ground to prevent rodent and mechanical damage. Only the ends of the microtubes are above ground.

After initial heavy use of the system, we settled on operation of the system 1½ hours per day, tempered by rainfall. The system is operated either by a manual switch or a timer switch.

The iron content of our water has created some problems. Initially, on the advice of a consulting chemist, we pumped from a ditch. This was done in the hope that all iron in open water would be precipitated and filterable. However, it was found that some soluble iron was still present and precipitated in the lines, causing problems. We have gone back to well water containing 5 ppm iron. We are injecting acid into the water to depress the pH and keep this iron in solution until it comes out of the microtubes. This method seems to work well. Constant vigilance is necessary when this type of water is used to prevent a buildup of iron precipitates. The response of the trees to this method of irrigation has been very pleasing. A sand filter and a 160 mesh screen filter are used to filter out particulate matter. A five horsepower motor turning a 3 inch centrifugal pump waters the entire tract.

The 94 acre tract has 6,015 trees set 18 ft. by 27 ft. This yields 68 net planted acres by tree count giving a 72% land use factor.

# INFLUENCE OF ROOTSTOCK ON COLD HARDINESS OF AVOCADOS

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*Abstract.* **Cold hardiness of 'Gainesville' and of 'Mexicola' avocados (Persea americana Mill.) in field trials at Gainesville was not influenced by rootstocks that varied widely in their resistance to cold. Cold hardy cultivars on cold-tender West Indian seedlings can be safely used if the trees are planted with the graft union approximately 4 in. (10.2 cm) below the soil surface to protect the bud union from cold.**

Avocado cultivars differ widely in their hardiness to cold. Cultivars of the West Indian (WI) race, such as 'Waldin', are damaged at temperatures only 2 to 3° F. (1.1 to 1.7° C) below freezing. Some cultivars of the Mexican (M) race such as 'Mexicola', will withstand temperatures of 15 to 20° F (—8 to —11° C) with only slight damage, and hybrids of the 2 races are often intermediate in their hardiness to cold (4, 5.). Moreover, seedlings of the West Indian race are all tender to cold and those of the Mexican race are generally cold hardy. Thus, it would appear advantageous to graft hardy Mexican cultivars on seedlings of the Mexican race. California nurserymen, who propagate field-grown seedlings that are T-budded when they reach proper size, often use Mexican seedlings. Florida nurserymen, however, who graft container-grown seedlings soon after germination prefer West Indian seedlings because they produce thicker stems at an earlier age and are easier to graft than Mexican seedlings. Texas nurserymen also use container-grown seedlings and also prefer West Indian rootstock because they are more tolerant to saline conditions. The use of West Indian-race rootstocks poses no problem for avocados grown in warm areas. Many Florida homeowners, however, grow specimen avocado trees in areas where only cold-hardy types can be used, and there is also increasing interest in the possibility of developing small commercial avocado plantings in colder areas.

Cultivars of citrus (1), a broad leaf, subtropical evergreen, are less hardy to cold when grown on certain rootstocks, hence there is reason to assume avocados might be similarly influenced. Research reported here was designed to determine whether there is a relationship of rootstock to the cold tolerance of hardy avocado cultivars.

## Materials and Methods

Ten trees each of the 'Gainesville' (M) cultivar were propogated as rooted stem cuttings (CR), on 'Waldin' (WI) seedling rootstock (WR), on 'Mixicola' (M) seedling rootstock (MR) and on 'Brogden' (M x WI) seedling rootstock (BR). Plants were grown for 1 season in 8-inch pots and

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transplanted to the field in April, 1966. Trees were set out at random in the center of the cultivar test block at Gainesville on a 10 x 15 ft. (3 x 4.6 m) spacing and with the graft unions 4 in. (10.2 cm) below the soil surface to protect them from cold. Above-ground portions of the trunk and lower framework branches were also protected from cold the first winter by banking them with soil.

Five trees each of 'Mexicola' on 'Waldin' and 'Mexicola' seedling rootstocks were planted alternately in a single row at the northwestern edge of the cultivar test block in 1969 and handled in a similar manner.

Minimum temperatures were measured with mercury thermometers shielded in standard temperature shelters in the cultivar planting. Heaters were occasionally used to protect small trees not in the rootstock trial but no heat was provided on several occasions when temperatures were sufficiently low to cause damage. Trees were inspected periodically after given freezes and rated as to the damage suffered, Tables 1,2. Trees damaged negligibly or not at all were rated 1. Three degrees of severity of leaf, twig and limb damage respectively were assigned ratings of 2 through 10, with a rating of 10 indicating the severest injury.

## Results and Discussion

Data in Table 1 indicate the 'Gainesville' avocado was equally hardy on rootstocks that varied widely in their ability to withstand freezing temperatures. Cold tolerance of 'Mexicola' on seedling 'Waldin' and 'Mexicola' rootstocks, respectively, was also equal; however, these tests were less extensive than those with 'Gainesville'. All 1-year-old 'Gainesville' and 'Mexicola' trees were killed to the protective soil banks at 18 F (—7.8 C) and 19 F (—7.2 C) respectively, while older trees suffered only slight damage at similar temperatures. The greater damage to the 1-year-old trees was at least partly due to their inability to trap warm air arising from the ground, as does the large dense canopy of older ones. The trees grew very rapidly the second year and formed a dense canopy. 'Gainesville' trees were not subjected to a severe freeze the second winter but they suffered only slight damage, at 20 F (—6.7 C) the third year. Two-year-old 'Mexicola' trees withstood 20 F (—6.7 C) with only slight damage. The data are not precise because they are based on subjective judgments following freezes in which only ambient air temperatures were measured. Temperatures of plant tissues in a given freeze may be appreciably different from those in another one in which air temperatures are similar. Freeze damage, as indicated by necrosis of damaged parts, is often not evident for several weeks or even months. Other freezes may occur in the meantime and thereby confound the results. Thus, one can not conclude from the data that a rootstock may not slightly influence the cold hardiness of the cultivar grafted on it. The generalization that rootstock does not appreciably affect the cold hardiness of cold hardy avocados is valid. Thus, growers can safely use cold-hardy cultivars grafted on West Indian rootstocks if the graft unions are protected by placing them about 4 in. (10.2 cm) below the soil surface. Previous experience does indicate that the West Indian portion of the trunk will freeze if it is not protected.

Roots did not form on the scion portion of the trunk below the soil surface with any of the combinations. Scion rooting, however, would not be harmful because 'Gainesville' trees produced from rooted stem cuttings appeared to grow as well as those on the various rootstocks. Growth of trees on all rootstocks was extremely vigorous with

Table 1. Evaluation of freeze damage to the Gainesville cultivar on several different rootstocks.

| Year | Tree age | Minimum temp | Rootstock[1] RC | WR | BR | MR |
|---|---|---|---|---|---|---|
| | | (F) (C) | (mean damage rating)[2,3] | | | |
| 1966-67 | 1 | 26-3.3 | 2.9 | 2.7 | 2.8 | 3.0 |
| | 1 | 18-7.8 | 10.0 | 10.0 | 10.0 | 10.0 |
| 1967-68 | 2 | 25-4.0 | 2.1 | 2.2 | 2.4 | 2.1 |
| 1968-69 | 3 | 20-6.7 | 3.1 | 3.3 | 3.1 | 3.0 |
| 1969-70 | 4 | 19-7.2 | 2.7 | 2.5 | 2.6 | 2.8 |
| 1970-71 | 5 | 18-7.8 | 2.4 | 2.4 | 2.2 | 2.5 |
| 1971-72 | 6 | 24-4.4 | 1.0 | 1.0 | 1.0 | 1.0 |
| 1972-73 | 7 | 25-4.0 | 1.0 | 1.0 | 1.0 | 1.0 |

1 Rooted cuttings (RC); Waldin rootstock (WR); Brogden rootstock (BR); Mexicola rootstock (MR)

2 None (1), slight (2), moderate (3), severe (4) leaf damage; slight (5), moderate (6), severe (7) twig damage; slight (8), moderate (9), severe (10) damage of limbs up to 1-in. in dia.

3 No statistical differences between mean damage ratings following any given freeze.

Table 2. Evaluation of freeze damage to the Mexicola cultivar on several different rootstocks.

| Year | Tree age | Minimum temp | Rootstock[1] WR | MR |
|---|---|---|---|---|
| | | (F) (C) | (mean damage rating)[2,3] | |
| 1969-70 | 1 | 19-7.2 | 10.0 | 10.0 |
| 1970-71 | 2 | 18-7.8 | 3.4 | 3.6 |
| 1971-72 | 3 | 24-4.4 | 2.6 | 2.5 |
| 1972-73 | 4 | 25-4.0 | 2.3 | 2.4 |

1 Waldin rootstock (WR), Mexicola rootstock (MR).

2 None (1), slight (2), moderate (3), severe (4) leaf damage; slight (5), moderate (6), severe (7) twig damage; slight (8), moderate (9), severe (10) damage of limbs up to 1-in. in dia.

3 No statistical evaluation made.

observations that those on West Indian rootstock were no more vigorous than any of the others.

The lack of rootstock influence on cold tolerance of hardy avocado cultivars is probably due in part to the lack of pronounced domancy in the winter. Mexican race cultivars begin blooming in late December and continue through February and even into March in some years. Blossoms and occasional new shoots formed in the winter are killed by relatively mild freezes but new ones arise which may in turn be killed by a later freeze. Mature vegetative portions of the trees remain quite hardy, however, throughout the winter. Hardiness to cold does not appear to be related to whether trees are in or out of bloom, nor does cold tolerance of avocados appear to rise and fall following periods of cold and warm weather, respectively, as reported for citrus. Research with cold-hardy avocados in Texas support these observations (3). West Indian cultivars bloom later than those of the Mexican race, suggesting more pronounced dormancy in the former, and yet they are more tender to cold. Thus, any slight influence which rootstocks might have on dormancy or vigor of growth, factors commonly related to cold hardiness in many other fruit crops, was unimportant.

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# THE 'TOMMY ATKINS' MANGO

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*Abstract.* **The 'Tommy Atkins' mango developed from a seed planted in the early 1920's near Ft. Lauderdale, Florida. The heavy fruit production and outstanding red color of the fruit attracted favorable attention of local people and additional trees were grafted about 1945. As more trees came into bearing it became evident that the fruit had good shipping quality and considerable resistance to anthracnose disease. Commercial mango growers recognized the potential of the 'Tommy Atkins' and began to plant orchards of grafted trees in the late 1950's. Recently this variety has been planted more than any other in Florida. Internal breakdown of the fruit is a serious problem in some years.**

Many interesting and valuable mango varieties have originated in Florida. These have become well known in other areas of the world where mangos are grown. One variety which has received much attention recently is the 'Tommy Atkins'. Brief descriptions of this variety have been published by Popenoe (3), Ledin (2) and Campbell and Malo (1).

The present account contains a detailed description, based on field and laboratory observations, and a history compiled from the records of the Florida Mango Forum and the University of Florida Agricultural Research and Education Center, Homestead, and from information supplied by Florida mango growers[1].

## History

The original Tommy Atkins tree grew from seed of unknown parentage planted about 1922 in an orchard in Broward County, Florida, north of Ft. Lauderdale. The exact year it first bore fruit is not known, but apparently it was in the early 1940's. The outstanding color of the fruit attracted the attention of Mr. T. H. Atkins, who believed that it had potential as a commercial variety.

About 1945 Mr. Atkins decided to graft additional trees and offer them for sale in containers. Trees were first sold in 1948.

Fruits were submitted several times to the Variety Committee of the Florida Mango Forum for evaluation. Existing records indicate that fruits were submitted in 1947, 1949, 1950 and 1951, but there is reason to believe that the first evaluation was earlier than 1947. The fruit attracted favorable attention particularly because of its color.

[1]Mr. Ed Mitchell was particularly helpful as a source of information.