

# TAPPING EXPERIMENTS ON BUDDER TREES

## EXPERIMENTS ON PILMOOR ESTATE. I

BY

C. E. T. MANN, F. BILLINGTON AND K. N. KAIMAL

### Introduction

The experiments described in the present paper were carried out on young budded trees of a number of untested clones planted on Pilmoor Estate, Selangor, in late 1924. The history of the selection of the parent trees of these clones has been described by Sanderson and Sutcliffe (1) and details taken from the original records of budding and subsequent planting of the young budded trees are given in the present article for the sake of completeness in Table I.

### The Experimental Material and Methods

The experimental plot consists of an area of approximately 8 acres of flat land cleared from virgin jungle early in 1924. Surface timber and small jungle stumps were removed and a mixed cover of *Centrosema pubescens* and *Calapogonium mucunoides* was established.

The soil is a light, quartzite loam of moderate fertility. During the first three years, drainage was not good but this was remedied in 1928 and 1929 since when, drainage conditions have been very satisfactory. A plan of the plot showing the general distribution of the experimental material is given.

Planting was commenced in November and completed in December 1924 so that when experimental tapping was commenced in January, 1928, the trees were about 3 years old, age being reckoned from the date of planting. The buddings had been made in the nursery and allowed to develop for about 9 months before transplanting. They were then pruned to a height of 18 inches and planted out in the field as "stumped" buddings. The planting distance was 20 feet by 20 feet; a plan of the plot is given in Figure 1.

Clones were planted in successive blocks or rows, an arrangement which is simple and convenient for tapping and recording but detracts from the value of the experiment as regards comparisons between different clones. However, as the conditions over the whole plot are very uniform and the differences between clones are very large the failure to plant clones in replicated plots does not seriously affect the value of the most important results.

# PLAN OF EXPERIMENTAL PLOT, PILMOOR ESTATE.

CLONES

A8	A 44	B 50	B 58	B 84	B 90	C 72	D 61	D 29	B 65 A11	B 16	B 95 C94 E95	B 11 D 38
47	72	120 144 168	261	264 288 312 336	384	432	480 504	552 576 600 624 648	672 696 720 744 768	816 840 864 888 912 936 960	1008 1032 1056 1080	1152
22	46 70 94 118 142 166	190	238	286 310 334 358 382	406 430 454	526	550 574 598	622 646	670 694 718 742 766 790	814 838 862 886 910 934 958 982 1006 1030 1054	1078 1102 1126 1150	1200
21	45 69 93 117 141 165	189 213	261	285 309 333 357	381	405 429 453 477 501 525 549 573 597	621 645 669 693 717 741 765 789 813 837	861 885 909 933 957 981 1005 1029 1053 1077 1101 1125 1149 1173	1197 1221 1245 1269 1293 1317 1341 1365 1389 1413 1437 1461 1485 1509 1533 1557 1581 1605 1629 1653 1677 1701 1725 1749 1773 1797 1821 1845 1869 1893 1917 1941 1965 1989 2013 2037 2061 2085 2109 2133 2157 2181 2205 2229 2253 2277 2301 2325 2349 2373 2397 2421 2445 2469 2493 2517 2541 2565 2589 2613 2637 2661 2685 2709 2733 2757 2781 2805 2829 2853 2877 2901 2925 2949 2973 2997 3021 3045 3069 3093 3117 3141 3165 3189 3213 3237 3261 3285 3309 3333 3357 3381 3405 3429 3453 3477 3501 3525 3549 3573 3597 3621 3645 3669 3693 3717 3741 3765 3789 3813 3837 3861 3885 3909 3933 3957 3981 4005 4029 4053 4077 4101 4125 4149 4173 4197 4221 4245 4269 4293 4317 4341 4365 4389 4413 4437 4461 4485 4509 4533 4557 4581 4605 4629 4653 4677 4701 4725 4749 4773 4797 4821 4845 4869 4893 4917 4941 4965 4989 5013 5037 5061 5085 5109 5133 5157 5181 5205 5229 5253 5277 5301 5325 5349 5373 5397 5421 5445 5469 5493 5517 5541 5565 5589 5613 5637 5661 5685 5709 5733 5757 5781 5805 5829 5853 5877 5901 5925 5949 5973 5997 6021 6045 6069 6093 6117 6141 6165 6189 6213 6237 6261 6285 6309 6333 6357 6381 6405 6429 6453 6477 6501 6525 6549 6573 6597 6621 6645 6669 6693 6717 6741 6765 6789 6813 6837 6861 6885 6909 6933 6957 6981 7005 7029 7053 7077 7101 7125 7149 7173 7197 7221 7245 7269 7293 7317 7341 7365 7389 7413 7437 7461 7485 7509 7533 7557 7581 7605 7629 7653 7677 7701 7725 7749 7773 7797 7821 7845 7869 7893 7917 7941 7965 7989 8013 8037 8061 8085 8109 8133 8157 8181 8205 8229 8253 8277 8301 8325 8349 8373 8397 8421 8445 8469 8493 8517 8541 8565 8589 8613 8637 8661 8685 8709 8733 8757 8781 8805 8829 8853 8877 8901 8925 8949 8973 8997 9021 9045 9069 9093 9117 9141 9165 9189 9213 9237 9261 9285 9309 9333 9357 9381 9405 9429 9453 9477 9501 9525 9549 9573 9597 9621 9645 9669 9693 9717 9741 9765 9789 9813 9837 9861 9885 9909 9933 9957 9981 10005 10029 10053 10077 10101 10125 10149 10173 10197 10221 10245 10269 10293 10317 10341 10365 10389 10413 10437 10461 10485 10509 10533 10557 10581 10605 10629 10653 10677 10701 10725 10749 10773 10797 10821 10845 10869 10893 10917 10941 10965 10989 11013 11037 11061 11085 11109 11133 11157 11181 11205 11229 11253 11277 11301 11325 11349 11373 11397 11421 11445 11469 11493 11517 11541 11565 11589 11613 11637 11661 11685 11709 11733 11757 11781 11805 11829 11853 11877 11901 11925 11949 11973 11997 12021 12045 12069 12093 12117 12141 12165 12189 12213 12237 12261 12285 12309 12333 12357 12381 12405 12429 12453 12477 12501 12525 12549 12573 12597 12621 12645 12669 12693 12717 12741 12765 12789 12813 12837 12861 12885 12909 12933 12957 12981 13005 13029 13053 13077 13101 13125 13149 13173 13197 13221 13245 13269 13293 13317 13341 13365 13389 13413 13437 13461 13485 13509 13533 13557 13581 13605 13629 13653 13677 13701 13725 13749 13773 13797 13821 13845 13869 13893 13917 13941 13965 13989 14013 14037 14061 14085 14109 14133 14157 14181 14205 14229 14253 14277 14301 14325 14349 14373 14397 14421 14445 14469 14493 14517 14541 14565 14589 14613 14637 14661 14685 14709 14733 14757 14781 14805 14829 14853 14877 14901 14925 14949 14973 14997 15021 15045 15069 15093 15117 15141 15165 15189 15213 15237 15261 15285 15309 15333 15357 15381 15405 15429 15453 15477 15501 15525 15549 15573 15597 15621 15645 15669 15693 15717 15741 15765 15789 15813 15837 15861 15885 15909 15933 15957 15981 16005 16029 16053 16077 16101 16125 16149 16173 16197 16221 16245 16269 16293 16317 16341 16365 16389 16413 16437 16461 16485 16509 16533 16557 16581 16605 16629 16653 16677 16701 16725 16749 16773 16797 16821 16845 16869 16893 16917 16941 16965 16989 17013 17037 17061 17085 17109 17133 17157 17181 17205 17229 17253 17277 17301 17325 17349 17373 17397 17421 17445 17469 17493 17517 17541 17565 17589 17613 17637 17661 17685 17709 17733 17757 17781 17805 17829 17853 17877 17901 17925 17949 17973 17997 18021 18045 18069 18093 18117 18141 18165 18189 18213 18237 18261 18285 18309 18333 18357 18381 18405 18429 18453 18477 18501 18525 18549 18573 18597 18621 18645 18669 18693 18717 18741 18765 18789 18813 18837 18861 18885 18909 18933 18957 18981 19005 19029 19053 19077 19101 19125 19149 19173 19197 19221 19245 19269 19293 19317 19341 19365 19389 19413 19437 19461 19485 19509 19533 19557 19581 19605 19629 19653 19677 19701 19725 19749 19773 19797 19821 19845 19869 19893 19917 19941 19965 19989 20013 20037 20061 20085 20109 20133 20157 20181 20205 20229 20253 20277 20301 20325 20349 20373 20397 20421 20445 20469 20493 20517 20541 20565 20589 20613 20637 20661 20685 20709 20733 20757 20781 20805 20829 20853 20877 20901 20925 20949 20973 20997 21021 21045 21069 21093 21117 21141 21165 21189 21213 21237 21261 21285 21309 21333 21357 21381 21405 21429 21453 21477 21501 21525 21549 21573 21597 21621 21645 21669 21693 21717 21741 21765 21789 21813 21837 21861 21885 21909 21933 21957 21981 22005 22029 22053 22077 22101 22125 22149 22173 22197 22221 22245 22269 22293 22317 22341 22365 22389 22413 22437 22461 22485 22509 22533 22557 22581 22605 22629 22653 22677 22701 22725 22749 22773 22797 22821 22845 22869 22893 22917 22941 22965 22989 23013 23037 23061 23085 23109 23133 23157 23181 23205 23229 23253 23277 23301 23325 23349 23373 23397 23421 23445 23469 23493 23517 23541 23565 23589 23613 23637 23661 23685 23709 23733 23757 23781 23805 23829 23853 23877 23901 23925 23949 23973 23997 24021 24045 24069 24093 24117 24141 24165 24189 24213 24237 24261 24285 24309 24333 24357 24381 24405 24429 24453 24477 24501 24525 24549 24573 24597 24621 24645 24669 24693 24717 24741 24765 24789 24813 24837 24861 24885 24909 24933 24957 24981 25005 25029 25053 25077 25101 25125 25149 25173 25197 25221 25245 25269 25293 25317 25341 25365 25389 25413 25437 25461 25485 25509 25533 25557 25581 25605 25629 25653 25677 25701 25725 25749 25773 25797 25821 25845 25869 25893 25917 25941 25965 25989 26013 26037 26061 26085 26109 26133 26157 26181 26205 26229 26253 26277 26301 26325 26349 26373 26397 26421 26445 26469 26493 26517 26541 26565 26589 26613 26637 26661 26685 26709 26733 26757 26781 26805 26829 26853 26877 26901 26925 26949 26973 26997 27021 27045 27069 27093 27117 27141 27165 27189 27213 27237 27261 27285 27309 27333 27357 27381 27405 27429 27453 27477 27501 27525 27549 27573 27597 27621 27645 27669 27693 27717 27741 27765 27789 27813 27837 27861 27885 27909 27933 27957 27981 28005 28029 28053 28077 28101 28125 28149 28173 28197 28221 28245 28269 28293 28317 28341 28365 28389 28413 28437 28461 28485 28509 28533 28557 28581 28605 28629 28653 28677 28701 28725 28749 28773 28797 28821 28845 28869 28893 28917 28941 28965 28989 29013 29037 29061 29085 29109 29133 29157 29181 29205 29229 29253 29277 29301 29325 29349 29373 29397 29421 29445 29469 29493 29517 29541 29565 29589 29613 29637 29661 29685 29709 29733 29757 29781 29805 29829 29853 29877 29901 29925 29949 29973 29997 30021 30045 30069 30093 30117 30141 30165 30189 30213 30237 30261 30285 30309 30333 30357 30381 30405 30429 30453 30477 30501 30525 30549 30573 30597 30621 30645 30669 30693 30717 30741 30765 30789 30813 30837 30861 30885 30909 30933 30957 30981 31005 31029 31053 31077 31101 31125 31149 31173 31197 31221 31245 31269 31293 31317 31341 31365 31389 31413 31437 31461 31485 31509 31533 31557 31581 31605 31629 31653 31677 31701 31725 31749 31773 31797 31821 31845 31869 31893 31917 31941 31965 31989 32013 32037 32061 32085 32109 32133 32157 32181 32205 32229 32253 32277 32301 32325 32349 32373 32397 32421 32445 32469 32493 32517 32541 32565 32589 32613 32637 32661 32685 32709 32733 32757 32781 32805 32829 32853 32877 32901 32925 32949 32973 32997 33021 33045 33069 33093 33117 33141 33165 33189 33213 33237 33261 33285 33309 33333 33357 33381 33405 33429 33453 33477 33501 33525 33549 33573 33597 33621 33645 33669 33693 33717 33741 33765 33789 33813 33837 33861 33885 33909 33933 33957 33981 34005 34029 34053 34077 34101 34125 34149 34173 34197 34221 34245 34269 34293 34317 34341 34365 34389 34413 34437 34461 34485 34509 34533 34557 34581 34605 34629 34653 34677 34701 34725 34749 34773 34797 34821 34845 34869 34893 34917 34941 34965 34989 35013 35037 35061 35085 35109 35133 35157 35181 35205 35229 35253 35277 35301 35325 35349 35373 35397 35421 35445 35469 35493 35517 35541 35565 35589 35613 35637 35661 35685 35709 35733 35757 35781 35805 35829 35853 35877 35901 35925 35949 35973 35997 36021 36045 36069 36093 36117 36141 36165 36189 36213 36237 36261 36285 36309 36333 36357 36381 36405 36429 36453 36477 36501 36525 36549 36573 36597 36621 36645 36669 36693 36717 36741 36765 36789 36813 36837 36861 36885 36909 36933 36957 36981 37005 37029 37053 37077 37101 37125 37149 37173 37197 37221 37245 37269 37293 37317 37341 37365 37389 37413 37437 37461 37485 37509 37533 37557 37581 37605 37629 37653 37677 37701 37725 37749 37773 37797 37821 37845 37869 37893 37917 37941 37965 37989 38013 38037 38061 38085 38109 38133 38157 38181 38205 38229 38253 38277 38301 38325 38349 38373 38397 38421 38445 38469 38493 38517 38541 38565 38589 38613 38637 38661 38685 38709 38733 38757 38781 38805 38829 38853 38877 38901 38925 38949 38973 38997 39021 39045 39069 39093 39117 39141 39165 39189 39213 39237 39261 39285 39309 39333 39357 39381 39405 39429 39453 39477 39501 39525 39549 39573 39597 39621 39645 39669 39693 39717 39741 39765 39789 39813 39837 39861 39885 39909 39933 39957 39981 40005 40029 40053 40077 40101 40125 40149 40173 40197 40221 40245 40269 40293 40317 40341 40365 40389 40413 40437 40461 40485 40509 40533 40557 40581 40605 40629 40653 40677 40701 40725 40749 40773 40797 40821 40845 40869 40893 40917 40941 40965 40989 41013 41037 41061 41085 41109 41133 41157 41181 41205 41229 41253 41277 41301 41325 41349 41373 41397 41421 41445 41469 41493 41517 41541 41565 41589 41613 41637 41661 41685 41709 41733 41757 41781 41805 41829 41853 41877 41901 41925 41949 41973 41997 42021 42045 42069 42093 42117 42141 42165 42189 42213 42237 42261 42285 42309 42333 42357 42381 42405 42429 42453 42477 42501 42525 42549 42573 42597 42621 42645 42669 42693 42717 42741 42765 42789 42813 42837 42861 42885 42909 42933 42957 42981 43005 43029 43053 43077 43101 43125 43149 43173 43197 43221 43245 43269 43293 43317 43341 43365 43389 43413 43437 43461 43485 43509 43533 43557 43581 43605 43629 43653 43677 43701 43725 43749 43773 43797 43821 43845 43869 43893 43917 43941 43965 43989 44013 44037 44061 44085 44109 44133 44157 44181 44205 44229 44253 44277 44301 44325 44349 44373 44397 44421 44445 44469 44493 44517 44541 44565 44589 44613 44637 44661 44685 44709 44733 44757 44781 44805 44829 44853 44877 44901 44925 44949 44973 44997 45021 45045 45069 45093 45117 45141 45165 45189 45213 45237 45261 45285 45309 45333 45357 45381 45405 45429 45453 45477 45501 45525 45549 45573 45597 45621 45645 45669 45693 45717 45741 45765 45789 45813 45837 45861 45885 45909 45933 45957 45981 46005 46029 46053 46077 46101 46125 46149 46173 46197 46221 46245 46269 46293 46317 46341 46365 46389 46413 46437 46461 46485 46509 46533 46557 46581 46605 46629 46653 46677 46701 46725 46749 46773 46797 46821 46845 46869 46893 46917 46941 46965 46989 47013 47037 47061 47085 47109 47133 47157 47181 47205 47229 47253 47277 47301 47325 47349 47373 47397 47421 47445 47469 47493 47517 47541 47565 47589 47613 47637 47661 47685 47709 47733 47757 47781 47805 47829 47853 47877 47901 47925 47949 47973 47997 48021 48045 48069 48093 48117 48141 48165 48189 48213 48237 48261 48285 48309 48333 48357 48381 48405 48429 48453 484			

The general maintenance of the area has been carried out according to normal good estate practice but during the first two years careful pruning of side branches on the young buddings did not receive sufficient attention. As a result, the plot contains a rather large proportion of trees with low branches and crooked trunks. This is especially noticeable in clone A. 44, for the buddings of this clone have a strong tendency to branch early, producing strong lateral branches one of which may replace the true terminal shoot. This branching habit can be easily controlled but, if early pruning is neglected, an irregular main trunk results. In this respect the Pilmoor clone A.44 resembles the AVROS clone 152.

In December, 1927, girth measurements were taken on all trees in the experimental area. Girth was measured at a height of 40 inches from the union. Examination of the figures showed that quite a fair proportion of the trees exceeded 15.5 inches in girth and, as this had been considered by previous workers to be a suitable standard for commencement of test-tapping, it was decided to commence tapping experiments in January, 1928. Preliminary tests showed that the tapping of trees having a girth considerably less than 15.5 inches presented no difficulty and finally all trees over 13 inches in girth at a height of 40 inches from the union were included in the tests. In Table I the numbers and percentages of tappable trees in each clone are summarised. Losses between planting and commencement of these tests are accounted for by root disease, wind damage and the growth of seedling shoots from the original stocks where the scions had failed to shoot after pruning.

#### CHOICE OF TAPPING SYSTEM AND PROCEDURE

In view of the tender age of the trees it was considered desirable to adopt a very light tapping system and to introduce frequent rest periods between successive tests. It was therefore decided to tap alternate daily for one month (16 tappings) followed by one month of rest, and to continue the tests on the same lines so long as no ill effects on the trees became apparent.

In clone A.44, since a large number of trees was available, tapping was also carried out every third day in alternate months on a second group of trees.

Trees were marked for tapping with a single left to right cut at an angle of  $30^\circ$  so that the lowest point of the cut was at a height of 20 inches (50 cms.) above the union. Owing to a mistake in the instructions given for marking the trees in preparation for tapping, the original tapping cuts were all marked at a standard length of 8 inches. This length of tapping cut was exactly equivalent to half the circumference on the smallest trees but was slightly less than a half circumference cut on the largest trees. The

error was corrected during the second tapping period and subsequently all trees were tapped over half the circumference.

One Tamil tapper was employed throughout the tests. Tapping commenced at 6.15 a.m. and was completed at about 8.30 a.m. and the order of tapping was changed on each tapping day. On wet mornings the trees were tapped late so that the full number of 16 tapings was obtained in each period.

#### METHOD OF RECORDING YIELDS

At each tapping, latex was coagulated in the cup with a few drops of 5 per cent. solution of acetic acid, the coagulum pressed into a rough biscuit and hung on a labelled wire hook attached to the tree. The small amounts of "cut" scrap and cup film were added to the latex at each tapping. At the end of each week samples were collected, creped separately, dried and weighed at the laboratory. Records of total yield in grams of dry rubber per tree per tapping were obtained.

### Experimental Results

#### GENERAL OBSERVATIONS

The summary of results presented in Table I brings out a number of important points. The results obtained again confirm that, by vegetative propagation, it is possible to produce from certain selected parent trees buddings which are capable of giving high yields at an early age. The actual yields recorded for the most promising clones, A. 44, B.84 and B.58, compare very favourably with the yields recorded for some of the best known proved clones e.g. AVROS 49, at comparable age.

The parent trees are arranged in order of yield merit and it is at once apparent that, if they are judged on the basis of these early tapping tests on their budded offspring, the highest yielding parent trees do not necessarily give the highest yielding clones. For example, the highest yielding parent tree gave the fourth highest yielding clone, and the fourth highest parent tree gave the second best clone. Buddings from parent tree B.90 gave practically no latex during the first tapping period and, even during the second period, the flow of latex was hardly sufficient to reach the tapping cup. Yet, the parent tree gave a very good yield for a seven year old tree and was the sixth highest yielder in a group of 500 trees.

After the first tapping period the poorest clones were omitted from the tests. After the third tapping period, completed in June, tapping of clones C.72, D.29, E.95, B.95 and D.65 was discontinued. Clone C.72 was abandoned on account of the weak branching habit of the trees. Every strong wind resulted in two or three casualties

TABLE I

*Records of the Parent Trees, Establishment of Buddings, and a Summary of the Results of Test Tapping of Buddings in 1928*

Parent Tree	Parent trees 1922-1923 (Age 7 to 8 years)				Mean yield in grams per tapping	Buddings 1928 (Age 3 to 4 years)									
	Girth in inches at height of 20 inches	Numbers of latex vessel rows at heights of:-				Date of Budding	No. of buddings planted November to Dec. 1924	Number growing in December 1927	Number of trees tapped January 1928	Percent-age of tappable trees	Summary of Records of buddings tapped in 1928				Order of Merit based on yield
		5 inches	10 inches	20 inches							Mean girth in inches at height of 40 inches December 1927	Mean girth in inches at height of 40 inches January 1929	Number of tappings	Mean yield in grams per tree per tapping in 1928	
B. 58	44	15	14	11	42.3	1924 Jan.	90	80	21	25.1	14.4	18.5	96	7.3	4
A. 44	42	...	14	12	42.1	1923 Dec.	145	133	30	22.5	14.3	18.7	96	12.5	1
C. 72	47	21	19	14	34.8	1924 Feb.	153	120	66	55.0	15.4	20.1	48	3.5	8
B. 84	41	27	21	20	28.7	" "	50	40	20	50.0	15.4	20.5	96	10.8	2
A. 8	41	...	18	17	28.2	1923 Dec.	28	26	...	...	...	...	...	...	...
B. 90	43	20	17	16	27.3	1924 Feb.	132	105	45	42.9	15.8	21.0	...	...	...
D. 61	43	24	19	17	26.3	" Mar.	50	35	1	2.8	15.8	20.5	96	10.4	3
D. 38	46	20	20	18	25.8	" Jun.	36	26	...	...	...	...	...	...	...
B. 65	33	13	11	10	25.3	" Mar.	40	27	...	...	...	...	...	...	...
D. 29	36	20	19	17	25.1	" "	46	32	18	56.3	14.7	23.7	48	2.7	9
E. 95	42	31	27	20	24.5	" May	26	15	3	20.0	15.4	21.8	48	3.6	7
B. 16	37	13	10	9	24.3	" Apr.	116	92	...	...	...	...	...	...	...
A. 11	44	...	15	12	24.1	" "	28	18	2	11.1	15.4	21.5	16	1.7	11
E. 41	44	24	24	19	23.6	" "	11	7	...	...	...	...	...	...	...
B. 50	40	32	20	18	22.8	" Jan.	81	68	17	25.0	14.1	18.9	96	5.2	5
B. 95	45	26	22	22	22.8	" Apr.	55	45	7	15.5	14.2	20.9	48	2.1	10
C. 94	45	17	14	11	21.5	" "	33	25	...	...	...	...	...	...	...
E. 43	38	19	16	13	20.4	" Mar.	13	9	2	22.2	14.3	20.0	16	1.4	12
D. 65	33	15	13	10	17.7	" "	6	5	2	40.0	15.1	18.6	48	4.7	6
A. 87	45	...	35	22	12.2	" May	4	2	...	...	...	...	...	...	...
B. 11	44	26	21	17	10.1	" "	27	15	1	6.7	16.0	21.8	16	0.2	13

and it was felt to be a waste of time to continue work on a clone possessing this undesirable weakness. Clones D.29, E.95, B.90 and B.95 were omitted on account of their low yields. Tapping of clone D.65 was discontinued on account of the small number of trees available. The yields recorded for the two trees in tapping were quite good but it was considered best to run no risk of damaging the trees at this stage, in view of the fact that only five buddings were available for future work.

It must be emphasised that a reliable comparison of the clones cannot be made on the basis of these early tests. Only the largest trees of the most vigorous clones had reached the arbitrary standard of girth regarded as necessary for the initiation of test tapping. It is possible that some of the clones of less vigorous growth may prove to be as good as, or even superior to those included in the present tests. Later experiments will decide this point; in the meantime it is proposed to describe in more detail the records obtained on the most promising clones tested in this first investigation.

#### RECORDS OF THE YIELDS OF INDIVIDUAL TREES OF CLONES A.44, B.84 AND B.58

Tapping was carried out on alternate days for six periods.

1st period	January	10th	to	February	9th 1928	...	16	tappings
2nd	„	March	12th	„	April	11th	„	do
3rd	„	May	12th	„	June	11th	„	do
4th	„	July	12th	„	August	11th	„	do
5th	„	September	12th	„	October	12th	„	do
6th	„	November	9th	„	December	9th	„	do

Total tapping days :—96

In Table II the average yield per tree in grams of dry rubber per tapping during each period is given, together with the mean yield for each tree over the whole year. Girth measurements, taken at the beginning and again after the conclusion of the tests in January, 1929, are also given.

The figures reveal a very high degree of uniformity in the yields of the trees of the same clone; in general the largest trees of each clone are the highest producers. The actual statistics for the correlation between tree girth and yield have not been included on account of the small number of trees available in each clone. Since only the best trees of each clone could be tapped, statistical examination of the limited data from these would not give a true indication of the variation within the clone.

TABLE II

*Summary of Growth and Yield Records of budded Trees of Clones A.44, B.84, and B.58.*

Tapped on half circumference alternate daily with alternate monthly  
Periods of Tapping and Rest.

CLONE	TREE NUMBER	Girth at height of 40 inches from the union		Yield in grams dry rubber per tapping on successive monthly periods.						Average Yield per tree per tapping grams
		Dec. 1927 inches cms.	Jan. 1929 inches cms.	1st	2nd	3rd	4th	5th	6th	
A 44	40	14.0 35.6	19.5 49.5	5.6	6.8	9.3	10.8	14.3	18.1	10.8
	109	14.0 35.6	18.8 47.8	7.4	5.9	9.9	11.9	14.3	16.5	11.0
	114	14.8 37.6	18.8 47.8	7.3	7.6	11.0	11.6	13.9	21.2	12.1
	116	15.0 38.1	17.5 44.5	14.2	13.1	17.3	19.8	22.7	26.0	18.9
	138	15.5 39.4	19.8 50.3	8.7	10.0	14.0	16.6	17.8	21.9	14.8
	156	16.3 41.4	18.8 47.8	10.7	9.8	13.4	16.0	18.3	20.7	14.8
	165	16.3 41.4	20.3 51.6	6.9	9.7	13.3	19.7	20.2	24.5	15.7
	168	14.8 37.6	20.0 50.8	7.6	6.3	11.2	14.5	15.9	22.7	13.0
	46	13.5 34.3	19.0 48.3	...	8.8	8.0	10.7	12.5	16.8	11.3
	87	13.5 34.3	17.5 44.5	...	9.3	8.6	10.8	13.9	15.9	11.7
	92	13.5 34.3	17.3 43.9	...	9.9	7.6	8.1	10.1	13.0	9.7
	145	13.5 34.3	19.5 49.5	...	10.4	9.6	13.1	15.8	17.6	13.3
	148	13.5 34.3	18.8 47.8	...	10.6	13.0	12.7	15.7	18.3	14.1
	160	13.5 33.8	17.0 43.2	...	8.1	7.5	10.5	11.0	13.6	10.2
	172	13.2 33.5	17.5 44.5	...	6.4	7.0	7.9	11.4	12.7	9.1
Mean	15 trees	14.3 36.3	18.7 47.5	8.6	8.8	10.7	13.0	15.2	18.6	12.7

TABLE II—(Continued)

CLONE	TREE NUMBER	Girth at height of 40 inches from the union		Yield in grams dry rubber per tapping in successive monthly periods						Average yield per tree per tapping grams
		Dec. 1927 inches cms.	Jan. 1928 inches cms.	1st	2nd	3rd	4th	5th	6th	
B. 84	346	16.9 40.6	21.2 53.8	2.3	7.0	8.4	10.6	13.2	23.2	10.8
	351	15.3 38.9	21.5 54.6	4.0	7.3	11.2	10.5	12.9	21.1	11.2
	353	16.0 40.6	21.3 54.1	2.2	6.1	8.9	12.5	11.4	20.3	10.2
	354	14.0 35.5	19.7 50.0	3.0	7.6	10.0	10.8	11.3	15.7	9.7
	355	17.0 43.2	21.0 53.3	2.7	7.7	11.3	13.8	15.6	20.9	12.0
	356	16.8 42.7	21.0 53.3	3.2	5.6	9.5	12.5	15.4	20.9	11.2
	358	15.8 40.1	20.0 50.8	3.9	8.4	8.5	13.9	14.7	20.6	11.7
	365	14.8 37.6	19.5 49.5	2.0	4.9	6.6	11.5	14.7	25.3	10.8
	368	15.8 40.1	20.3 51.6	2.3	5.2	8.4	12.8	14.1	21.7	10.8
	370	14.3 36.3	19.3 49.0	2.6	8.6	7.4	10.7	13.1	21.0	10.6
	374	16.5 41.9	21.5 54.6	3.2	6.5	9.8	10.9	12.4	17.8	10.1
	379	17.8 45.2	23.0 58.4	2.8	8.3	10.6	13.9	12.9	22.0	11.8
	382	19.0 48.3	27.5 69.9	2.4	6.2	7.6	12.5	13.8	18.7	10.2
	392	16.5 41.9	21.5 54.6	2.2	8.2	13.6	16.9	19.4	36.3	16.1
	397	14.5 36.8	19.0 48.3	2.8	7.6	10.6	12.7	13.9	22.6	11.7
	347	13.3 33.8	18.0 45.7	...	7.1	9.4	13.8	14.6	21.8	13.3
	364	13.8 35.3	18.8 47.8	...	5.9	7.2	11.1	13.3	18.2	11.1
	375	13.0 33.0	17.7 45.0	...	5.4	7.2	10.9	14.0	21.1	11.7
	381	13.8 35.3	19.0 48.3	...	3.3	6.0	8.6	10.5	14.6	8.6
	390	13.3 33.8	13.3 47.5	...	4.3	6.7	8.6	10.5	15.9	9.2
Mean	20 trees	15.4 39.1	20.5 52.1	2.8	6.6	8.9	12.0	13.6	21.0	11.1



TABLE II—(Continued)

CLONE	TREE NUMBER	Girth at height of 40 inches from the union		Yield in grams dry rubber per tapping in successive monthly periods						Average Yield per tree per tapping grams.
		Dec. 1927 inches cms.	Jan. 1927 inches cms.	1st	2nd	3rd	4th	5th	6th	
B. 58		15.3	18.3							
	257	38.9	47.5	1.9	7.2	5.9	5.5	6.7	13.1	6.7
		15.8	19.2							
	265	40.1	48.8	3.0	8.3	9.2	8.4	8.7	20.4	9.7
		14.3	18.0							
	272	36.3	45.7	2.8	6.0	6.3	7.3	7.3	12.4	7.0
		16.8	22.7							
	275	42.7	57.7	2.5	5.7	7.8	10.1	12.1	22.9	10.2
		15.3	18.3							
	276	38.9	47.5	2.4	6.8	5.8	4.7	5.4	14.0	6.5
		14.3	16.5							
	282	36.3	41.9	1.9	5.2	4.8	3.4	5.6	14.6	5.9
		14.5	18.6							
	287	36.8	47.2	2.2	5.6	7.1	7.7	9.2	19.8	6.6
		14.0	19.0							
	295	35.6	48.3	2.2	5.3	5.3	6.5	8.6	19.5	7.9
		14.3	18.0							
	311	36.3	45.7	2.0	4.5	5.3	5.8	8.9	21.9	8.1
		14.0	18.0							
	317	35.6	45.7	1.5	4.3	3.0	4.8	5.5	12.9	5.3
		15.5	20.2							
	324	39.4	51.3	1.9	4.4	5.8	6.9	6.7	17.1	7.1
		15.0	19.0							
	333	38.1	48.3	1.7	5.4	5.1	5.5	6.3	15.4	6.6
		14.0	18.0							
	335	35.6	45.7	2.5	6.8	5.5	4.6	8.6	16.6	7.4
		14.5	18.3							
	340	36.8	47.5	3.1	6.8	6.8	8.8	12.2	21.4	9.9
		13.8	18.0							
	269	35.3	45.6	...	3.1	3.5	3.4	4.9	12.2	5.4
		13.8	18.7							
	278	35.3	47.5	...	4.7	4.6	4.6	5.6	14.6	6.8
		13.5	17.0							
	279	34.3	43.2	...	4.8	5.9	4.9	5.6	13.6	6.4
		13.3	17.5							
	286	33.8	44.5	...	2.3	3.8	4.4	5.3	9.6	5.1
		13.5	19.0							
	291	34.3	48.3	...	7.3	9.5	8.4	14.2	26.0	13.1
		13.5	18.0							
	315	34.3	45.7	...	3.9	5.7	6.8	9.4	17.5	8.7
		13.0	17.5							
	331	33.0	44.5	...	3.4	4.2	4.9	5.5	13.7	6.3
Mean	21 trees	14.4 36.6	18.5 47.0	2.3	5.3	5.6	6.1	7.7	16.6	7.3

TABLE III  
*Mean Yield per Tree on successive tapping Days*  
 (Each figure is a mean of six records)

CLONE	Yield in grams of dry rubber per tree per tapping																Mean yield in grams per tapping
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
A. 44	6.2	9.0	11.6	12.7	<b>16.0</b>	15.8	15.7	14.8	13.6	13.3	12.5	12.7	11.7	11.8	11.1	11.3	<b>12.5</b>
B. 84	4.8	7.6	10.9	11.2	13.0	13.1	<b>13.2</b>	11.7	11.4	11.6	10.7	11.1	10.7	10.5	9.9	10.6	<b>10.8</b>
B. 58	2.4	4.4	5.6	6.1	8.7	<b>9.7</b>	9.4	8.7	8.0	8.2	7.6	8.0	7.7	7.8	7.8	8.1	<b>7.4</b>

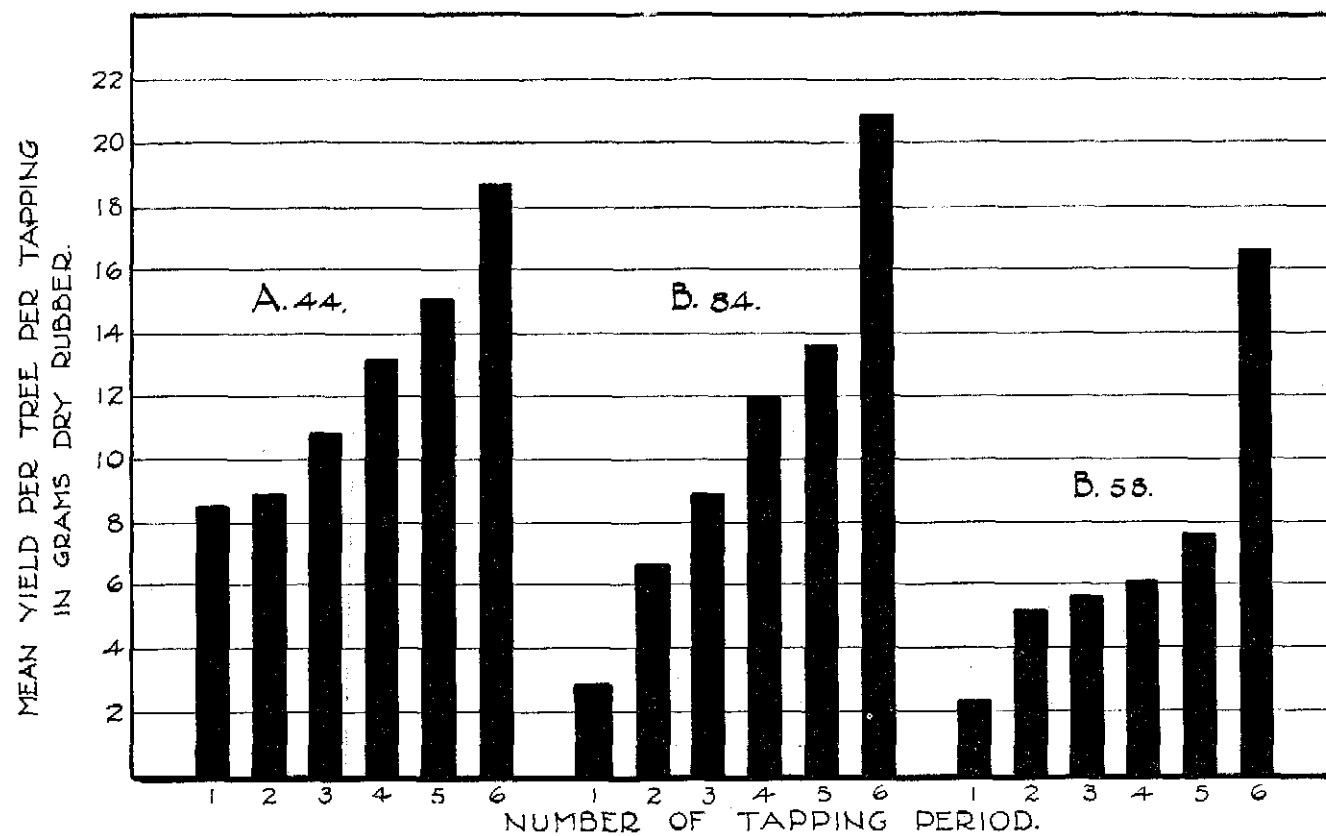


FIGURE 2  
Illustrating the progressive increase in yield of Clones A.44, B.84 and B.58

# COMPARISON OF THE RESPONSES OF DIFFERENT CLONES TO THE SAME TAPPING SYSTEM

The initial high yield of Clone A.44 in the first tapping period in comparison with the yields of Clones B.84 and B.58 is noteworthy. It seems that clone A.44 responds much more rapidly than either of the other clones to the stimulus of tapping. Incidentally the records show how misleading the results of a short period of test tapping may be in judging the relative values of clones at an early age.

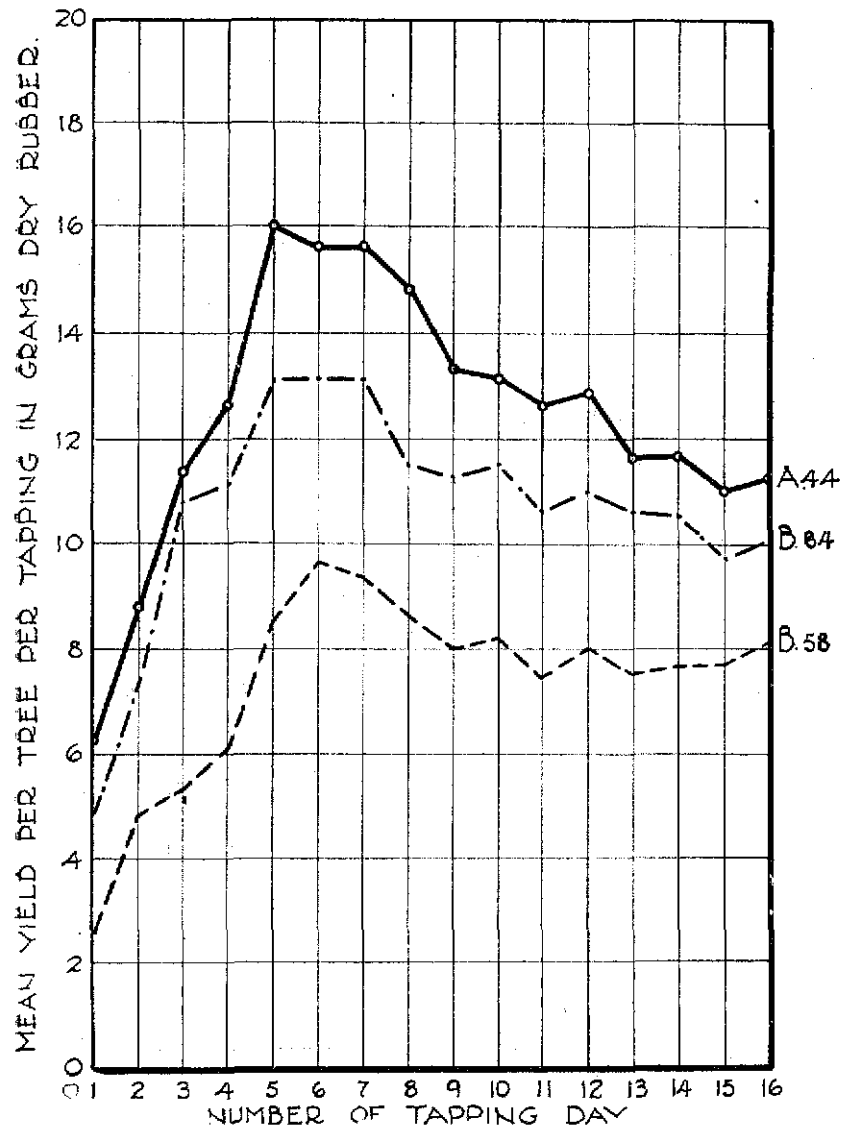


FIGURE 3  
Illustrating the course of yield increase during an average tapping period

The rates of increase in yield of the three clones are illustrated graphically in Figure 2.

The response to tapping is further examined in more detail from the daily records of yield in the six periods of test-tapping. For each clone the mean daily yield per tree on the first, second and successive tapping days has been calculated. The results are presented in Table III. and illustrated in Figure 3.

The yield of clone A.44 rises to a sharp maximum value about the 5th day and then falls somewhat rapidly to a minimum value on the 15th day. In clones B.84 and B.58 the yield rises much more gradually to a maximum value on the 6th or 7th day and thereafter the decline in yield is much less rapid than in clone A.44. These differences between the clones in response to tapping have been further investigated in a later experiment and will be discussed in more detail in the next paper of this series. Holder and Heusser have shown a similar variation in response of different clones to a uniform tapping system. (2)

#### THIRD DAILY TAPPING IN ALTERNATE MONTHS

When these experiments were started the influence of tapping at a very early age on the behaviour of the trees was not known and a lighter tapping system was therefore tested for comparison with the general system of alternate daily tapping in alternate months. Unfortunately, only in clone A.44 were sufficient trees available for this test but the results given in Table IV are of interest.

TABLE IV

*Comparison between the Results of Test Tapping on Clone A.44*

(a) Alternate daily in alternate months

(b) Third daily in alternate months

Tapping system	No. of trees	Girth at height of 40 inches from union		Yield in grams of dry rubber per tapping in comparable periods					Mean yield per tree per tapping (grams)
		Dec. 1927 (inches) (cms)	Jan. 1929 (inches) (cms)	1st	2nd	3rd	4th	5th	
(a) Alternate daily	15	14.3 36.3	18.7 47.5	8.8	10.7	13.0	15.0	18.6	13.2
(b) 3rd daily	15	14.2 36.1	18.6 47.2	7.0	10.1	12.4	15.5	21.8	13.4

There is close agreement between the two series of records presented in Table IV, yet the trees in group (a) tapped alternate daily, received 80 tappings whilst those in group (b) tapped third daily, received only 55 tappings. The total weight of rubber harvested from the two groups of trees was almost exactly proportional to the number of tapping days. Had the alternate daily tapping system been too severe, one would expect a lower average yield from the trees that were being too severely taxed. That no evidence of this is found in the results obtained on clone A.44 suggests that tapping of young budded trees from 3 to 4 years of age on an alternate daily alternate monthly system can be undertaken without detriment to the trees. During the period of test the average girth of the trees increased from 14.3 to 18.7 inches and a similar satisfactory rate of growth was recorded in the other clones tapped (see Table I). Not a single tree showed any signs of brown bast during the whole period of the tests. At the conclusion of the tests an examination of virgin and renewed bark was made on the trees which had been test-tapped. The results of this examination, which have already been reported (3), showed bark renewal, in the early stages, to be very satisfactory.

### Notes on the Characters of Individual Clones

#### CLONE A.44

Growth of the trees is moderately vigorous. The main trunks require careful pruning when young, otherwise ugly irregularities may develop. Branching is strong, the lateral branches making a wide angle with the trunk. The crown is globular being built up of a large number of spreading branches of equal strength. The bark is smooth and greyish and shows rather pronounced swellings near the dormant buds. Though the yield of this clone in the test tapping period was extremely good, the vegetative characters are not pleasing.

#### CLONE B.58

Growth is less robust than in any other clone in the experimental block but the buddings appear perfectly healthy. Trunks are erect and slender, branches are strong and well spaced, forming a conical well-shaped crown. The bark is rough and grey-brown in colour.

#### CLONE B.84

This is one of the most vigorous clones in the collection and one of the most attractive in appearance. Trunks are strong and erect; the union with the stock is very smooth and, as the bark is deep brown, rough and considerably more corky than is usual in

budded trees, it is sometimes difficult to distinguish a budding of this clone from a well grown seedling tree. Branches are very strong and slightly spreading, forming a somewhat heavy crown.

#### CLONE D.61

Only one tree of this clone was tapped but since this tree gave a very satisfactory yield it may be of interest to give further details. The parent tree of this clone was chosen as a brown bast subject with a high yield. The buddings are not attractive trees and already the trunks of most of the trees show signs of burr development. The high yield, provided that later tests confirm the results of the early tapping, is about the only good character which this clone possesses.

#### CLONE D.65

The five buddings of this clone are remarkably uniform in appearance. Trunks are erect and sparsely branched. Bark is smooth and greyish. In general form the buddings are very similar in appearance to those of clone AVROS 50.

The remaining clones, since they do not appear to possess the necessary high yielding characters, do not merit detailed description at this stage.

### Summary

1. A method of test-tapping of young budded trees from 3 to 4 years of age is described.
2. It is shown that young buddings, having reached a certain stage of development, indicated by a minimum girth of 13 inches at a height of 40 inches from the union, can be tapped for the purpose of selection, on an alternate daily alternate monthly system for one year without any apparent detriment to their health and vigour of growth.
3. The results of early tapping tests indicate that the yield of a parent tree cannot be taken as a reliable criterion of its value as a clone parent. From a group of 19 trees selected from a population of 500 only four have given buddings which appear to possess the desirable high yielding characters of their parents, at least at an early age.
4. Clones A.44, B.84, B.58 and D.65 appear promising.
5. The responses of different clones to the same tapping system may show considerable variation.

**Literature Cited**

1. SANDERSON A. R., and STCLIFFE H.  
Vegetative characters and yield of Hevea.  
*Journal R.R.I. of Malaya* **1**, 75-90, 1929
2. HOLDER H. J. V. S., and HEUSSE C.  
Experimental tapping on Hevea buddings and seedlings on Bockit  
Maradaja Estate.  
*Archief v.d. Rubbercultuur* **12**, 25-49, 1928.
3. BILLINGTON F.  
Observations on bark thickness and renewal in Malayan buddings.  
*Journal R.R.I. of Malaya* **1**, 125-131, 1929.





PLATE I

Clone A.44. Budded tree at the age of 3 years 4 months.



PLATE II

Clone B.84. Budded tree at the age of 3 years 3 months--Note low branching habit which must be corrected by early pruning.



PLATE III

Clone B.58. Young budding age 3 years 4 months—Erect branching habit with well formed conical crown.