Annona montana, mountain soursop, had less injury with only leaf burn and some twig die back.

Antidesma bunius, bignay. Old plants protected by surrounding vegetation were not injured, but those in exposed places had a number of branches killed. This injury was not as severe as in 1956. At the Ft. Lauderdale planting young plants were severely injured.

Calocarpum sapote, mamey sapote. Both old and young plants had considerable damage to the branches, but it was less severe than in 1956.

Chrysophyllum cainito, star-apple. Old and very large trees were severely damaged as well as younger plants in exposed places.

Eugenia malaccensis, Malay-apple. Two medium-sized trees even under the protection of larger trees were severely damaged.

Flacourtia cataphracta, paniala. Older trees in a protected location showed no damage, but younger trees in exposed places were killed.

Flacourtia indica, governor's plum. Large plants in protected locations were not injured. The thornless variety growing in the field with no protection showed considerable damage, some plants killed outright, others nearly to the ground.

Flacourtia inermis, lovi-lovi. Young plants killed.

Melicocca bijuga, Spanish-lime. Two large trees with nearby protection of large spreading candle-nut trees were not injured and, in fact, produced a good crop of fruit this year. Two large trees in a more exposed location were killed nearly to the ground. At Ft. Lauderdale young plants suffered leaf burn and twig injury.

Muntingia calabura, capulin. Medium size trees were killed to the ground, even plants with overhead protection. At Ft. Lauderdale plants showed leaf burn and twig injury.

Pouteria cainito, abiu. Young plants in exposed area were killed; those protected by neighboring plants showed very little damage.

Spondias cytherea, ambarella. Very large trees were severely injured with large branches killed. At Fort Lauderdale younger plants had considerable leaf burn and twig injury.

EFFECT OF BEDDING AND MULCHING ON LAKE EMERALD GRAPES UNDER CULTURE ON SOUTH FLORIDA FLATWOODS SAND

N. C. Hayslip and L. H. Stover

Historical.—References to desirable vineyard locations, soil types and drainage are found frequently in literature on viticulture. Many vineyards in Europe are set on slopes and hillsides, and not infrequently narrow vine terraces cling precariously to steep mountain sides. Most of the successful grape plantings in California, New York and Michigan are established on either rolling or steeply sloped lands that are well drained.

Florida grape growers have long been interested in topography and drainage, and references in early bulletins and public reports indicate that rolling land was generally preferred. Authentic statements on this are found as far back as 1894 when George W. Wright, chairman of the Standing Committee on Grapes of the Florida State Horticultural Society said: “Seven years ago (1888) the planting of grape began quite largely in South Florida. A large acreage was planted mostly to White Niagara, and up to the last year there were 500 acres in Orange County alone, and at least half that amount in adjoining counties.”

Following the remarks by Wright, a Mr. Mott had this critical comment to make concerning the vineyard site selection in that day: “They have picked out the land that has been under water: land that was never
intended that should be planted to grapes. They have cleared out the swamps and planted, and I am not surprised at the failures we have heard of and are hearing of. They planted grapes on land that nothing else would grow on."

About 30 years later several acres of elevated lands near Montverde, within 30 miles of Orlando, were planted to T. V. Munson hybrid bunch grapes from Texas, predominantly Big Extra (Florida Beacon), Carman and R. W. Munson. At that time these were known to be hardier than any of the popular *Vitis labrusca* varieties of which Niagara, Concord and Worden were leaders. Within 10 to 12 years the Munson hybrids died regardless of excellent planting sites and reasonably good care.

The extent to which disease accounted for grape decline formerly attributed to environmental and physiological causes was made clearer in recent years with studies on Pierce’s disease virus in Florida grapes. Results of investigations at Leesburg indicated that Pierce’s disease has been the major factor responsible for the decline of bunch grapes in Florida.\(^2\)


Evidently Pierce’s disease has been responsible for symptoms often attributed to bad site selection involving poor drainage and to unsatisfactory soil types and conditions.

Background for Studies.—Past records and experience show that the soil type and drainage have a definite influence on the growth of grapes, and low flatlands are generally considered a poor risk for grape production. However, little information has been accumulated on possible methods of making the low flat-lands suitable for grape culture. The studies reported here were made to determine whether a system of grape production could be developed on low, poorly drained soils in south Florida.

Early Plantings At Indian River Field Laboratory

The first planting of Lake Emerald grapes at the Indian River Field Laboratory was made in the winter of 1954-55. Three vines were planted near a small drainage ditch on Immokalee fine sand; (1) at soil level; (2) six inches above, and (3) 12 inches above the normal soil level. The two elevated vines made vigorous growth, while the one set at soil level was not nearly as vigorous. In another plot two vines were planted near the

Table 1. Summary showing effect of bedding and mulching on vegetative growth, fruit production, and sugar content of fruit.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dormant Wood (Pounds)(1)</td>
</tr>
<tr>
<td>Bedded, mulched</td>
<td>32.9</td>
</tr>
<tr>
<td>Bedded, no mulch</td>
<td>12.0</td>
</tr>
<tr>
<td>Flat, mulched</td>
<td>7.0</td>
</tr>
<tr>
<td>Flat, no mulch</td>
<td>1.6</td>
</tr>
</tbody>
</table>

(1) Total from four plants

(2) Total soluble solids content of juice samples determined by hand refractometer.
edge of a deep drainage ditch on Parkwood soil. These vines developed nutrient deficiency symptoms (probably due to high pH) and failed to make good growth.

A second planting made in January 1956 consisted of nine Lake Emerald plants spaced nine feet apart on three beds 30-feet long by 12-feet wide elevated 12 inches. The plants grew rapidly and made vigorous vines. A hay mulch was placed on the beds in the spring of 1957. Grape production was fairly good in the summer of 1957 and 1958.

**Experiment With Raised Beds and Hay Mulches**

Growth of the 1955 and 1956 plantings indicated that Immokalee fine sand, if bedded, may produce satisfactory grapes. In order to determine the value of bedding and of mulching, a third planting of Lake Emerald grapes was made in January 1957 on Immokalee fine sand. This trial compared grapes grown on raised beds with those grown on flat soil, and plots heavily mulched with pangolagrass and clover hay with un-mulched plots.
Procedure.—Dolomitic limestone, at 2,000 pounds per acre, was broadcast and disked into the soil January 14, 1957 on an area 60 by 160 feet. Two rectangular areas measuring 12 by 64 feet were separated by a longitudinal alley 12 feet wide. These were divided laterally by an alley 12 feet wide to form 4 plots.

Two plots (flat) were at normal ground level; two plots (bedded) were raised 16 inches above the furrows on each side of the beds.

Fifteen hundred pounds of steamed bone meal per acre were applied January 15 in a shallow band in line with planting positions. One-fourth pound of 4-8-8 commercial fertilizer was applied at each plant location, and two days later eight vines spaced eight feet apart were set in each plot. One-fourth pound of 4-8-8 fertilizer per plant was applied March 7 and again April 15, 1957. On April 25, 250 pounds of 15-0-14 per acre were applied broadcast and one-half of each plot was mulched with pangolagrass-clover hay. On May 14 and June 11, 1957, 125 pounds of 15-0-14 per acre were applied.

Seasonal dormant pruning was done February 7, 1958, about 13 months after planting. All plots were in good cultural condition at the time of pruning and cane growth was generally healthy. One thousand pounds of 4-8-8 per acre were applied broadcast on February 11 and again on April 15, 1958.

A count of fruit clusters was made July 18, 1958, and at the same time percentages of soluble solids in fruit samples were determined with a hand refractometer. The grapes were harvested and weighed July 28.

Discussion of Results.—The amounts of dormant wood pruned from the 13-month old grapevines are shown in Figure 1 and Table 1. Both bedding and mulching greatly increased vigor and growth of the grapevines. The flat-unmulched plots were in poor condition, and the bedded-mulched plots appeared too vegetative and vigorous. Growth of the flat-mulched and the bedded-unmulched grapevines was normal. This marked difference in growth appeared in the early spring of 1957 at which time the bedded vines were growing much more rapidly than those planted on normal elevation. Later when the heavy mulch was applied to one-half of each plot, those grapevines growing in the mulched plots became much more vigorous than comparable un-mulched plots.

After the dormant wood was pruned in February 1958, many lateral buds remained dormant while those near the terminal end of the pruned canes and spurs began to grow at a rapid rate. Other buds finally sprouted, but many remained dormant. This erratic bud growth was responsible for a smaller yield of grapes and, to a certain extent, non-uniformity of ripening.

Another serious problem was the breaking of young shoots during strong winds. A moderate number of fruiting shoots were lost in this manner. This damage has occurred to some extent each spring.

In the spring of 1958, plants in the bedded-mulched plots were excessively vegetative. The dense vines appeared to over-shade the fruit, delay maturity and reduce both the yield and size of the grapes. Based upon the general appearance of the vines and grapes, the un-mulched-bedded and the mulched-flat plots were superior to the mulched-bedded or the un-mulched-flat plots.

Fruit cluster counts and yield data showed wide differences between the two replications within the same treatment. Some of this variation was probably due to the variation in distances of the plots from a drainage ditch located at the north end of the experimental area. For example, the "A" replicate of the
flat-unmulched plot was about 100 feet from
that ditch and the grapevines in that plot
were almost dead by the time of harvest. The
“B” replicate of this plot was located about
25 feet at its nearest point from the drainage
ditch, and the vines were in fair condition.

The soluble solids content of juice, Table
1, was lower on hay mulch plots.

Based upon general observations of grape
plantings made at the Indian River Field
Laboratory during the past three years and
upon the experiment reported in this paper
the following tentative conclusions were
drawn:

1. Lake Emerald grapes can be produced
on low, flat land Immokalee fine sand in
the Indian River area provided they are
grown on beds with adequate drainage.

2. Organic mulches reduce the weed and
grass problem, but the cost of mulching
may off-set this advantage. While an or-
ganic mulch will produce a more vigorous
vine, excessive vegetative growth at the
expense of grape production, uniformity
of ripening, and quality may be difficult
to prevent. Mulching may markedly reduce
the sugar content of grapes, regardless of
whether the vines are grown on bedded or
flat land.

3. Grapevines in wet soils may benefit from
heavy mulching as a means of maintaining
a shallow effective root system. A reduc-
tion in mineral fertilizer usage, especially
nitrogen, may be advisable where organ-
ic mulches are used.

While these results show promise, much ad-
ditional research will be necessary. Future
work with grapes should include a search for
improved varieties, insect and disease control,
soil fertility studies, prevention of wind dam-
age and breaking dormancy in fruiting buds.

Summary

Limited studies with Lake Emerald grapes
in the Indian River area have involved the
production of vines on raised beds versus un-
bedded culture, and heavy mulching with
pangolagrass-clover hay versus no mulch.

Grape plantings made in the winter of 1955
and 1956 indicated that Lake Emerald grapes
would grow on low flat land Immokalee fine
sand if they were produced on raised beds.
In order to check these observations an experi-
ment was established in the winter of 1957.
Main plots (duplicated) were 12 feet wide
and 64 feet long with eight grapevines planted
at eight foot intervals. Two of these plots
were bedded 16 inches high and two were
left flat. Each plot was divided and a heavy
pangolagrass-clover mulch was placed on one-
half of each main plot.

The bedded grapevines grew off rapidly
and produced a fair crop of grapes. Mulching
bedded plots caused the vines to become too
vegetative at the expense of fruit production,
uniformity of maturity and quality. Vines in
the flat plots made very poor growth if un-
mulched, but made fair growth when mulched.

The following tentative conclusions were
drawn from these studies: (1) Lake Emerald
grapes can be produced on beds in low flat-
lands of the Indian River area, and bedded
grapes probably should not be mulched. (2)
If grapes must be grown un-bedded on wet
soil, a heavy organic mulch may be beneficial
in maintaining a shallow and effective root
system.

OBSERVATIONS OF THE EFFECT OF COLD ON LIMES IN
DADE COUNTY

Hugh Whelchel

Dade County Agricultural Department
Miami

The freezing weather of February 5 once
again brought home the fact that the Persian
or Tahiti Lime, although in the citrus family,
is basically a tropical fruit when viewed from
the standpoint of cold tolerance. Tempera-
tures as low as 25 and 24° were recorded
over the County for as long as five hours
with very little if any wind. Damage in gen-
eral seemed to increase directly with severity
of cold in the local area. However, many fac-
tors such as air drainage, elevation, wind-