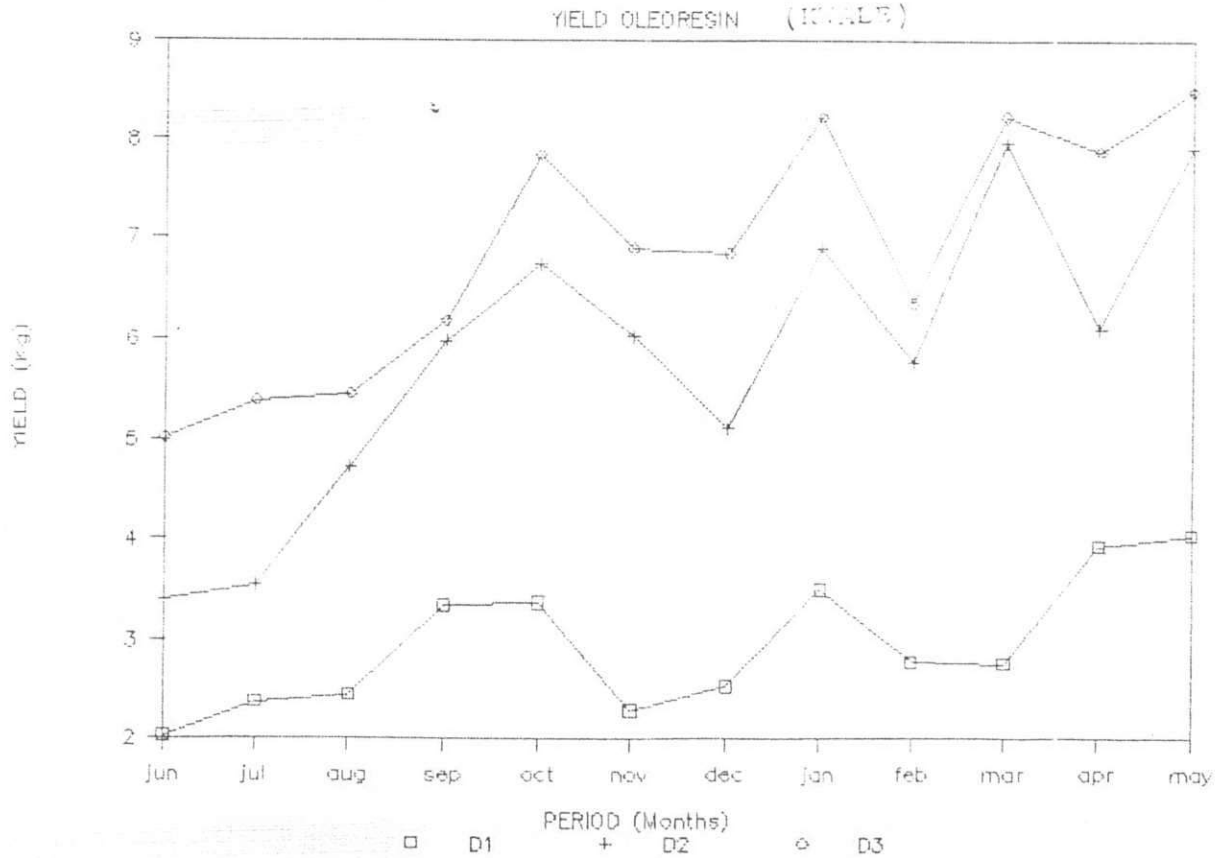


Fig. 4 INFLUENCE OF WORKING FACES ON YIELD OLEORESIN (KG/HA)



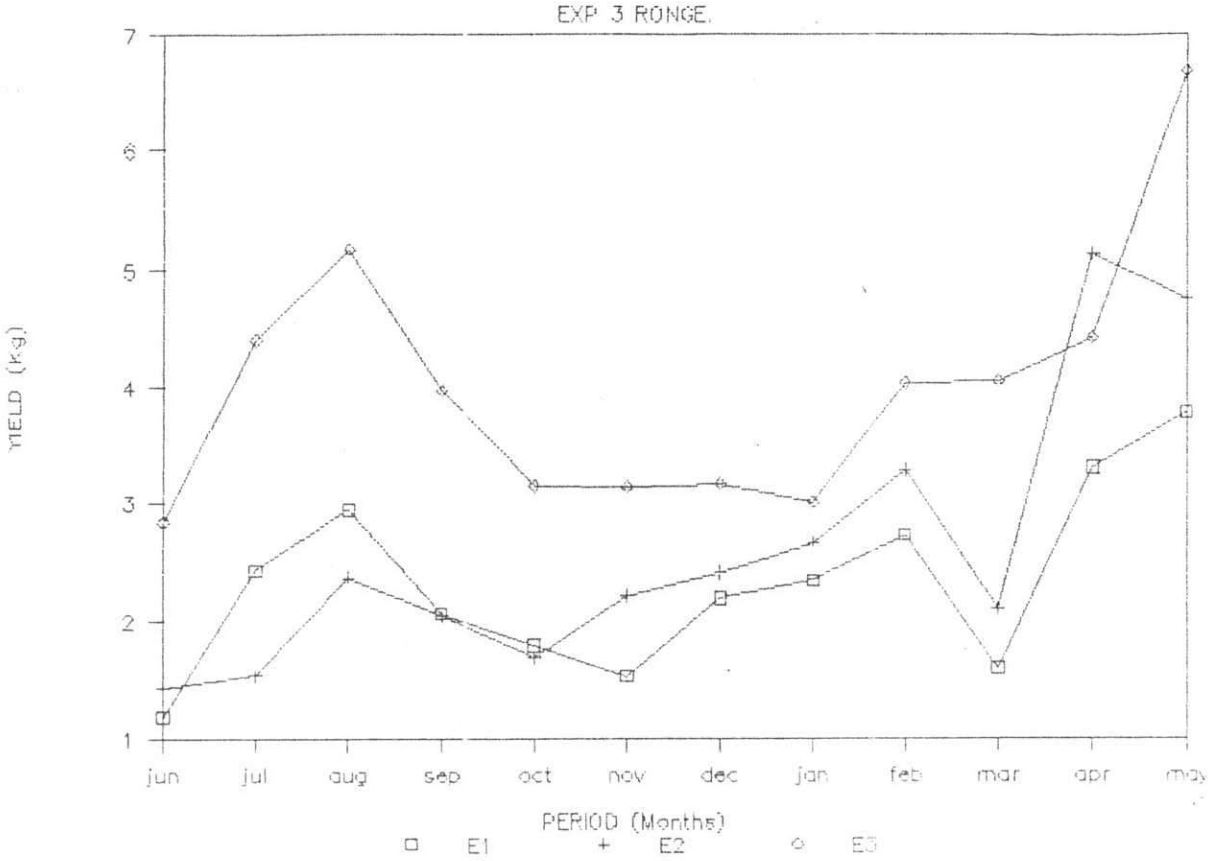
3.1.3. Influence of face width on yield and growth.

This experiment (exp. 3) and experiment 4 were only established on P. elliottii. The results are presented in table V and figure 5. More Oleoresin was obtained from wider face width than narrow ones. At 0.05 level of significance trees with face width of 11 cm produced higher Oleoresin content than those with 9 cm or 7 cm width. Effect on growth is yet to be determined.

Table V EFFECT OF PHASE WIDTH

TREATMENT	MONTHS												RONGE:	
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
3-E1	1.188	2.435	2.950	2.069	1.799	1.539	2.202	2.352	2.735	1.607	3.301	3.784	27.96	2.33
3-E2	1.439	1.543	2.374	2.045	1.699	2.220	2.408	2.666	3.290	2.117	5.143	4.751	31.70	2.64
3-E3	2.842	4.402	5.185	3.972	3.146	3.139	3.165	3.016	4.041	4.057	4.419	6.685	48.07	4.00

Fig. 5 EFFECT OF FACE WIDTH



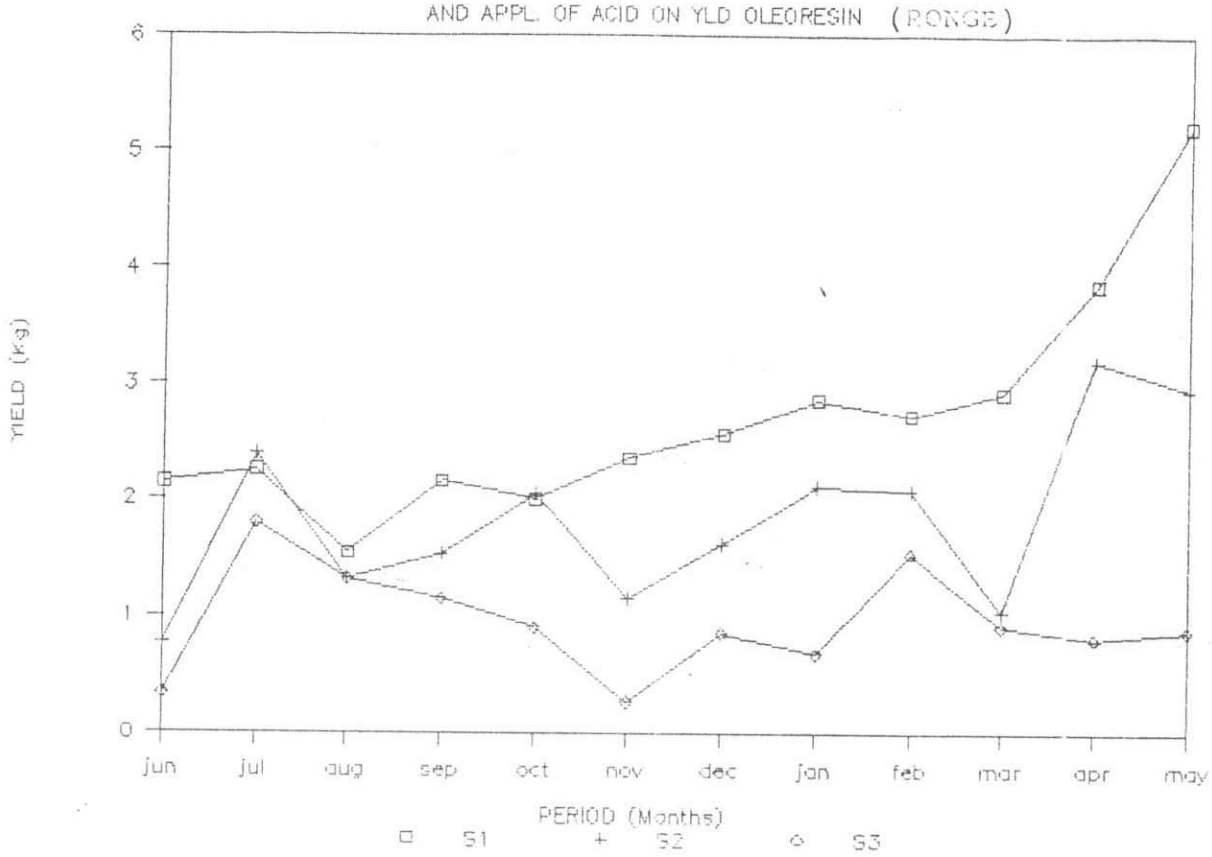
3.1.4. Influence of frequency of streaking and application of acid on yield.

Results are presented in table VI and fig. 6. Trees streaked once a week gave highest yield while lowest yield was obtained from those streaked once after every 21 days. Further analysis showed that the amount of Oleoresin was significantly different among the treatments.

Table VI EFFECT OF FREQUENCE OF STREAKING AND APPLICATION OF ACID ON OLEORESIN YIELD

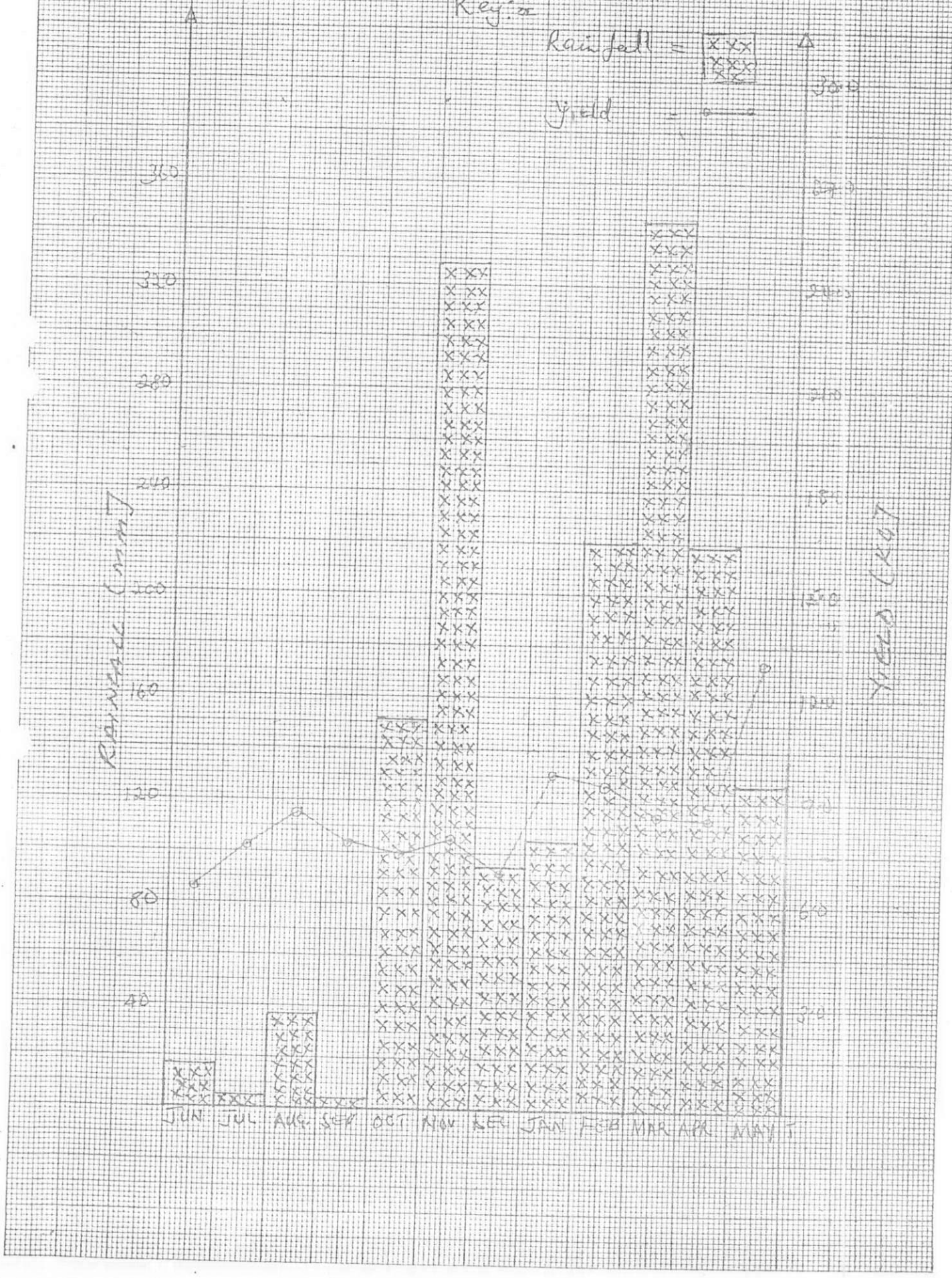
TREATMENT	MONTHS											RONGE:		
	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	TOTAL	AVER.
4-S1	2.147	2.200	1.544	2.158	2.003	2.352	2.561	2.862	2.724	2.922	3.867	5.226	32.61	2.72
4-S2	0.769	2.384	1.328	1.540	2.051	1.158	1.619	2.109	2.083	1.144	3.213	2.948	22.35	1.86
4-S3	0.342	1.800	1.328	1.156	0.904	0.269	0.855	0.682	1.541	0.916	0.817	0.883	11.49	0.96

Fig. 6 EFFECT OF FREQUENCY OF STREAKING AND APPL. OF ACID ON YLD OLEORESIN (RONGE)



With regard to species and seasonality on yield, it was observed that P. carribbeae produced more oleoresin than P. elliottii. Monthly oleoresin production for P. carribbeae was double the amount obtained from P. elliottii. Rainfall was the main parameter used in analysing influence of seasons on yield. Data on temperature is being aquired and will be incorporated later. Figure 7 shows the influence of rainfall on yield for Ronge station. The station has two rainfall seasons October-December (long rains) and March May (Short season). Oleoresin production was generally high in the month of August '89, January '90 and May '90. These appeared to be relatively dry months.

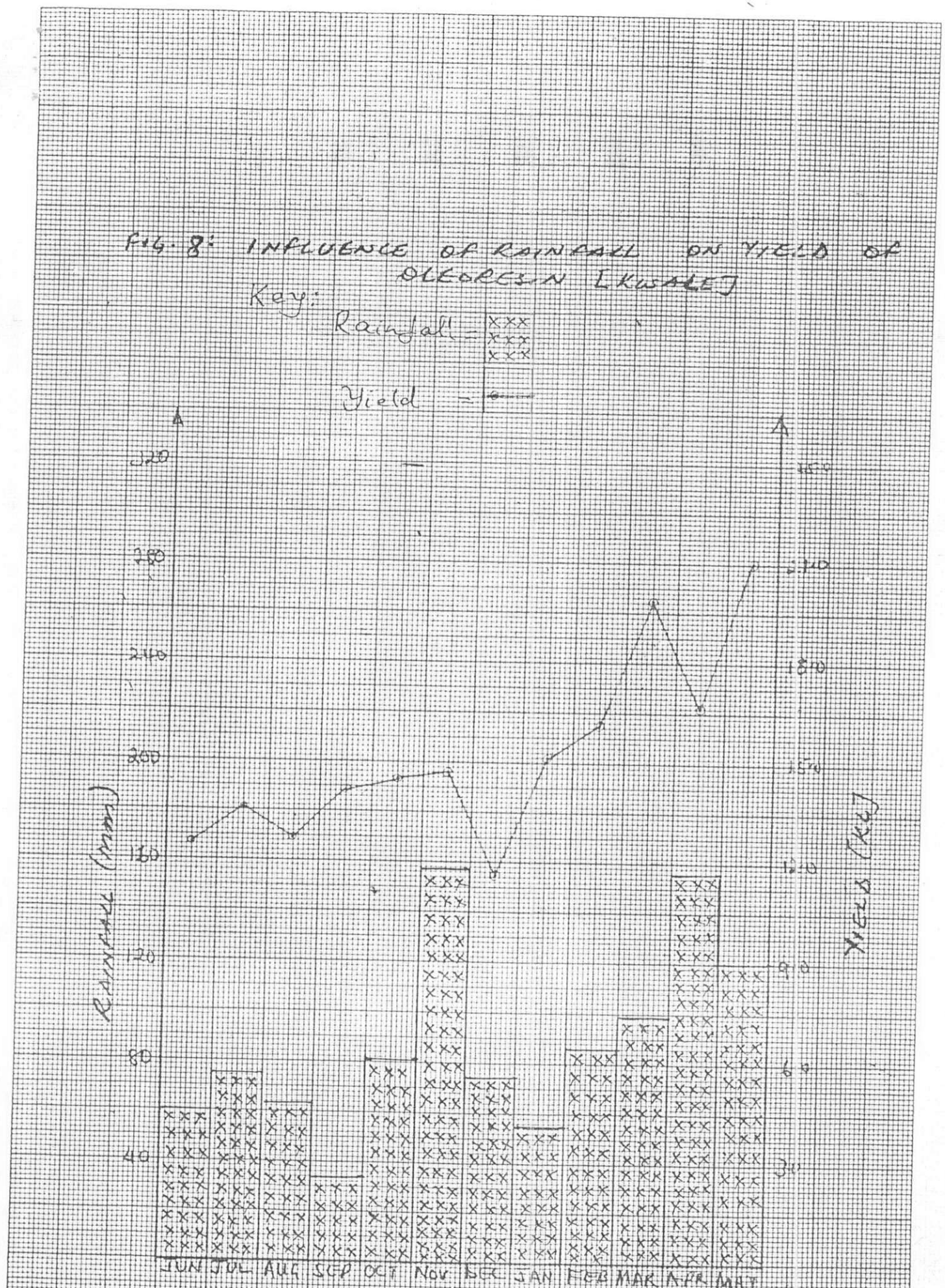
FIG. 7: INFLUENCE OF RAINFALL ON YIELD OF OLEORESIN [LONG].



Kwale receives rainfall throughout the year with highest amount in the month of March-May (fig. 8). However, Oleoresin yield seemed to increase throughout the year of tapping with peak production in the month of May '90.

Kwale

Fig. 8: INFLUENCE OF RAINFALL ON YIELD OF OLKOREST N LKWALE]



3.2. Discussion.

After one year of tapping, there appear to be a positive correlation between yield of oleoresin and tree diameter. This result is consistent with earlier studies (Harrington, 1969, Clements, 1972). In the present study, trees with dbh more than 30 cm produced 57% more oleoresin compared to those below 30 cm. The higher yield among trees of large diameter with well developed crown is due to higher proportion of resin canals and generally good growth vigour.

The positive correlation between yield and the number and width of the faces is clear. More faces per tree have more or less similar effect as face width since they result in opening up more resin canals. However, this needs to be examined carefully in relation to effect to tree growth. Because the operation involves opening the bark which is responsible for transportation of sap (food), there is need to compromise on the optimum number of working face and face width. It is worth to examine further the influence of two faces of 9 cm each on yield compared to the others and the aspect of sustained production.

On the part of streaking and application of acid on yield, there is no justification to change the present practice. However, there is a tendency of shortening the working cycles and

increased costs of acid. The need for coming up with an acid paste formulation is called for.

At present, Pinus caribbeae is a better yielder than P. elliottii. Whether this is because of site is not clear since the conditions of growth for the two species are quite different. P. caribbeae is growing under hot humid conditions along the coast while P. elliottii under generally cooler conditions. What is clear from the result is that P. caribbeae is equally a potential producer of oleoresin and a pilot study covering about 40,000 stems could be started. Good production is realised during the dry season preceeding the rains.