

# SOME NOTES ON THE SELECTION OF HIGH-YIELDERS ON DOOMBAGASTALAWA ESTATE, KOTMALE\*

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Selection work was commenced on Doombagastalawa Estate, Kotmale, towards the end of 1940, and is still in progress. The first step was to decide upon the type of bush which appeared to do best on the estate and then to take steps to pick out all those bushes which conformed to this type. Such selection is essentially visual in its nature, and was carried out in the following manner:—

Preliminary selection was made by the pruners at the time of pruning. Each pruner was told to leave 10 to 15 of the largest bushes in his row in each day's

task. It was explained to them that these bushes must

- (a) be of good jat.
- (b) be not on the sides of roads, or drains, or bordering the boundaries of the field.
- (c) be not adjacent to vacancies, or young supplies, or on spoil earth, and must be neighboured on all sides by vigorous bushes.
- (d) be single, and not compound bushes.

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\* The Institute does not necessarily endorse the views expressed in papers contributed by persons not members of the Institute's Staff.

These conditions were laid down with the object of eliminating, as far as possible, the possibility that the bushes finally selected for propagation would owe their capabilities entirely to a favourable environment. This is of the greatest importance, for the characteristics it is desired to reproduce must be inherent in the mother tree itself and not derived by it from any outside influence, such as an advantageous location.

The bushes so selected were then marked with numbered metal plates. When the prunings in the field had dried, the bushes left unpruned stood out clearly, and an individual visual examination of these was made. Those which appeared to be below standard, or which did not satisfy *all* the above conditions, were pruned down and discarded. The bushes left appeared to the eye to possess much the same characteristics relative to one another, but as it was difficult to carry out a visual comparison between widely separated bushes, it was felt that some further criterion than mere observation was necessary if a greater degree of uniformity were to be achieved in the bushes selected. Having then, rejected those bushes which were *obviously* below the standard required, the circumferences of the remainder were measured, their average ascertained, and those below this average rejected.

It is doubtful whether rejection on such grounds was wise. It is difficult to measure the circumference of a tea bush with any degree of accuracy, for it might vary considerably with even slight differences in the height above the ground at which the measurement is taken, and also with slight differences in the tension applied to the tape. It is possible, therefore, that a number of potential high yielders were rejected because their measurements were undertaken somewhat haphazardly.

Further eliminations were carried out at the time of tipping, the primary branches being counted over three tipplings and rejections being made of those below the average in this respect. The idea was based on the assumption that the yields of bushes vary directly with the number of primary branches in the bushes. Such an assumption is probably not true, and this reason alone would be sufficient to render the test valueless. Besides, it is probable that many subsidiary shoots were counted as primary branches at the second and third tipping, whilst many bushes undoubtedly formed primary branches much later than others, and after the third tipping.

The selection and rejection of bushes by the above methods will no doubt be considered by many to be a mistake in view of the fact that a number of potential high-yielders were probably lost. On the other hand, those retained did survive a series of rigorous tests. They were remarkably uniform in appearance, and that, after all, was the object aimed at — uniformity of type. Inherent and invisible characteristics could be determined later under more searching tests. It must be remembered that the average superintendent has not the time, labour, or factory accommodation to carry out prolonged yield tests on thousands of bushes. He has, therefore, to be absolutely ruthless in his early rejections, selecting for actual yield tests only perhaps a few hundreds of his very best bushes every year. Indeed, ruthlessness in early rejections is the very essence of selection work, and the loss of at least some potentially good material is practically unavoidable, whatever methods are adopted.

Subsequent to the above, some preliminary selection was carried out by pluckers in other fields, just before pruning those fields. The same conditions regarding location, etc. as laid down for pruners, were adhered to and, in addition, it was

stipulated that the bushes must be in vigorous flush. The idea behind this last condition was to select bushes which were obviously staying the full course of three or four-year pruning cycles, and not those which, though possessing all other desirable characteristics, were "bad stayers." Eliminations were made solely on the basis of yield over eight regular weekly plucking rounds.

The objection to this method is the difficulty of making visual comparisons for differences in external characteristics, for it is not easy to do this while all the other bushes in the field are in leaf. However, this is not a serious difficulty for after preliminary rejections have been made on a yield basis, the remainder can be subjected to visual examination after the rest of the field has been pruned, and prior to more prolonged tests for yield after pruning. A further difficulty is the one of supervision. A large gang of pluckers is liable to leave out potential high-yielders, while a small gang of pruners is more easily checked in this respect.

Having, by these methods, made a preliminary selection for uniform type, the bushes selected were subjected to actual yield tests.

Linen weighing bags 18 x 7 inches with two tapes, one at the top and one at the centre, were obtained from the Wellawatte Spinning and Weaving Mills. On these bags were stencilled red numbers to correspond with the number of the field in which they were to be used, and black numbers to correspond with the selected and numbered bushes in that field.

After the third tipping, each selected bush was plucked at regular weekly intervals. The bags were tied by the centre tape and the leaf from each bush was put into the top half of the bag, the number on which corresponded with the number on

the bush. The bags were then tied at the top and sent to the factory. This process was continued for 8 regular weekly pluckings. Before each pluck, after the first, the centre tapes of the bags were untied so that the leaf from the previous pluck fell to the lower half of each bag, which was then retied at the centre before commencing the new pluck.

On arrival at the factory, the bags were hung near the drier, the prior permission of the Insurance Co. having been obtained without any difficulty. At the end of the 9th week, *i.e.*, a week after the 8th pluck, the bags were put into the drier where, without rotating the trays, they were dried for about two hours at a temperature of 180 degrees F. to a moisture content in the tea of between 4 per cent and 6 per cent. The fired leaf in the bags was then weighed, on an ordinary letter balance, to the nearest 4-oz. and the yield of each bush recorded. This procedure was repeated over 48 regular weekly pluckings, *i.e.*, for 6 plucking periods of 8 plucks each. Rejections were made on the yield basis at the end of every 8 plucks as follows — 50 per cent at the end of the 8th pluck, 25 per cent at the end of the 16th pluck, 10 per cent at the end of the 24th, 32nd, 40th, and 48th plucks.

The table (page 49) gives the results in respect of the bushes finally selected in one field — the results being similarly tabulated in respect of each of the other fields.

At the head of each column are the plucking rounds, below which are indicated the moisture contents. The total moisture content is taken as the mean of the moisture contents for the 6 plucking periods. The figures in the columns proper are the weights in ozs. The bracketed figures represent the order of merit at each pluck, within the limits of the bushes finally selected for consideration. . . . .

Consideration must now be given to these figures with the object of selecting from them those bushes from which it is desired to propagate. It is not intended to lay down hard and fast rules as to how such final selection should be made. This will depend upon such factors as the nursery space available, the land available for the establishment of clones, and so on. A few guiding principles may, however, be laid down.

would vary. As with the moisture contents, the results could be scaled to a common rainfall, but this would be quite valueless as it is improbable that there is any definite correlation between crop and rainfall. It is for such reasons as these that results from one field should not be examined against those of another. As far as plant selection work is concerned, scaling of any description is nothing more than a mathematical trick which proves nothing.

Bush No.	1/8 5.75%	9/16 5.00%	17/24 4.50%	25/32 4.75%	33/40 5.00%	41/48 4.25%	Total 4.88%
1	4.50 (2)	4.00 (1)	4.25 (1)	6.00 (1)	6.25 (1)	5.25 (7)	30.25 (1)
3	5.50 (1)	3.50 (2)	4.00 (3)	5.75 (2)	5.75 (3)	5.75 (2)	30.25 (1)
32	4.00 (4)	3.25 (3)	4.25 (1)	5.25 (4)	5.50 (6)	6.00 (1)	25.28 (3)
33	3.75 (7)	3.00 (5)	4.00 (3)	5.75 (2)	5.75 (3)	5.50 (4)	27.75 (4)
24	4.50 (2)	3.25 (3)	3.50 (8)	5.00 (6)	5.75 (3)	5.25 (7)	27.25 (5)
198	4.00 (4)	3.00 (5)	3.75 (5)	5.00 (6)	6.00 (2)	5.50 (4)	27.25 (5)
4	4.00 (4)	2.00 (11)	3.75 (5)	5.25 (4)	5.25 (8)	5.25 (7)	25.50 (7)
7	3.50 (9)	3.00 (5)	3.75 (5)	5.00 (6)	5.00 (10)	5.00 (10)	25.25 (8)
28	3.50 (9)	2.50 (9)	3.25 (11)	4.75 (9)	5.25 (8)	5.75 (2)	25.00 (9)
219	3.50 (9)	2.50 (9)	3.75 (5)	4.75 (9)	5.00 (10)	5.50 (4)	25.00 (9)
206	3.75 (7)	2.75 (8)	3.50 (9)	4.50 (11)	5.50 (6)	4.50 (11)	24.50 (11)

Firstly, it is essential that the results from each field should be examined separately. It is mathematically possible to scale the results from a number of fields to a common moisture content and then to examine them as a whole. This would not be satisfactory. Soil conditions in different fields may vary. The plucking of the bushes in different fields would probably have been carried out over different periods, during which climatic conditions

On the other hand, if the results from each field are examined separately, we have a number of bushes all plucked at the same time, under the same weather conditions, and situated in a more or less unvarying type of soil. In such circumstances the figures are fairly comparable.

Secondly, consideration should not only be given to the highest total yields, but the orders of merit should also be taken into

account. A bush giving a high total yield may quite easily have given the greater part of that yield in one or two plucking periods and then have dropped to a low position in the order of merit at all other plucking periods. The type of bush desired is one which not only gives a high yield, but does so consistently. For instance, bush No. 1 in the above table is not only the highest yielder but is so on four occasions out of six. In its last plucking period it dropped to seventh position but its yield in this period is only three-quarters-of-an-ounce less than the highest-yielder in the same period. Its low position in the order of merit can therefore be ignored and, indeed, may be due to an error in weighing, or some similar cause.

Thirdly, a standard should be laid down and all bushes not attaining this standard should at once be rejected, regardless of any other considerations. This standard should be at least five times the yield of the field over the period covered by the 48 pluckings. This is of the greatest importance for it guarantees that when the progeny of the mother-tree are ultimately planted out in the field in a replanting programme, the yield of that field will be substantially improved, though of course, the yield of the field cannot be expected to equal that calculated from the mother-tree alone. There would be what one might call an "averaging out" of the yield, due to the influences of the varying environments in which the progeny are grown. For comparison of bush yields with field yields we may assume that a field contains approximately 3,200 bushes per acre, so that an ounce per bush would represent a field equivalent of 200 lb. per acre. For instance, in the given table, bush No. 1 with a yield of 30.25 oz. is giving the equivalent of 6,050 lb. per acre, which is 7½ times the yield per acre (812 lb.) of that field.

Finally, the number of the selections may be limited by such factors as the nur-

ery space available for propagation. In this case it is suggested that selections and rejections should be made at the gaps in the total yields, if such occur. For instance, in the table given, it may be difficult to decide whether to retain bush Number 32 and reject Number 33. The difference between them is only half-an-ounce, which is not sufficiently significant to enable one to say with any certitude that the former is a better bush than the latter. There is, however, a fairly significant gap between the yields of bushes Nos. 1 and 3 and the next in order of merit. We may therefore safely retain the first two bushes and reject the rest. If it is desired to retain more than two bushes we may retain the first six in order of merit, for it will be noticed another fairly significant gap occurs in the yields at this point. The question of how many bushes should be retained for propagation is one of personal choice and it may later be found desirable, for one reason or another, to make use of some of those rejected in the first instance.

The writer makes no claim that the methods adopted by him on Doombagas-talawa are either perfect or ideal. Indeed, experience has shown that a great deal of unnecessary work was undertaken, and the following improvements are suggested:—

(a) Let the pruners or pluckers do the preliminary selection, as described above. There is much to be said for both methods, and perhaps the best would be a combination of the two. Pluckers could carry out the preliminary selection just before pruning and their selections tested for actual yield over 8 plucks. Eliminations should be ruthless. The bushes retained can be easily compared for visual characteristics after pruning the rest of the field. At the same time, pruners can be instructed to leave any bushes they consider better than those left by the pluckers.

(b) After a visual comparison of the bushes has been undertaken and rejections made where thought desirable, they should be pruned down, and those retained subjected to actual yield tests as described. It is unnecessary, however, to undertake more than 24 plucks as it is found that relative values are not sufficiently altered by more pluckings as to justify the extra work involved. No time should be lost in measuring bushes, counting primary branches, or any similar plan. Such methods are of doubtful value and a waste of time. It would seem preferable to get straight on to actual yield tests.

(c) Should a number of potential high yielders be lost, either through adopting methods of selection subsequently found to be not the best, or through inability to deal with a large number of bushes at any one time, the following remedy is suggested:—

For the sake of convenience, we will call an 8-round pluck a "plucking period." At the *beginning* of any plucking period a number of bushes which appeared to be good yielders, may be added to those already under test. At the end of the plucking period we shall then have yield records of two sets of bushes — those which have been tested over perhaps several plucking periods, and those of the "new entrants." We eliminate the undesired bushes in the first set according to plan. Of the bushes remaining, there will be one which is the lowest yielder. In examining the "new entrants" we eliminate all those whose yields are below that of this lowest yielder, retaining for further test those whose yields are above it. This process can be carried on indefinitely, the lowest yielder of those retained in the original set plus any additions subsequently made, being the criterion for the retention or rejection of the "new entrants." In this way a very large number of bushes can be sub-

jected to actual yield tests without involving very much additional work or subjecting factory accommodation to too great a strain. The objection to this plan is that the records of some bushes finally selected may be incomplete, rendering total yield comparisons useless, but this, is not a serious objection. What is required are the outstanding bushes, and a bush which can gain entry into the circle of the original *elite*, and remain there to the end of the tests, must be worthy of its position, even though its yield records are incomplete. It must be remembered that if selection work is to produce the results desired the search for material must be *thorough*.

(d) Bushes suffering from disease should be rejected. It may be thought that if a bush is a high-yielder in spite of the effects of a disease, probably due to an unhealthy environment, its progeny will certainly be higher-yielders in a more favourable locality where the disease is not prevalent. This is so, but one of the objects to be aimed at in selection work is the selection of mother-trees which are disease resistant, and therefore if it is known that a bush is not disease resistant it should be rejected out of hand.

(e) Moisture contents were recorded for the purpose of scaling described, but this is deemed to be of no value, so the recording of moisture contents may be dispensed with. On Doomba,astalawa the moisture content of each plucking period was recorded from a sample of the bulked leaf from all the bags. The moisture contents of individual bushes might vary considerably on either side of that of a bulked sample. To record the moisture content of each bag separately is impracticable as, apart from the time involved, while one bag was being tested the others would rapidly absorb moisture from the surrounding atmosphere.

(f) Results given in terms of dry tea are more accurate than those given by any other means, but it is doubtful if great accuracy in yield determinations is of importance in the early stages of selection work. What is required are *relative* values and these may be expressed more easily in terms of the green leaf-weight or flush counts. Yield records in terms of fired tea must again be made later when clones are laid down and the progeny of the selected mother-trees are established under identical environmental conditions. If time is of no account the recording of yields in terms of fired tea on the lines indicated may be

undertaken. On the other hand, it would seem desirable to reach the stage of clonal tests in selection work as rapidly as possible and, for this reason the determination of relative values would be achieved very much more easily and rapidly by either counting pieces of flush, as recommended by Dr. Eden in *The Tea Quarterly* Vol. XIV, Part III (October 1941), or merely weighing the green leaf.

It is proposed to adopt the former method in future tests on Doombagas-talawa.