

VEGETATIVE PROPAGATION OF TEA— THE MANUFACTURING ASPECT

E. L. Keegel

The economic possibilities of replanting tea with selected high yielders by means of vegetative propagation are now being appreciated by more and more estates. Yield and other physiological characteristics of a bush are not necessarily the only things to be considered; the quality of the manufactured product is equally important.

The extent to which quality can vary among individual bushes has perhaps not been fully realized. Considerable differences exist even amongst plants of similar morphological characters. Examination of hundreds of plants at the Institute has not shown any clearly definite relationship between quality and leaf type. Generally speaking, however, the small leaf varieties have been found to give good quality, but on account of their low potential yield vegetative propagation is now confined to the larger leaf types. These have given vastly different teas, ranging from common low grown tea to quality that would under normal conditions compare favourably with teas produced in the Nuwara Eliya district.

It will be a grave mistake, therefore, to take no notice of the characteristics of the manufactured product in the process of selection. Testing for quality should, in fact, be done simultaneously with observations in the field. Periodical tests will soon reveal the undesirable types. The worst quality bushes are rejected and on the clones propagated from those selected for their desirable characteristics further manufacturing tests will have to be carried out to confirm the results previously obtained.

Of the numerous bushes and clones tested at the Institute, it was noted that, without exception, all the intrinsic manufacturing characters were transmitted from the mother bush to the progeny. It may be that if grown at a different elevation, a clone would not have the identical characteristics of the parent bush. There is insufficient evidence on this point. Selected bushes from low country estates have always given very strong and coloury teas, but never the quality of an up-country tea. Whether the characteristic quality associated with growth at the higher elevations could be obtained at lower levels by propagation of specially selected plants from up-country areas, it is difficult to say as yet.

If it is to be established that any promising characteristic is not the result of some external factor such as age from pruning, season or soil or environment, a systematic study is obviously essential. Wrong conclusions might be easily drawn from sporadic tests.

The Institute has from time to time assisted many estates in manufacturing leaf from individual bushes but such isolated tests can serve very little purpose if they are not followed by a series of manufactures. Estates should experience no difficulty in carrying out their own quality tests and it is hoped that what follows in this article will enable them to do so and to interpret results as accurately as possible.

In the testing of individual characteristics of different bushes the most important point to remember is that, no matter what tea-making equipment is employed for

the purpose, the technique developed must give consistent results. This is an essential prerequisite which, if ignored, makes quality tests a farce. The use of a pestle and mortar or a rolling pin or any other makeshift arrangement to bruise the leaf may be all very well for rough and ready tests but such methods cannot be recommended in selection work. Too much is left to chance in an investigation which by its very nature depends on its success for the estimation of a value of a tea on a strictly comparable basis.

The method devised at the Institute was tested by carrying out a number of successive manufactures of flush from pairs of different bushes. Results were consistent over a long period, the same differences of characteristics inherent in the bushes being always recognised by a tea-taster. Although normal teas were not produced—an impracticability with only a few shoots—the method of manufacture on such a miniature scale was standardized accurately enough to assess small differences in the more important characteristics of a tea liquor.

In brief, the method adopted was to bruise withered leaf in a hand operated, small scale Clivemear roller set at a fixed pressure. The leaf was then minced in an ordinary mincing machine, sifted over a hand sieve, fermented and fired. The teas so produced were generally strong and harsh, having a certain brassy coarseness and the leaf itself was abnormally brown and flaky as a result of the severe treatment. Since the quality factor is the most important these peculiar features do not matter but it should be mentioned that despite the extra colour and strength induced by this technique, variations in these two characters due to intrinsic properties of different bushes were noted. As these two factors may assume considerable importance under normal methods of manufacture they cannot be left out in selection work. Consequently, some allowance must be made when assessing colour and strength in teas produced from an abnormal system of manufacture and if a true discount is to be made a *standard* method of manufacture must be employed. The method must leave no room for doubt that the observed differences are due to inherent characteristics.

The technique adopted at the Institute, which involves the use of the Clivemear roller, may not be found acceptable to most estates. The use of a mincing machine alone, however, should present no difficulties. In fact, the omission of clivemearing is in some ways preferable since the tea taster's job is made easier as a result of the teas possessing less strength which, if too prominent, can obscure quality.

The ordinary household mincing machine is available in different sizes and it is recommended that the smallest be used for individual bush manufacture. It is provided with different types of cutters, the selection of which for the work in hand must be made with care. Too coarse a cutter results in insufficient bruising of the leaf. If it is too fine the leaf is reduced to pulp, and a certain amount of cell sap is also lost. A few preliminary experiments will reveal the most suitable cutter which would bring out the best characteristics of the leaf. The cutter of one's choice should of course not be changed under any circumstances. It is necessary to take two more precautions. One is to have the machine and all its parts chromium plated and the other to observe scrupulous cleanliness.

For inexact tests, chiefly with a view to rejecting poor fermenters, withering is not necessary. Some idea of the fermenting properties of a bush may be formed by mincing the green leaf but it is inadvisable to rely entirely on such findings for two reasons. In the first place, although leaf may appear to ferment well the actual infusion after brewing can be greenish and secondly, quality does not bear the same close relationship to colour of infusion as is generally the case with normally manufactured teas. Many instances have been noted where greenish infusions have been associated with excellent liquors as coloury and pungent as those combined with bright, reddish infusions. That this was not accidental was proved by repeated manufactures. To discard shy fermenters, therefore, without a proper quality test is most certainly unwise.

The method for quality tests of leaf from individual bushes, which is recommended for estates, is as follows:—

Withering:—No special precautions are necessary but to facilitate the work it is suggested that small tats of hessian be used. Each tat must be mounted on a wooden frame, 24" × 18", supported on short legs. Such an arrangement will ensure easier control of the withering process since the leaf can be taken to any part of the factory. When hot air is not required and there is a danger of the leaf being overwithered the tats could be placed in the coolest section of the factory, namely, the rolling room. They will be found most serviceable in exceptionally dry weather. At such times a good natural wither can be obtained by just keeping the leaf in the rolling room.

Too hard or too soft a wither is not suitable for individual bush manufacture and with a little practice the correct wither could be obtained by varying the rate of spread during withering. In the later stages when it is desired to check the wither, standing the trays on a wetted floor proves helpful.

Bruising (Rolling):—The equipment needed should consist of the following:—

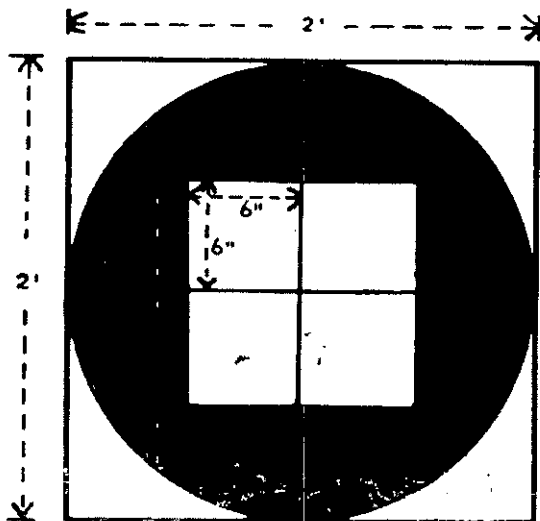
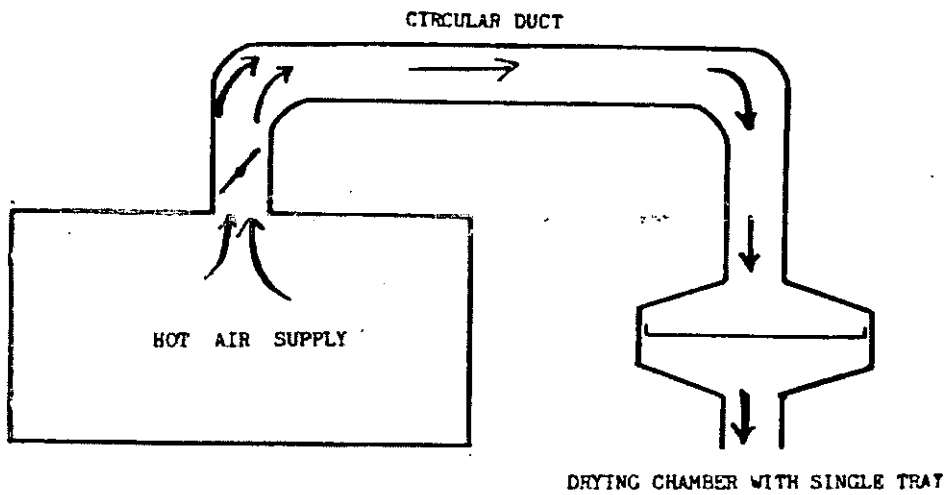
- (1) A mincing machine. (Chromium plated).
- (2) A hand sieve (not more than 16" in width and 1" in depth) fitted with No. 10 brass mesh or preferably, stamped aluminium with 2 mm perforations.
- (3) A spatula made of thick aluminium about 2½" by 1½", for rubbing the minced leaf over the mesh.
- (4) A sheet of stainless steel or aluminium, about 2 feet square, for collecting the dhool.

For normal routine examination of a few samples, duplication of this equipment should be more than sufficient.

Since great care must be taken to see that the leaf once minced does not come into direct contact with the hands it is necessary to use a small broom made of 'cikel' (about 7" long) for cleaning the machine of all leaf in the crevices. If this is supplemented with a small cardboard tray, lined with aluminium foil for the collection of leaf during the different operations the risk of extraneous taints is considerably reduced.

The bruising operation commences with the mincing of the leaf, which should as far as possible be of a fixed weight. Two samples can be handled simultaneously in two mincing machines and a further two a few minutes later as soon as the machines are free. A delay in sieving would not be serious enough to effect the comparability of four samples at a time.

The leaf is first weighed in a letter balance of the postal scale type on an aluminium pan (about 10" × 6" × 2" deep), a fixed weight being decided on and minced twice. It is then sifted over the hand sieve and the lumps broken up with the spatula until all the leaf goes through. This operation should not take longer than 10 minutes if the leaf is of a good standard and correctly withered. The presence of coarse leaf, however, will make thorough sifting difficult. There is no alternative then but to discard the fraction that fails to pass through the mesh. Every effort should be made to get the maximum amount of dhool and this can only be done by picking out as much as possible of the tough leaf before mincing.



CIRCULAR TRAY SHOWING PARTITIONS FOR 4 INDIVIDUAL BUSH SAMPLES.
 THE AREA, NOT REQUIRED, IS COVERED WITH A DETACHABLE PIECE OF FLAT ALUMINIUM.

Fermenting:—The dhool is transferred to a small open box (with an aluminium bottom), about 5" long, 2" wide and 1" deep. Fermenting on open surfaces is not recommended since there is a risk of the samples drying out.

A fixed period should be selected, say between 2 and 3 hours, and maintained for all tests. This is most important in the early stages of selection work. When making the final selection the optimum period might be sought.

Firing:—This presents the only difficulty. A miniature drier is a costly item and will be found wholly unsuitable unless trays can be changed periodically. The rapid moisture testers of the type which functions on a rapid air flow at a high temperature can on no account be recommended. The main disadvantages are:—

- (a) Most of the leaf on account of its finely divided state is blown off.
- (b) If steps are taken to prevent this by placing trays with leaf one above the other air flow is restricted, as a result of which the temperature rises rapidly. Though electrically operated, perfect control is difficult even should one sample be fired at a time.
- (c) The fired tea generally has a roasty and greenish character.

A method that will not be very difficult to adopt on estates is to use the hot air supply from a commercial drier by a duct connected with a small chamber fitted with a single removable tray. The tray should be of very fine mesh not larger than No. 24 and have an area of about 3 square feet. If this is divided by detachable partitions into sections, 6" × 6" each, four samples or more could be handled at a single time at say half-hourly intervals. (The diagrams show the layout.) It is most essential that the air-flow should be in a downward direction in order that there might be no 'blow out'. As a precaution against 'fall through' the leaf should first be spread in little trays made of wire mesh of the same size used for the main tray. These are then placed in the sections provided.

The teas may be fired for about 15 minutes at 190°F while the commercial drier is in operation, but it would be preferable whenever possible to work the drier empty at a lower temperature and fire for a longer period.

An alternative method used by some estates is to place the samples in wire cages and suspend them in the duct or below the bottom tray of the drier. Satisfactory results are known to have been obtained.

After drying, the teas should be stored in small sample bottles until required for sifting as they are very liable to go off if unnecessarily exposed.

Sifting:—All dust should be removed by sifting over No. 30 or No. 40 mesh. What is left then for tasting is a sample closely resembling a Fannings grade. The necessity of having the leaf particles of the same size in every sample need hardly be emphasized. Standardization of the grade is just as important as regulating the method of manufacture.

Tasting:—So long as it is remembered that there is a small degree of abnormality in the liquor, a natural consequence from lack of rolling, a tea taster should not find it hard to estimate the cup characters of a tea. Discounting the special strong, harsh character, which is naturally induced by mincing, it is remarkable how small differences in quality could be detected. To ascertain the variations in inherent characteristics with a fair degree of accuracy from the usual type of report given by a tea taster is not easy even if it is decided to choose one sample as a standard for purposes of comparison and manufacture it on every occasion quality tests are done. Some method of systematizing reports is essential and it is recommended.

that at least the two main characteristics, colour and quality, be expressed on a basis of marks. A report from of the type shown below will provide all the information needed:—

Sample No.	Colour Marks *	Quality Marks *	RANK A. above average. B. average. C. below average.	Order of merit. First 3 or 4 samples.	REMARKS	
					Infusions	Liquors
General Comments :—						

* Maximum possible—10.

Standardization of manufacture on the lines indicated will enable quality to be assessed without any appreciable error. However, certain factors other than those referred to, have to be taken into consideration as well before it can be concluded that the character of the tea produced from any particular bush is solely intrinsic.

Season:—The season during which a test is made does, without a doubt, influence quality to a great extent. In a study of the properties of various bushes at St. Coombs there have been many instances of 'C' class bushes (below average quality) producing 'A' class teas (above average quality) during periods when extra quality is induced by favourable weather conditions. Accordingly, it is incorrect to presume that a bush is suitable for propagation on the score that its teas are ranked 'A' when it has been tested only during a good quality period.

In fact, the proper time when a bush should be tested is when climatic conditions are unfavourable for the production of good quality and if exceptional quality is noted no doubts can exist as to what has contributed to the result. Still, repeated tests in the same period are necessary to confirm the result. A bush with outstanding quality will be found to give consistently good teas in all seasons.

Age from pruning:—A precaution that must be taken is not to test bushes from a young field or to manufacture flush from shoots allowed to grow for the purpose of taking cuttings. A bush must be in *regular plucking* and at least a year old from pruning (first tipping at high elevations) before tests are contemplated. Failure to observe these rules will make a quality test worthless. It is equally important when comparing different bushes to see that they are all of about the same age from pruning.

Standard of plucking:—The influence of the standard of plucking is too well known to be commented upon. In view of the infinitesimal amount of leaf manufactured, the greatest care should be taken in the plucking, which need not be of too fine a standard so long as some uniformity is maintained. The characteristics of the tea from a single bush are considerably affected by the nature of the pluck and comparison will not be true if the composition of the flush is variable.

Period of fermentation:—Attention has already been drawn to a fixed period of fermentation for the initial tests. It must not be overlooked, however, that owing to the wide variability of the rate of fermentation from bush to bush and the impracticability of altering the bruising technique a fixed period of fermentation might not be advisable for some teas. Optimum quality may in certain circumstances be obtained without sacrificing the other desirable properties of a tea liquor by a suitable adjustment in the period of fermentation.

Accordingly, it is always best to try out various periods before rejecting a bush merely because it might have given an average quality tea. In the case of rapid fermenters, for instance, it was revealed that shortening of the fermentation by about one fourth the normal time generally resulted in an improvement in quality. Another very interesting point of note, observed in the group of rapid fermenters identified, was that those with really poor quality were not in any way improved by a shorter fermentation. *Poor fermenters* on the other hand do not seem to benefit by lengthening the period of fermentation. For bushes of outstanding quality varying the period within reasonable limits made no appreciable difference.

The necessity for a repeated number of manufactures is clearly indicated by what has been discussed so far and this warning is given in view of the current practice on many estates to rely on one or two tests for their conclusions. Twelve consecutive manufactures at monthly intervals should be adequate to judge the prospective value of a clone.

Clonal material:—The method described for individual bush manufactures will be found suitable for clonal material as well and the availability of more leaf will minimize to a great extent some of the errors introduced when handling only a handful of flush from a single plant. The object of quality tests on clones is, as stated earlier, to confirm the results obtained from the mother bush. It is highly desirable that these should be done because of the influence of the numerous factors mentioned.

The maximum amount of leaf that can be comfortably handled by the equipment recommended for individual bush manufacture is 4 ounces of green leaf, equivalent to 1½-2 ounces of withered leaf. A dozen or so bushes should suffice to provide this amount of leaf even during low cropping periods. Generally more plants are put out in the multiplication plots. If the number exceeds 40 advantage should be taken of the extra amount of leaf that would be made available by using a miniature roller instead of the mincing machine. Since teas closely resembling normal manufacture can be produced there will be greater scope for studying the finer characteristics. Nevertheless, it must be stressed that just as in the case of individual bush manufacture, *standardization* is necessary.

A machine with a jacket 6" in diameter and 6" in height can take a charge of 1½ to 2 pounds withered leaf. If pressure is carefully adjusted it will be possible to do 3 rolls. Dhools are separated over a hand sieve fitted with No. 6 mesh and finally amalgamated with the big bulk before firing. The same drying tray as that used for individual bush samples will serve for firing if the detachable partitions are removed. (See diagrams). Sifting can proceed on normal lines and by the use of a cutter, a grade of about the size of a small B.O.P. can be obtained for tasting. Here again, it must be emphasized how important it is to standardize all the processes. A larger or smaller outturn of the grade taken, can, for example, alter all the characteristics of the liquor.

Infusion and quality:—The observations made during manufacture have often agreed with a tea-taster's report, particularly as regards 'nose' from the quality stand-point. But it is a mistake to presume that a good colour in the fermenting leaf denotes a good quality tea. At the same time it must not be imagined that a coppery infusion will result from leaf that appears to be fully fermented at the time

of firing. It can be greenish after brewing. It is also incorrect to take for granted that coloury liquors cannot be associated with greenish infusions.

Nearly 2,000 independent tests of hundreds of samples have been done in the past 18 years and it can be definitely stated that there is no relation between the colour of the infusion and the liquoring properties of a tea. If, therefore, ordinary fermentation tests are not followed by an examination of the liquor most misleading inferences may be drawn.

Since infusion plays such an important part in governing the value of the commercial product the following few examples are given to illustrate the disparity that can exist between infusion and quality:—

- Bush No. 169 —Above average quality; infusion not very bright and rather greenish.
- Bush No. 361 —Fairly bright infusion but very poor quality.
- Bush No. 1006 —Quite useful quality but infusion much too green.
- Bush No. 1082 —*A very good infusion but disappointing liquor.*
- Bush No. 930 —*Excellent quality but commercially out of the running owing to too green an infusion.*
- Bush No. 506 —Quite a nice tea but rather different in type; its infusion is poor compared with its quality.

Variations in characteristics:—The considerable variations in the characteristics of the teas tested at the Institute have been astounding. That it is the genetic factor which has contributed to these results is beyond question. Further examples taken at random and given below strikingly convey the variations in the type of tea produced from different bushes:—

- Bush No. 884 —Rich liquor with plenty of body; remarkable for its creaming and strength but the *infusion is rather dull.*
- Bush No. 896 —Very dull infusion, appears to be manufactured from tippings or the coarser leaves of young tea and lacking in quality and character.
(Note:—This bush on one occasion received 4½ marks for colour and 0 for quality).
- Bush No. 777 —*Bright reddish infusion* with good strength and quality and has a dryness reminiscent of autumnal 'Dooars'.
- Bush No. 407 —Tastes like smell of *old fermented tea leaves.* Quality nil.
- Bush No. 216 —A typical good Dimbula.
- Bush No. 21 —*Exceptional combination of colour with very useful quality.*
- Bush No. 1294 —*An excellent tea, stand out with good flavour.*
(Note:—These remarks were made when it was manufactured in August in the middle of the S. W. Monsoon).

Bush No. 170 —Unusual characteristic with an unpleasant *sweaty tang.*

The tea of one bush from another estate and manufactured at the Institute received the unusual report of being *overfired.* That was the impression the tea-taster had of the liquor but there was no question of it being over-fired because three other teas fired with this particular sample at the same time and on the same tray under strictly identical conditions were considered quite normal. Another manufactured during June (S.W. Monsoon) with a few others from the same field in St. Coombs estate had a touch of flavour and prompted this question: "*Is this bush subject to more wind than the others?*" Yet another had a *malty character,* while bushes in close proximity gave greenish liquors, one of which was described as *sickly green.*

This list will not be complete if special mention is not made of one particular bush (No. 9), the teas from which did not ferment. The infusion was very green and the liquor thin and green and it was considered a useless tea commercially. Varying the degree of wither and even *extending the period of fermentation to 24 hours* failed to ferment it. Normal fermentation was induced only by the addition of an oxidase preparation, yet the infusion did not acquire a coppery hue.

Conclusion:—The results bring home sharply the old saying:—“Tea is made in the field”. It is indisputable that the improvement that can be effected in a tea by any method of processing bears no comparison to what can be achieved from the right type of leaf, and all the skill in tea manufacture will not be able to make up for the absence of something which nature has not provided. The predominant influence of the raw material belittles the extravagant claims sometimes made on behalf of any particular manufacturing technique. This significant factor alone should alter one's outlook on manufacture.

It is earnestly hoped, therefore, that this article will not only bring about a common sense approach to tea manufacture, but also stimulate an interest in vegetative propagation. It can be readily perceived without any further proof that the industry can ill afford to continue replanting with doubtful material and that only by careful selection will a teamaker's dream be brought a step nearer to realization.