

## NURSERY SELECTION.

F. R. TUBBS.

The history of almost every cultivated crop has begun with the cultivation of types differing little, if at all, from the wild plant. In the case of long-lived temperate crops, such as the apple, methods of vegetative propagation were developed relatively early. Dissatisfaction with the erratic types of seedling progeny, leading to the selection and propagation of desirable individual plants, resulted in the gradual elimination of the poorer types. The realisation that desirable types could be maintained by vegetative propagation, but that the dice were heavily loaded against the chance seedling of a good tree producing as good fruit as its parent, doubtless accelerated the adoption of methods of vegetative propagation.

In the case of short-lived plants whose relatively low *individual* value rendered vegetative propagation an uneconomic process, the attention and care of gardeners and plant breeders resulted in the production of improved varieties by careful methods of crossing and selection. In the majority of cases these improved varieties have been fairly well "fixed," the progeny coming true to type provided cross fertilization with other varieties is prevented. In consequence, the use of seed provides a cheap and acceptable method of propagation of such plants.

These processes of selection and fixing involve the passage of many generations of the plant, and such work has naturally tended to remain restricted to annual and biennial plants where a number of generations can be grown in a relatively short total period of time. Work upon the breeding of plants which reach maturity only after a number of years, or which are not conveniently propagated by seed, has been almost entirely restricted to those cases where it is economically feasible to eliminate the lengthy process of "fixing" the desired type by having recourse to the vegetative propagation of desirable seedlings obtained as a result of artificial crossing. The apple and the garden rose may be taken as examples.

The case of tea, where the time taken to produce seed in useful quantity, though variable, amounts to many years, and where the value of the individual bush is so low as to eliminate on economic grounds any expensive method of vegetative propagation, is peculiarly difficult. The magnitude of the problem may be illustrated by comparison with the garden onion (which produces seed in its *second*

year) for which a scheme of selection covering at least four generations is recommended merely for the improvement and purification of *existing good varieties*. In tea no such relatively pure varieties yet exist, and it is therefore to be expected that many more than four generations would be needed to achieve the same result. Adding to this the difficulty of dealing with the large numbers of progeny which must be individually tested for yield and other desirable properties, it becomes apparent that pure line breeding alone would be so stupendous and lengthy a task that no individual or group of individuals could hope to produce economic results for the benefit of the industry during the course of a life-time.

Nevertheless, there is room for great improvement in the type of tea plant used, and this applies particularly to Ceylon, which has so far displayed in tea, as in rubber, far less interest in the improvement of its planting material than have other countries. There are, however, signs that awakening interest in the problem is already resulting in individual Superintendents examining the possibilities of effecting the first stages of selection of their existing plant material with a view to improving the type of material used for replanting and supplying. Disappointments are inevitable in such work, and it is very desirable, in fact essential, that such attempts should be carefully planned with a view to eliminating as far as possible the risks of selecting plants whose apparent superiority over the average is in reality spurious. It is hoped that the following pages may be of assistance in indicating some of the pitfalls and the methods by which they may be avoided, and that it may stimulate those interested in the problem to seek assistance from the Institute in the planning of their experiments.

It will be noticed that argument is avoided upon the subject of the desirability or necessity for selection, as it is considered that no one would seriously oppose it. The real questions are "Can fixed varieties be selected and propagated in a *reasonably short time on a commercial scale and at an economic cost per plant*? If not, what progress in that direction can be achieved within the limits imposed by economic conditions?" For example, it would be of no assistance to produce a tea clone by vegetative propagation giving double the profit per acre, if its establishment involved trebling the capital value of the estate. But it might well be profitable to use the seedling progeny of selected plants, provided that the average profit-yielding capacity of such seedlings was sufficiently greater than that of the original unselected material, and in spite of the fact that some individual plants from such progeny might be little, if at all, better than the existing average.

① The first criterion of selection must obviously be yield; it would appear to be inadvisable to restrict further examination of the bushes to the very highest yielders alone, however, lest by undue emphasis upon this character the types having other desirable characteristics be unintentionally excluded. It must be remembered that at present we are entirely ignorant of the genetic relationships of the various characters of the bush, and that this state of affairs will be remedied but slowly.

② The second criterion of the value of a particular bush will be the market value of its produce. Tentative methods for the comparable manufacture of very small quantities of leaf have been worked out and are being examined in India and Java, as well as in Ceylon. The possibility of substantial aids to progress being contributed by the Biochemist must not be forgotten; the subject has already received attention in Russia. Timocenko considers it essential that the tannin and caffeine content of the leaf harvested be considered in selection work, and his data suggest that very large variations in tannin content may occur from bush to bush, amounting to as much as fifty-two per cent of the average content. While tannin content is by no means the only factor affecting the market value of made tea, Evans' conclusions, that seasonal price trends were associated with seasonal variations in tannin content, may be recalled. Gogh also advocates selection on a chemical basis, in Java. It is hoped to examine the variability that occurs under local conditions in the composition of the flush from different bushes in order to determine the desirability of chemical selection in Ceylon. It will not, however, be possible to commence work on this subject in the immediate future. It may be found that varieties rich in tannin present difficulties in the way of vegetative propagation by budding, and alternative methods may have to be adopted, since it has been found in several plants that a high tannin content in the cambial layer led to poor success in grafting. It is to be hoped that this subject will receive further attention.

Other desirable characters upon which the final choice of the best type will depend will be disease resistance, ease of propagation, good callus formation, rapid wound healing, and the production of fairly large flush to permit of cheap plucking. It is also possible, indeed probable, that individual bushes will be found to vary as to the rapidity of the increase in banji formation with age from pruning and in the size of the seasonal fluctuations in the amount of banji. The character of branching, etc., should also receive attention, since some bushes adopt a sympodial type of growth under plucking that leads to abnormally high rates of increase of the height of the plucking table.

It is obvious that the final selection will depend on the results of experiments and tests covering a number of years. The first step therefore lies in the selection of a number of high-yielding bushes, from which may be selected those which are desirable owing to the chemical composition of their growth, and the quality of the manufactured produce. It must also be verified beyond reasonable doubt that the high yields characterising the selected bushes are due to causes individual to the bushes, and not to the chance occurrence of favourable environmental conditions. For example, absence of competition, deeper or more fertile soil, the presence of drains or spoil earth from roads and paths, all contribute to variability of the individual yields. While it is a relatively simple matter to select the high-yielding bushes from those of lower yield, it is not possible without further experiment to divide the selected bushes whose high yield is due to inherited yield characters from those in which it is due to the chance favours of the environment. This can only be achieved by the vegetative propagation of the selected bushes and an examination of the yield capacity of a number of the individuals from each clone formed thereby. This number must be sufficiently large to ensure that the average environmental background of each clone under comparison is approximately the same. When this is the case, the yields will provide an index of the yield capacity of the clones under conditions similar to those in which the trial is conducted.

The separation of true from spurious high yielders having been achieved by properly conducted yield trials, the stage is set for a final selection of the most desirable of the high-yielding types. Thereafter the problem will be to apply the most effective means of multiplication of the selected type — either by attempts to "fix" as far as possible the desired combination of characters with a view to the subsequent commercial propagation of the type by seed, by recourse to further multiplication of the original bush selected by vegetative propagation, or by selection among the seedling progeny.

It is essential to stress the fact that there is no possibility of proved clones becoming available in Ceylon for many years. It is, therefore, of the utmost importance that immediate steps be taken to ensure that the reckless planting of almost every seedling that can possibly be called tea be abandoned, and that in future *only the very best* material available shall be used for replanting. Attention has previously been drawn to the urgent necessity of improving the type and uniformity of seed-bearers. The startling uniformity of many jâts in Java and India when compared to our own is a sufficient indication that there will be no necessity for the areas now being replanted to mirror the hopeless heterogeneity of

older areas, if care is taken by seed-producers and consumers in Ceylon. It is not perhaps generally realised that continuous selection with the aim of producing more uniform and improved jâts is actively carried on by many seed-growers in other countries. Improvement will obviously demand co-operation between the seed-producer and consumer, the former by strict attention to uniformity of the type supplied, and the latter by supporting the former by a discriminating choice of the source of seed. It is greatly to be hoped that a more lively interest will be taken by all concerned, and that it will be generally realised both by estate and agency interests, that the purchase of seed containing, say, a high proportion of sinkers is possibly less important than ensuring that time, money, and space are not wasted on a proportion of plants of undesired type, whose presence may be a source of annoyance and loss for several decades.

While harsh words have been used about Ceylon jâts in other countries, such as those of Cohen Stuart: "The consequence has been that Ceylon tea is an awful medley of tea hybrids, and that Ceylon, as a seed-producing country, stands in very bad repute among Java planters, however good its manufactured tea may be," and while we are informed that "Ceylon jât" and "Stinker" are interchangeable terms in one tea-producing country, the fact must not be lost sight of that the blame for this state of affairs cannot be justly laid on the doors of the estates who have so long borne a good name for the seed they supply, which will bear critical examination by Ceylon standards. *The fact is that the standards internal to Ceylon are being challenged by those of other countries, and no reference to variability of type can fairly be construed as criticism, but rather the drawing of attention to the fact that the evolution of the tea industry is demanding evolution in Ceylon's methods and that planting material which has served our purpose for many years will not serve us in the future, in the light of the strides made by other tea-producing countries.*

However, the planter who, while realising the fundamental importance of the issues which have to be tackled by the industry, has received instructions to replant, may well ask "What methods should I adopt at present to ensure that my planting material should at least be better than what has been used in the past, even if it is not equal to what may yet be achieved?"

It is possible for such a planter, if allowed, to achieve a distinct improvement in the uniformity and yield potentiality of his plants, as has already been abundantly demonstrated by research workers in Java, who have conducted admirable researches on this and kindred subjects. The method employed is to select from among the types of seedlings found in the nursery beds those whose characters are

the most suitable, discarding the rest. The paucity of nursery sites on estates in Ceylon, together with the enhanced initial cost of planting material that will result from the discarding of poor seedlings, will possibly give pause to those considering the use of such methods, but the following description of the results of their application in Java will show that advantages accruing may well more than compensate for a higher initial cost of planting. The difficulty of nursery sites is relatively easily overcome, since if areas are to be replanted it will obviously be convenient to use a portion amid the actual tea area as a nursery, uprooting the tea on the site and establishing the nursery a year or more before the main area is cleared.

Too much emphasis cannot be laid on the point that it is essential, if costly replanting is to be done, that every precaution be taken to see that it is done with only the best available material. The mere procuring of several thousand "tea" stumps or so many maunds of "tea" seed cannot be considered sufficient, even if every care is taken to choose a reputed jât. Variation within jâts must be recognised. Once it is, the arrangement of a replanting programme in such a way that nursery sites are available to permit of selection of the good individuals and discarding of the poor becomes a logical, and even an essential, proceeding.

The basis of selection in the nursery must be vigour and uniformity. The selection of plants for vigour is rendered difficult by the fact that the observed vigour of an individual is a function of its inherited constitution, and of the favourableness or otherwise of its particular local environment. Thus edge plants may be better or worse than those in the centre of the bed, and the plants in half the bed may be worse than in the other half. Such differences are mainly due to local variations in nursery environment, and it is therefore desirable to prevent their interference with the selection process. It has been found in Java that this may be best achieved by regarding marginal plants as a separate group and selecting from them and from those in the centre of the beds independently. The paucity of suitable nursery areas in Ceylon renders the alternative of having the seedlings planted in rows at regular distances, and not in beds, rarely feasible. However, such a policy should certainly be adopted where possible when nursery selection is intended.

The problem of differences in growth due to local differences of fertility and depth of soil within the individual nursery bed may be got over by dividing the area into smaller areas and selecting a given percentage of the best plants from within the smaller areas. This procedure is based on the general tendency of fertility variation within

small areas to be less than that within larger areas. The result of experiments has indicated that this method is preferable, both in ease and accuracy, to the method of discarding the worst plants from large areas.

Before describing a method for actual procedure in the field, the criteria to be used for the estimation of vigour and the percentage of plants to be taken remain to be discussed. Selection for height is not desirable as the presence of branches may result in a vigorous plant being shorter than a less vigorous one which has produced no laterals. The weight of branches and leaves obtained when the plant is stumped, or the thickness of the stem at ground level, provides the best measure of vigour, but it is apparent that direct measurement is not suitable as a means of selecting large numbers of plants. An experiment carried out in Java and designed to test the efficiency of selection by eye indicated that the visual examination of the plants in groups of one hundred resulted in from 60 per cent to 90 per cent of the plants selected as the 20 per cent heaviest being found to be in the 20 per cent heaviest as found by actual weighing. The percentage success varied according to the observer. Visual selection thus provides a fairly efficient, while quite practical, method of judging the vigour of the plants.

In passing, it may be noted that the close agreement found to exist between variations in weight of root and in weight of stem and leaves resulted in those bushes selected for most vigorous branch growth being also those with the best root systems.

The research workers in Java have carried out, over a large number of years, experiments designed to determine what yield increases may be expected to result from nursery selection. The degree of effect obtained will naturally increase according to the variability of the original material, and it is apparent therefore that the beneficial results of nursery selection are likely to be larger in the case of the more heterogeneous Ceylon jâts than was found to be the case in the experiments to be quoted, and the process correspondingly more economic. Wellensiek has pointed out that nursery selection is always effective in raising the *average production* from the bushes planted out as compared with the whole population, although of course every individual selected may not prove to be a high-yielder. Very extensive tests of the system are reported by the same author. Seed from seed-bearers selected for evenness of jât (in 1915!) was planted out, and subsequently 19,817 seedlings were examined by cutting them back to 15 cm., and weighing the tops removed individually.

Arranging the weights in classes of 100 gm. the following distribution was found:—

Class size	0	100	200	300	400	500
	10768	6111	7027	595	187	
	500	600	700	800	900	1000
	89	27	8	3	1	
	1000	1100	1200	1300	1400	
	0	0	0	1		

The groups are overwhelmingly one-sided, the vast majority of the plants being relatively very small. (A moment's reflection, bearing in mind that in Ceylon nearly all plants are sooner or later put out in the field, will show that Ceylon's tea bushes consist mainly of bushes grown from those plants which were relatively weakly in the nursery).

The average weight of the 364 (1.83 per cent) heaviest plants was 412.9 gm., of the 3,913 (20 per cent) heaviest plants 255.1 gm., and of the 'average' plant 116.4 gm. No figure is given for the poorest. The "average" or "standard" plants were planted as controls to indicate the probable average productivity of the whole 10,817 plants, together with the 20 per cent heaviest plants. They were planted at 5 feet x 6 feet to eliminate the effect of competition between bush and bush upon growth.

In April, 1932 the plants were cut across at 60 cm. (23½ inches) and later plucked at a level of 70 cm. (27½ inches). Individual yields were determined for each bush over eight plucking rounds; the average yields of the 1.83 per cent heaviest stumps and of the 20 per cent heaviest were found to be 158.5 per cent and 131.4 per cent of that of the "standard" plants respectively.

These yields were computed in half-kilogrammes of dry leaf per hectare to determine what relation they bore to normal yields. Converting the figures given to lbs. per acre, the expected yield from "standard" plants would be 617 lbs. per acre, from the 20 per cent heaviest plants 811 lbs. per acre, and from 1.83 per cent heaviest plants 978 lbs. per acre. The plucking garden reached the age of four years during the course of the experimental pluckings. The twenty-four best yielders cropped at the rate of 2,523 lbs. per acre.

In conclusion, the author points out that in an highly efficient tea garden (given even environmental conditions, F.R.T.) every individual yield would differ but slightly from the general average

of the whole plantation. In actual fact, however, the presence of high and low yielders results in low efficiency, with the consequence that, in the case under consideration, selective removal of 10 per cent, 25 per cent, 50 per cent and 75 per cent of the lowest yielders would have resulted in losses of only 2 per cent, 8 per cent, 25 per cent and 50 per cent respectively, in yield.

The same author cites further results bearing upon the relation of seedling vigour to subsequent yield capacity.

Class	Pruning weight of nursery plants in grams	Subsequent average yield, in 8 pluckings in grams
1	45.6	157.3
2	107.5	164.9
3	173.0	170.9
4	249.9	171.5
5	434.1	192.9
5a*	712.0	221.0

(\* a sub-division of Class 5.)

Class 5 comprises approximately the 20 per cent heaviest nursery plants and selection to this extent thus gave an increased yield of 12.5 per cent, while selecting to the limits of Class 5a (approximately 2 per cent) increased the subsequent production capacity by 28.9 per cent.

A more complete experiment, in which border plants were considered separately from the centre plants of the nursery beds gave the following results:—

*Differences between Border and Centre Plants of the Nursery.*

Group	No. of Plants	Average Pruning weight in gms.		Average Diameter in mm.	
		In Nursery	2 years after transplanting	In Nursery	2 years after transplanting
Border Plants	613	107.0	608.9	8.6	18.4
Centre Plants	981	52.2	553.4	6.4	18.0
Difference		54.8 ± 3.78	55.5 ± 22.17	2.2 ± 0.75	0.4 ± 0.35

Differences *within* Border and Centre Plants of the Nursery.

Group	Class	Average Pruning weight in gms.		Average Diameter in mm.	
		In Nursery	2 years after transplanting	In Nursery	2 years after transplanting
Border Plants	1	23.3	416.7	4.8	15.5
	2	54.4	557.5	7.2	17.1
	3	84.7	560.8	8.6	18.2
	4	125.2	678.3	10.2	19.9
	5	223.9	735.8	13.1	19.1
General Average		108.0	619.8	9.0	18.1
Group 5a		393.1	1012.5	16.8	23.8
Centre Plants	1	11.6	449.7	3.7	16.2
	2	26.7	487.5	5.4	17.1
	3	41.7	602.5	6.5	18.8
	4	61.7	585.5	7.7	18.6
	5	112.4	683.9	10.0	20.5
General Average		52.8	567.8	6.8	18.3
Group 5a		198.8	735.8	12.1	21.2

It will be seen that the differences between border and centre plants have decreased considerably or have disappeared two years after planting out, while those between different *classes* of border plants and between different *classes* of centre plants decrease but are still observable. This indicates that while the differences between centre and border plants are mainly due to the effect of differences in local environment within the nursery, those between classes within either centre or border plants are partly due to inherited characters which continue to exert an effect after transplanting. As is to be expected, the yields, after planting out, of centre and border plants were found not to differ.

## Yields subsequent to planting out.

	1st 48 pluckings	2nd 48 pluckings
Border Plants ...	400.6	807.6
Centre Plants ...	395.7	824.4

The plants described in the following tables were plucked for two pruning cycles, each composed of forty-eight pluckings.

The differences found in the subsequent yields of the plants falling into different size classes as measured by weight, are illustrated by the following figures:—

Subsequent Yields, as Percentages of the General Average of Nursery Plants of Different Sizes.

Group	Class	First Yield Period Pluckings						Second Yield Period Pluckings					
		1—8	1—16	1—24	1—32	1—40	1—48	1—8	1—16	1—24	1—32	1—40	1—48
Border Plants	1	67.2	69.9	71.0	72.2	72.7	73.2	81.4	79.5	77.4	77.2	77.7	77.6
	2	92.8	93.6	94.8	95.5	96.5	96.7	90.4	91.4	92.8	93.4	94.3	95.6
	3	107.4	106.6	107.8	107.9	107.8	107.3	105.8	106.6	108.4	108.3	108.2	107.4
	4	109.5	109.7	109.4	109.7	109.2	108.8	109.0	110.1	109.8	109.8	109.5	109.9
	5	113.8	111.2	108.8	106.9	106.3	106.6	107.8	106.4	105.4	104.9	104.2	103.5
	Group 5a	177.3	171.2	157.5	147.8	146.9	151.8	149.4	143.0	144.3	140.7	140.1	134.0
Centre Plants	1	87.2	87.1	87.3	87.8	88.0	88.1	95.9	93.2	92.2	91.9	91.7	92.3
	2	99.8	99.2	98.1	97.5	97.6	97.4	100.5	99.6	98.8	98.5	98.3	98.2
	3	101.4	100.3	101.7	102.8	103.0	103.7	100.8	100.3	101.1	101.2	101.9	102.5
	4	98.7	97.4	96.9	96.6	96.5	96.1	94.4	95.2	95.3	95.3	95.9	96.2
	5	110.1	112.8	112.6	101.9	111.6	111.3	107.3	110.0	110.7	111.1	110.1	108.8
	Centre 5a	166.2	165.8	157.1	151.1	150.2	149.0	127.4	127.5	131.7	133.2	130.6	130.1

The figures provide an illuminating example of what nursery selection can achieve. For general purposes, the combined figures, including both border and centre plants are interesting:—

Class	First Period	Second Period
1	82.5	87.0
2	97.2	97.2
3	105.1	104.3
4	101.2	101.5
5	109.5	106.6
Group 5a	142.8	129.6

Class 5 consists of approximately the 23 per cent heaviest nursery plants, and the yield is 9.5 per cent and 6.6 per cent above the average yield per plant over the *whole group*. Group 5a, consisting of the 1.3 per cent heaviest nursery plants, gave increases of 42.8 per cent and 29.6 per cent over the *general average*.

In a third experiment quoted in the paper under discussion, the 20 per cent heaviest plants gave an increase of 8.8 per cent during eight pluckings while the 1.8 per cent heaviest gave an increase of 19.3 per cent over the general average. In a fourth experiment the 20 per cent heaviest plants gave an increase of 35.6 per cent and the 1.4 per cent heaviest one of 65.9 per cent over the "central" group of plants, taken as representative of the general mean. A fifth experiment gave a similar increase of 22.2 per cent in the yield of the 20 per cent heaviest nursery plants. The sixth experiment quoted showed an increased yield of 37.1 per cent as the result of selecting the 4 per cent heaviest plants.

The author states that selection of the twenty per cent heaviest plants always led to an increase in yield over unselected material, increases varying from 3.5 per cent (exceptionally low) to 37.2 per cent being noted. In general the stricter the standard of selection the larger the yield increases over the average that occur. The results also confirm the statement previously made that the differences in size between nursery plants are partly the result of inherited differences in vigour, a conclusion that is supported by work in Ceylon. Further, these inherited differences in vigour are later reflected in differences in yield capacity. The author stresses the point that nursery selection cannot result in *all* the good yielders being planted out and *all* the poor yielders discarded, but it does result in the average yield capacity being increased. It is perhaps worth recording that, in the opinion of the Tea Research Institute of Ceylon, similar results would be obtained under Ceylon conditions

and that the magnitude of the increases resulting from selection is likely to be even greater, owing to the greater heterogeneity of planting material in this country.

These figures, and the conclusions derived from them, are sufficient to indicate that nursery selection will enable improved material to be planted in the interregnum that must elapse before better methods and better planting material are elaborated and tested under Ceylon conditions. Before proceeding to outline a practical procedure, the financial implications of the method will be discussed.

Assuming that only 20 per cent of the nursery plants are planted in the field, taking the conservative estimate of a 15 per cent resultant increase in yield, with unselected stumps purchased at Rs. 40 per thousand, the process is not very attractive financially, but it must be remembered that the remaining 80 per cent poor plants can serve an extremely valuable purpose as anti-erosion hedges. It is when the plants are raised upon the estate that selection becomes financially feasible and desirable. If it is possible to grow stumps on the estate at between Rs. 15 and Rs. 20 per thousand, the extra cost involved will lie between Rs. 60 and Rs. 80 per thousand. An increase in yield of 15 per cent will then be likely to return a handsome profit on the extra expenditure.

It must also be borne in mind that it seems likely that the tea industry is passing into a stage of survival of the fittest in which the enhanced yields resulting from improved planting material may have a very material bearing on the result.

Wellensiek has suggested a modification of nursery selection wherein the seedlings are thinned out at six to eight weeks old (probably corresponding to ten or twelve weeks in Ceylon) discarding all but the 20 per cent or 25 per cent best plants, the beds being long and very narrow to reduce border effects. This arrangement avoids discarding so many large plants, but the advantage under Ceylon conditions would appear more fictitious than real, since the whole area would still require watering and attention. Further, chance differences in the amount of seed reserves would play a larger part in affecting the selection process than they would if its application was delayed until later. If abundant seed is available, as is the case when the estate possesses its own seed-bearers, it would be well worth while putting out germinated seed at half the normal spacing, and thinning out fifty out of every hundred ten or twelve weeks later, followed by a selection of the best forty in every remaining hundred when lifting prior to planting out in the field. This would give an effective selection of 20 per cent at about half the extra cost involved by performing the whole selection when lifting,

if the cost of the extra seed is neglected. Such a method is unlikely to be quite so efficient as the first, as differences in spacing, resulting from the first selection, will interfere with the second selection.

It is desirable that the method of actual selection of stumps for planting should be designed to avoid as far as possible the bias resulting from border effects and from fertility gradients within the nursery, while the need for personal supervision of each lifting cooly should be obviated as far as possible. The first desideratum is best satisfied, as already pointed out, by selecting a given percentage from small groups, considering *border* and centre plants separately. Thus, in a bed twenty feet long and three feet wide, containing say seven plants per square foot, a six-inch strip around the outside of the bed would be considered separately. Its area would be twenty-two square feet and from it the ( $\frac{2}{3} \times \frac{1}{3} \times \frac{100}{100}$ ), or say 31 plants which appear the heaviest are selected. The centre of the bed, amounting to 38 square feet would be divided into three equal portions and the ( $\frac{2}{3} \times \frac{1}{3} \times \frac{100}{100}$ ), or say 18, plants of heaviest appearance selected from each. A total of 85 plants will thus be drawn from in the bed, the rest being later used for terracing purposes, at three inches apart in the row. If the alternative plan mentioned above, involving a final selection of 40 per cent be adopted, the figures would have been 62, 36, and 170.

The selection of the heaviest plants should be done by a reliable person who has deliberately practised the art, checking his judgment against actual weighings. If done *in situ*, the plants should be marked in such a way as to be obvious to the lifting cooly, for example by stumping *in situ*. Alternatively the plants in the areas marked out as above may be lifted, and the requisite number of the heaviest plants picked out from the bundles. This latter procedure allows of root character also being taken into account in the selection process.

The desirability of paying strict attention to the type and vigour of the plants put out has always been tacitly acknowledged in Ceylon. In practice, however, the attention paid to the subject has been directed to the purchase of a favourite jat, and the generous treatment of the seedlings to ensure that, when they are put out in the field, they have formed well-developed plants. Neither of these measures take into account differences in vigour and type from seedling to seedling within a bed of a given jat. The time has come, it is suggested, when methods must be altered to allow of the selection of good plants and the elimination of weakly or off type plants from the material used for supplying or replanting.