

The Flowering of Teak (*Tectona grandis*) in Aspects of Tree Breeding.

Based on observations in Thailand

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Most trees have an unbroken main axis even after flowering has begun, because the flowering buds either are lateral or—if terminal—not until later in the life of the tree placed at the very top of the tree, but terminal on lateral branches. Most trees start their flowering by flower-buds placed either terminal on side-branches or lateral. In the latter case the possibility of a never broken main axis exists (f.inst. the Conifers and the Oaks). In the former group the first flowers occur on branches far from the top of the tree, but as the years pass, more and more side-branches will produce a terminal flower or inflorescence until at last the terminal bud of the main axis will give place to an inflorescence (for inst. Sycamore-Maple and Horse-Chestnut.).

Teak is an odd tree. Its first inflorescence occur rather early in the life of the tree, terminal on the main axis, sometimes accompanied by panicles on some of the side branches. Very seldom, and mostly due to injury to the top of the tree, the first inflorescence may be formed on side-branches.

The taxonomic group, *Verbenales*, to which *Tectona* belongs, is chiefly a group of herbs, and the way in which flowers are produced in Teak may be compared with that of a perennial herb. Only, in Teak the main axis has altered into an aerial, woody stem with long internodes. As far as we have seen, the Clerodendron-trees (closely allied to *Tectona*) may have exactly the same start of their flowering, as have the shrubby Clerodendrons and some other woody plants of herbal extraction, e.g. *Sambucus*, *Lonicera*, *Cornus* and others. Fig. 1 on Plate I shows the first inflorescence of a Teak-tree.

Hence the beautiful, straight stem of the young Teak is broken. The remainders of the inflorescence is a dead stake, and two or more of the opposite buds give rise to shoots competing to become the leading shoot, and often with equal success. Thus the stem is forked into two (or more) main branches.

As the Teak for a period mostly flowers every second year from the leading shoots, a broad crown is soon formed. This development takes place more quickly when a tree is solitary. In a close stand, or closely surrounded by other trees, this typical growth is less pronounced due to longer intervals between flowering of the individual shoots.

Under the conflicting conditions of growth in the tangle of a jungle such a Teak may be "lucky" and in spite of hindrances be forced to continue its upward growth without or with hardly perceptible branchings. It is probable that flowering is delayed due to light deficiency; then the Teak, under suitable shade from other trees, will shoot its unbroken shaft higher than in full light. Our observations in Thailand, however, leave no doubt that flowering time also depends considerably on genetically determined variation. Under the same external conditions, certain trees are to be found which flower at an early age. These trees grow only a very short, undivided trunk. Other specimens are found which are several times as tall before the axis of the tree is broken by the first flowering.

This condition is illustrated in fig. 2 (Plate I). It shows a stand in Maohuat Teak Plantation (between Lampang and Ngao) planted 11 years ago with one year old seedlings ("stumps"):

Tree 1: A tree, 14 m. tall, which has not yet flowered. The trunk is straight and unbroken in its entire length.

Tree 2: A smaller, thinner tree, which has not yet flowered; therefore the trunk is also straight and unbroken.

Tree 3: The leading shoots of this tree have flowered twice. The trunk, quite straight until flowering, has branched in the last couple of meters of growth.

Tree 4: Vigorous, handsome trunk. About halfway, the trunk has branched, presumably due to early flowering.

Tree 5: An early and prolifically flowering tree. It is short and broad in form and injurious to the other trees in the stand; a tree, ripe for felling, causing more harm than good, and not timber producing.

Of these five trees, 1, 2 and 3, only, have forestry value. — Tree 3 has the thickest trunk, 25 cm in diameter (at breastheight). Tree 1 has an unbroken trunk 14 m tall and a diameter of 24 cm. Tree 2 is an unusually handsome, straight specimen, with fine branches and an entirely unbroken trunk, with a diameter of only 13 cm.

It must be admitted that we have no proof that the differences in these trees are due to genetic factors alone. Observations of other tree species, however, lead us to state that it is highly probable that the different appearance depends on the above-mentioned difference in flowering.

Observations of Teak trees mature for felling, reveal, as in other tree species, individual differences. Those vary from short, broad-crowned specimens (fig. 3, plate I) to beautiful, tall trees with branchless trunks (fig. 4, plate II). This difference must be due to external conditions as well as to hereditary factors. Figs. 3 and 4 show two very unlike trees. In spite of the fact that they have grown under very different conditions, something in their appearance leads us to believe that there must be a clear difference in their hereditary factors. On the other hand it is more difficult to evaluate the two trees in fig. 5, even though the tree on the right, with its broad crown, has presumably flowered much earlier than the tree on the left.

The use of vegetative reproduction (grafting, budding) and arranging "tree shows" (C. Syrach Larsen: Genetics in Silviculture, Edinburgh 1956) is the way to prove the theories advanced here. It is also the way to preserve all the types of great forestry value in order that they may be used in future tree-breeding.

This may also be expressed as follows: During the period before its first flowering Teak passes through a juvenile stage. The duration of that stage seems to depend to some extent on hereditary factors as well as environment. In some specimens the stage seems to continue for twice as many years as in others. If a juvenile stage of long duration coincides with luxuriant growth, the result is a tree with a tall, straight, undivided trunk of primary importance for the economy of a plantation.

In Thailand Teak-trees are commonly planted along the main roads. The bad conditions there seem to shorten not only the shoots but the juvenile stage too.

Under continued investigations in this field it should be remembered that such studies, besides explaining the variations already mentioned, will also facilitate evaluation and utilization of possible differences in quality of the wood to the extent that these are determined by the anatomy of the tree itself.

The *quality of the wood*, without regard to its growth form or intensity (breadth of rings) is presumably also subject to variations. In Bangkaeng we were shown samples of Teak which were decidedly different in anatomy (distribution and number of vessels and rays). In Beech, known as a very homogenous species in its wood-anatomy, equal variations are described. In the future this will probably be of technical value. The cost and effort expended on such investigations are not merely "botanical studies". It is a technical work as well, for, after pointing out and saving the most valuable individual trees, the breeding of Teak itself will be brought a step forward,

Cultivation of Teak outside its natural range has frequently been studied in experiments during the past years. It is only reasonable to study a species of tree with wood of such outstanding quality. Some of the experiments, especially those in Trinidad and Central America, are very promising. From observations in Thailand, in particular those made near a monastery on Koh Samui, we are inclined to expect successful results in cultivating Teak further south than its present normal range. We would, however, *recommend an increased, strict control of the provenance of the seed* in order to determine its best sources. In the neighbourhood of some other monasteries in Thailand we saw Teak stands which appeared to have been laid out as plantations. It is very important to find more of these, and to know their origin. The difference in quality may be due to different treatment, but it is also possible that many years may be saved in the breeding work, based on selection of special types.

On our short trip we obtained only scant information about the possibilities of such plantations. Nor was there sufficient time to discover "single" trees.

These "*single*", *lone Teak trees*, far from others of their kind, and therefore forced to self-pollination, will be of great value in future work.

Teak is a monoecious plant. It is quite common that trees of that nature cross-pollinate. The seed thus formed combines the hereditary factors of two trees. Self-pollination may be difficult or nearly "impossible". Within a single species there are often individual variations, so that even among non self-pollinators, exceptions occur which by self-pollination produce desirable, fertile seed.

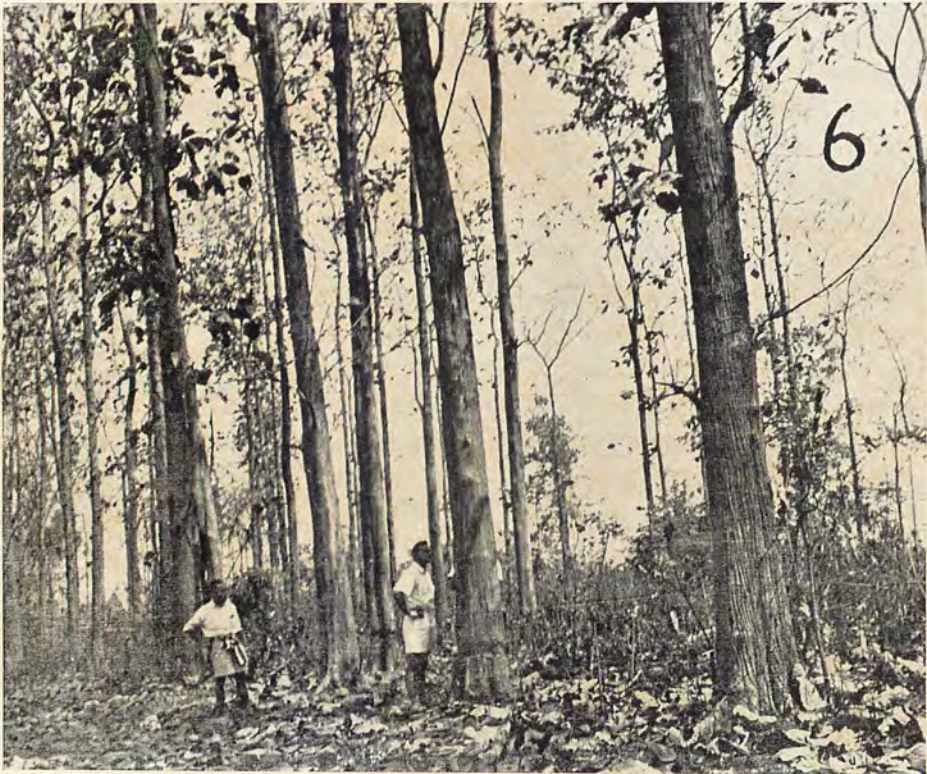
During recent years other plants (maize, for example) has been improved greatly by so-called in-breeding, followed by cross-breeding. If it were possible to find "single" Teak able to produce fertile seed, it would be a great stimulant for future

work in breeding. After observing some results with other trees we find it likely that such possibilities exist for Teak.

The age of old Teak trees, mature for felling, is often spoken of as very high. We speak of trees, hundreds of years of age, falling for the axe. In localities filled with piles of logs, we counted annual rings which indicated that such giants of the forest had existed, but they were few and far between, and when found, their wood was often of inferior quality due to rot and injury from forest fires. We were told that, on an average, the best returns came from trees 60-70 years old. More-over, when we note the promising results obtained after 45 years in small plantations at Phrae (fig. 6.), interest is stimulated to augment rational cultivation of Teak. From England it is reported that good results have been obtained by technical methods in testing 35 years old Teak trees grown in Trinidad.



(Explanations in text)



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