IMPROVED RUBBER SEEDS

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IN a former article (see *The Tropical Agriculturist* — Vol. LXXXIV No. 6, June, 1935) we have explained, that with the present development on rubber estates of the improvement of planting material increased attention is being paid to seedlings, and that, if buddings of well-proved clones must be considered at present as the most certain material with a higher yield, seedlings of some classes may eventually prove still better, but this will only hold true for seedlings of clonal seeds. Shortly after finishing the article I came across a lecture by J. S. Vollema of the West Java Experiment Station, on "The latest advances in relation to Hevea selection on the West Java Experiment Station" (*Bergcultures*, 1935, p. 40), which entirely confirms our statement about the difference between the various classes of seedlings, and which gives some data on the degree of improvement of these classes. The figures may interest the reader. I will reproduce a few of the data here.

The lecturer began with some data on the well-known Java clones, mentioning also a new clone developed on the Experiment Station fields and confirming again, what he said in a former lecture, that clonal plantings, established according to the newest views, viz: monoclonal plantings, starting with a dense stand of 160-200 buddings per acre, afterwards reduced by selective thinning out to 90-100 trees in the 15th year of age, may be expected to yield crops, under favourable conditions, going up from an average of 440 lb. per acre in the 6th year to 1,760 lb. per acre in the 15th year. I quite agree with this view of Mr. Vollema. After these introductory remarks Mr. Vollema discusses the value of seedlings. He divides them into several classes:

A. Seeds from fields, in which the poorer yielders have been removed by selective thinning-out.

B. Mother tree seeds, seeds from trees excelling by their high yields, in ordinary plantings. As the seeds have been generally formed after open pollination, apart from a certain percentage due to self-pollination, the largest part has an unknown father, which can be just as likely a good, as a poor yielder.

C. Clonal seeds, taken from buddings from one high-yielding clone. If this clone is, however, mixed with ordinary seedlings, for instance if the buddings are scattered in a common planting, the seeds of the clone have the same value as mother tree seeds. If, however, the clone is mixed with other clones the seeds represent a higher value, as the father or fathers, (although they are unlocated) are centainly also high-yielding trees. Seeds of buddings in the centre of a large monoclonal block may be considered as "legitimate" seeds (this term is used in Java to indicate seeds of controlled pollination — in this case self-pollination).

D. Legitimate seeds, for which mother and father are known. These seeds are obtained by artificial pollination — or, from seed producing fields, where there is a mixture of not more than two clones.

We will follow the data which the lecturer cited but at the same time point out some details, with which we do not agree. To mention one: in the case of seeds of the D. class one is never sure, if the seeds are autofecundated or formed by cross-pollination. For instance in the very interesting experiments of the AVROS Station about which in late years reports have been issued, seeds of AVROS 49 are described as "partly autofecundated, partly cross-pollinated with clone 33".

Mr. Vollema at first discusses the seeds mentioned under class A. For many years selective thinning-out has been practised in Java and practically all the seeds, collected in the newer plantings, are of this class; these are what are called, "broom swept seeds". Such seeds be it noted have already passed through a primitive selection as indicated. Several writers have drawn the attention to the fact, that the newer plantations in Java yield better than the older ones, probably for this reason. A case is cited in which a field planted with "broom swept seeds" gave in its 11th year nearly 660 lb. per acre.

For fields planted with Mother Tree Seeds (class B) Dr. Tengwall has calculated from extensive statistical data, that an improvement was obtained of at least 30 per cent. excess crop. Of course this figure depends on the care with which the choice of the mother trees has been carried out, and of the limits which have been put to these mother trees; the more severe the selection has been the better the quality of the offspring will be. Cases are mentioned of fields, where trees grown from mother tree seeds increased the yield from 3 kg. per tree (9th year) to 6 kg. (15th year), and of a planting established with mother tree seeds, which gave in its 11th year 968 lb. per acre.

The lecturer came then to the C. class, where still higher figures are found. A replanted area, of about 18 acres, established with seeds of mixed clones, gave at an age of 5 years 431 lb. per acre, certainly double the crop of ordinary seedlings.

As examples of the D. class, (so-called legitimate seed), Mr. Vollema cites the well-known AVROS crossings made by Heusser in the AVROS Station fields; the best families are equal in productivity to good medium clones. Dr. Schweizer of the Besoeki Experiment Station has obtained similar results. The Experiment Station for Rubber (now absorbed into the West Java Experiment Station) had already started in 1927 with artificial crossings and continued this work till 1931. In its experiment field Tjiomas there are now three sets of 50 "families" each corresponding to a certain crossing of two parent trees. The oldest of these families, 7 in number, were planted out in the beginning of 1929, the number of trees per family varies from 2 to 157. This field was put into tapping in 1933, its 5th year. The families A and G with 83 and 23 tapped trees, showed an average tree yield of 3·96 lb. and 4·18 lb. and are thus at the same level as buddings of first rate clones of this age; *T.R. 1* in the same place and planted the same year, gave, at 5 years old, 4·9 lb., *T.R. 16*, 4·6 lb. The variability of the seedlings is, of course, much larger. Family A gave a coefficient of variability of 36 per cent., G, 38 per cent., which means that, after discarding the extremes, the best tree gives nearly five times the yield of the poorest ones; the figures are comparable with those found by Heusser for the first tapping year. For clones the variability coefficient has been found to oscillate around 20 per cent. which means that after discarding the extremes the best trees give $2\frac{1}{3}$ times the yield of the poorest ones.

What may we now expect from our seedlings, after these first results of the West Java crossings? Mr. Vollema thinks, that in view of the yields of the various classes of seedlings and clones in large commercial plantings, we may expect, that the yields of the commercial plantings, established with seedlings of the new crossings will be at least as high as of our clones. Probably they will even surpass these in yield, as with dense planting and selective thinning-out the yields of seedling plantings can be more improved than monoclonal plantings, as the seedlings are variable.

Mr. Vollema recommends that seed producing fields of the West Java crossings should be established with the aim of disposing as soon as possible of this superior seed.

He considers it the best policy to lay out a seed producing field with the 5 clones, which have served as parents for the families of the 1929 plantings and to plant these clones in a rather dense planting, preferably in a quincunx arrangement and systematically mixed.

During the years of growing these seed producing trees further results of the families in the experiment garden will be known, so that it will be possible to base a selective thinning-out on these results and to keep the best combination.

This recommendation seems logical, if it is advisable to use for our seed producing fields mixture of clones. But is this advisable ? I do not think so. As Mr. Vollema himself states the seeds from the centre of a block of monoclonal planting are self-pollinated. That means that if we use them for a test planting, we are sure that we will always have the same seeds at our disposal, which the same intrinsic value, the same variations, the same characters, good and bad.

If we take seeds from a mixture of clones, even if only two clones, we have not this same guarantee, even if we only take seeds of one of the components, which is already from a practical point of view a much more difficult thing than collecting seeds from the centre of a monoclonal block. But what I think is an essential difference between the two kinds of seeds, is the fact, that even if we only pick seeds from one clone in a biclonal planting we never know which percentage are self-pollinated, and which have been fecundated by the pollen of the other component.

We may use a quantity of seeds for a test planting and find out, when we use seeds from the same plot again, guided by the results of the first test planting, that the later picked seeds give entirely different results. If the mixing of clones comprises 3 or 4 this is still more the case.

It is curious to note, that in the Netherlands Indies, in Java as well as Sumatra, the Experiment Stations have always gone in for establishing seed producing fields composed of pairs — or even of several different clones. Why they should be preferred to pure monoclonal plantings I do not understand. It would be a service to our industry, if Mr. Vollema could explain why. I attach special value to his opinion on this point, because he was the first, I think, in the Netherlands Indies to take a frank, clear-cut position on the question of polyclonal versus monoclonal plantings for commercial plantings in a lecture delivered (I cite from memory) about $1\frac{1}{2}$ years ago. It is true, that opinions had already changed then somewhat from the standpoint, taken by the Experiment Stations in the Netherlands Indies before 1930, where mixing of clones for commercial planting was recommended by them, but I think the advisability of monoclonal planting had not before been so clearly pointed out in Java.

Monoclonal planting was started in the beginning of 1928 in Malaya, in 1929 in Indo-China; and in these rubber-producing countries now blocks of hundreds, sometimes thousands of acres of one clone — in one solid block — are starting to produce seeds. Even in Ceylon I know of places, where blocks of several tens of acres have been planted with one single clone.

In my opinion the road to further improvement of Hevea starts from these blocks. We can take large quantities, I mean in the best cases millions of seeds, from them and plant them out for each clone apart. In our experiments in Malaya and Indo-China we subject them to a first selection when the plants are about a year old. We keep only the well-growing plants giving a good flow of latex. The yield figures of these plots will direct our further choice, when — especially for replanting — new plantings with improved seeds will have to be made, and, at the same time we try to take from our best yielding seedlings budwood for developing new clones, new seed producing trees — for we must go further, improve again on the improvements obtained.

I want to add one word more on the way we should make our choice. We must not only take into account yield figures, but full attention should be paid to secondary characters — just as it should also be done with clones — from the very beginning. I see that Mr. Vollema now rejects AVROS 71 for commercial planting because its secondary characters are unsatisfactory. I may claim, that we have never taken this clone into our planting programmes from 1928 on for this reason. I believe that AVROS 71 and 256 (with insufficient increase in yield) were already excluded from planting programmes years ago in Malaya and Indo-China.

So with seedling selection a careful choice should be made of the mother tree used for seed production. Are the secondary characters hereditary? Perhaps not always, but if you have seen the crossed seedlings in Dr. Heusser's Experiment Garden, or better still, laid out in nurseries, pure self-fecundated seeds of a clone like AVROS 152, you will agree that the whole habit of the mother is often repeated by the seedlings. That must make one very careful about including for instance in the mother trees for seed production such a type as Tjirandji 1, with its attractive extremely high yield, — but less satisfactory secondary characters. There is possibility that we can bring the yield up by thinning out from the nursery, but very little can be done to improve — or to correct — faults in the secondary characters.

If we want to apply drastic selective thinning-out we must have large quantities of seeds, at a low cost. Seeds of monoclonal plantings do not cost more than the expense for having them swept together and carried to the germinating beds. A field of 40 acres AVROS 50, established in 1930, is now represented in last year's nursery on Carey Island by 100,000 plants. Let me say at once that I cite this clone for this figure of seedlings, not as a desirable clone for use as a mother tree for commercial seedling plantings. What I want to explain is that with millions of seeds from monoclonal plantings at our disposal we can afford, as we did in clonal seedling test plantings, to thin out our young plants to one out of every 25-30; that means only keeping 3 or 4 per cent. of the number of seeds laid out; and

then to keep a stand of nearly 200 to the acre to allow further selective thinning-out, when the trees are three years old and can be submitted — following the clever system designed by Mr. Mann of the Rubber Research Institute in Malaya — to a first normal tapping, on which results such thinnings can be based.

I have somewhat extensively explained what I consider the direction our selection work should take. It would be interesting to hear what Mr. Vollema thinks of it. Of course, with our present knowledge various ways of looking at the problem are admitted — and I would make this concluding remark — if my views differ from his on this subject, this does not make me blind to the valuable data which this able worker is contributing to our knowledge.

CORRECTION NOTE

In Dr. Cramer's previous paper on "The Area Under Budded Rubber in the Netherlands East Indies" published in the June 1935 number of *The Tropical Agriculturist*, pp. 314 to 320, all figures for areas in the tables and in the text should read with the decimal point deleted and a comma inserted in its place. *e.g.*, in the table on page 317 first line Buddings, Seedlings and totals in hectares in Java should read as 35,825; 195,959 and 231,784 instead of 35·825; 195·959 and 231·784 respectively.