GIRDLING MANGO SEEDLINGS FOR INDUCING EARLY FRUIT BEARING

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Various procedures have been investigated for overcoming juvenility and promoting early flowering of perennial plants. In fruit crop development this is a subject of substantial interest since most tree fruits require several years to flower from seeds. Sax (6, 7, 8) has discussed both the history of conventional methods used to induce early fruiting and the results of his extensive efforts to produce early flowering in hardy trees. Among experimental methods for promoting floral initiation are the use of dwarfing rootstocks and interstocks, root pruning, unusual planting and pruning methods, girdling and the techniques developed by Sax which involve bark ring inversion and deformation of stems by tying them in knots. Of these procedures girdling is the simplest and therefore most easily utilized for large numbers of trees. The term girdling is used here to indicate severing of bark and underlying tissue by a knife cut made completely around a stem. This procedure does not involve removal of any tissue.

It is widely used to promote heavy bearing and to increase size of grapes (3). The benefits from such treatments, used for generations in European vineyards, have prompted many experiments with numerous other species. Various reports discuss results such as heavier flowering and fruiting, increased fruit size, earlier fruit maturity and improved fruit color (1, 2, 4, 5). These and other reports are concerned with results obtained from girdling asexually propagated fruit plants, and therefore provide little information about the value of girdling for shortening the juvenile or wholly vegetative stage in the life cycle of arboreous plants. This possibility was investigated in the experiments discussed below, performed with seedlings of the mango, Mangifera indica L.

PROCEDURE

Trials were begun in 1961 with open-pollinated seedlings of a Saigon mango, to compare Sax’s bark ring inversion technique with girdling. Trees were treated by both methods in September, using 3-year-old trees which had been growing in the field for 2 years. At that time their stem diameter was 60 to 80 centimeters.

Girdling consisted of making one or two cuts...
through the bark on the trunk of the trees below the scaffold limbs. These cuts were made with a heavy knife, and sufficient pressure was used to sever, completely around the tree, all tissue exterior to the cambium. A coat of grafting wax was applied over the incision to restrict dessication.

Twelve trees were used for this type of treatment. A single cut was made on 6 of the trees, and two cuts, about two inches apart, were made on the remaining 6.

For bark inversion treatments two-inch rings of bark were removed by making two transverse knife cuts as described above, then slitting the bark between the cuts longitudinally to allow removal, and replacing the ring of bark in an inverted position. The bark ring was fastened securely in place with rubber grafting strips and coated thoroughly with grafting wax. This bark inversion treatment was performed on 12 trees. Half were treated by applying this procedure to the main stem, about 12 inches above the ground, and the remainder by performing the bark inversions on the primary limbs.

In October, 1962, a replicated experiment was initiated. The results of the previous season's investigations discouraged interest in bark inversion, and this method was not used in 1962. The 1962 girdling experiment was performed with 3 groups of 4-year-old Saigon seedlings trees from different parents. Treatments consisted of girdling in October, girdling in January, and girdling at both times. The girdling procedure was the same as that used in 1961, but only a single knife cut was made. Ten replicate sets of treatments were applied to each of the three groups of trees.

**RESULTS AND DISCUSSION**

All trees in the 1961 experiment on which bark rings were inverted declined steadily in vigor for several months after treatment. No new leaves developed until late in the following summer after girdled or untreated trees had produced 2 or more new flushes. About a year was required for the trees to recover normal vigor, and at that time they were little larger than they had been at the beginning of the experiment. In contrast the girdled trees were delayed little in growth and in most cases after a year could not be distinguished from untreated plants. Figures 1 and 2 show the appearance of typical stems four months after girdling and bark ring inversion.

Both treatments caused the development of broad, angular terminal meristems characteristic of flowering terminals. In this first experiment only 1 tree, which received the bark-inversion treatment, actually flowered. This tree set several fruit, but all dropped within a few weeks. It could not be determined whether fertilization had occurred but the condition of the tree suggested that it was not capable of maturing fruit.

The severe effects of bark inversion doubtless resulted partly from the poor unions achieved. The bark rings were difficult to remove, particularly from the trunks of trees, without considerable damage. The thinner and more flexible bark on the limbs caused less difficulty and the inverted bark rings grew in place much more satisfactorily on limbs. The injury to the trees was nevertheless severe, even where reunion of the bark rings was perfect.

This procedure could doubtless be used with less difficulty if the treatments were applied to smaller trees such as Sax used. However, the results would probably be unsatisfactory from a practical standpoint regardless of the effect on flowering, since smaller trees would not be capable of maturing the quantity of fruit desired for evaluation.

Girdled trees showed no indications of adverse effects aside from a temporary cessation of growth. Broad angular terminals developed and new flushes were slower in appearing. In the first trial no differences were observed between trees girdled with single or double knife cuts, and for this reason only single cuts were made in 1962.

Percentages of trees which flowered under each treatment are given in Table 1. These data show clearly that the time of girdling determined the effectiveness of the treatments. Girdling in January did not induce flowering, and did not influence the effect of October girdling on flowering.

The complete absence of response in one of the groups and the uniform response of the other two groups indicate a degree of genetic control of flowering which should be examined. The difference in threshold age for induction of flowering, before which girdling is ineffective, should not be overlooked in determining breeding lines to be used in further selection.

In view of the indication that effectiveness of girdling is determined by the time at which such treatments are used, it is now desirable to establish the optimum time for such treatments. An experiment in progress is expected to provide
information on this point. Saigon mangos frequently flower erratically, producing panicles long before or after the customary Spring flowering season. These phenomena suggest that within fairly broad limits the time of applying flower-inducing treatments might not be highly important, but this assumption is not supported by the results of these experiments.

Some trees which flowered did not set and mature fruit. This occurred less frequently among trees which had been girdled in October. Also, among all treatments and controls in the two groups where flowering occurred, some inflorescences developed which had small numbers of flowers interspersed with leaves. These mixed inflorescences were more frequent on trees not girdled in October, and failure to set fruit occurred more frequently on inflorescences of this type. The data do not provide unequivocal evidence that flowers on girdled trees set fruit more reliably than those on ungirdled trees, but the results suggested that this occurred.

The practical application of girdling seedlings lies of course in its usefulness for reducing the time required to obtain fruit for evaluation. The results of these experiments indicate that girdling can be utilized for this purpose. Further experiments will determine whether it is desirable

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Table 1. Per cent of flowering in 3 groups of mango seedlings as affected by girdling.*

<table>
<thead>
<tr>
<th>Time of Girdling</th>
<th>Clone 1007</th>
<th>Clone 15269</th>
<th>OBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>45</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>October and January</td>
<td>40</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>January</td>
<td>20</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Control</td>
<td>15</td>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>

* Figures in each column not bracketed together are significantly different at the .05 level of probability.
to girdle trees in their fourth year, when apparently only a part of some progenies can be induced to flower, or to delay treatment for one or more years until all or nearly all could be induced to flower. The choice of procedure would be determined by the information most urgently needed about the population. For convenience in field-plot management it is preferable for fruiting to occur simultaneously on all or nearly all plants composing a single progeny, so that the effect of different growing seasons can be minimized in evaluation. However, it is often desirable to obtain, from the earliest possible girdling of a part of the population if necessary, information about the desirability of various parent plants for further use as sources of additional seedlings. Where new populations are started each year, it is advantageous to determine as soon as possible the characteristics transmitted by individuals chosen as seed sources and to avoid as soon as possible further use of those found to transmit few desirable characters to their offspring.

These requirements indicate the desirability of achieving fruit production at the earliest possible time in some if not all of a population, and the desirability of inducing fruit production in the same season by as many individual trees as possible. If girdling to induce fruiting in the fourth season reduces fruiting the following year it will become desirable to know whether repeated girdling, begun as soon as flowering can be induced, will insure regular fruiting in subsequent seasons. In a recent experiment (1) grafted apple trees did not, in subsequent seasons, revert to a vegetative condition after they were girdled once. Experiments now in progress will indicate whether mango seedlings also fruit regularly without repeated girdling.

The results of these experiments did not indicate that forcing fruit production by girdling affects size or appearance appreciably. That there may be some effect on fruit size, quality and maturity is indicated by reports cited previously.

These reports and others discuss various influences attributable to girdling and suggest that if detailed varietal comparisons were involved it would be necessary to study such treatment effects. However in these experiments fruit weight averages and ranges were similar from girdled and ungirdled trees, and there were no obvious differences in appearance. It was therefore apparent that these treatments do not affect fruit characteristics sufficiently to interfere with the preliminary stages of evaluation.

**Summary**

In trials with 4-year-old mango seedlings flowering was increased substantially by girdling in October, but girdling in January had no effect. Among trees in two populations, about 40 percent flowered in response to girdling in October. Less than 20 per cent of the untreated trees produced flowers. In a third group of seedlings of different parentage girdling was not effective. Fruit set was better on the flowering trees which had been girdled than on those which flowered without girdling. Inversion of bark rings was investigated as a method for inducing flowering, but was abandoned because of severe injury to the trees.

**Literature Cited**


**Promising New Guava Varieties**

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The common guava, *Psidium guajava* L., is well known in Florida and in most other subtropical and tropical areas of the world. Various aspects of guava culture in Florida are presented by Ruehle (6, 7). Several guava selections have been named and described in the state (4, 5). Most of these have been sweet types, suitable...