tigation is beyond the scope of this present study. We plan further studies of Florida minimum temperature records which may help to ascertain the usefulness of these techniques in connection with other techniques to better predict and understand the risk of cold weather damage to horticultural crops in Florida.

Literature Cited

1. Baron, W. R., G. A. Gordon, H. W. Borns, Jr., D. C. Smith. 1984. Frost-free record reconstruction for eastern Massachusetts, 1733-1980. J. Climate and Appl. Meteor. 23:317-319.
2. Brooks, C. E. P., and N. Carruthers. 1953. Handbook of statistical methods in meteorology. AMS Press. N.Y.
3. Cayan, D. R., and A. V. Douglas. 1984. Urban influences on surface temperatures in the southwestern United States during recent decades. J. Climate and Appl. Meteor. 23:1520-1530.
4. Climatological Data. 1897-85. Climatological Data for Florida. National Climatic Data Center, NOAA, Asheville, N.C.
5. Davis, T. F. 1910. The cold waves of the Florida Peninsula. A. B. Caldwell, Tallahassee, Fla.
6. Davis, T. F. 1937. Early orange culture in Florida and the epochal cold of 1835, Fla. Hist. Quart. 15:232-241.
7. Douglas, T., 1856. Autobiography of Thomas Douglas, Calkins and Stiles, N.Y.
8. Florida Citrus Mutual. 1984. Triangle. Vol. 34, No. 31.
9. Florida Citrus Mutual. 1985. Triangle. Vol. 35, No. 31.
10. Johnson, W. O. 1963. The big freeze of December 1962. Weather Forecasting Mimeo 63-1. Federal-State Frost Warning Service, Lakeland, Fla.
11. Karl, T. R., R. E. Livezey, and E. S. Epstein. 1984a. Recent unusual mean winter temperatures across the contiguous United States. Bul. Amer. Meteor. Soc. 65:1302-1309.
12. Karl, T. R., G. Kukla, and J. Gavin. 1984b. Decreasing diurnal temperature range in the United States and Canada from 1941 through 1980. J. Climate and Appl. Metero. 23:1489-1504.
13. Mearns, L. O., R. W. Katz, and S. H. Schneider. 1984. Extreme high-temperature events: Changes in their probabilities with changes in mean temperature. J. Climate and Appl. Metero. 23:1601-1613.
14. Mitchell, A. J., and M. R. Ensign. 1928. The Climate of Florida. Bul. 200. Univ. Fla. Agr. Expt. Sta.
15. Mitchell, J. M., Jr. 1953. On the causes of instrumentally observed secular temperature trends. J. Meteor. 10:244-261.
16. Sanders, M. L. 1980. The great freeze of 1894-95 in Pinellas County. Tampa Bay History. 2:5-14.
17. Thompson, R. C., R. A. Miller, and S. H. Crawford. 1983. Climate at the northeast research station. Louisiana Agr. Expt. Sta. Louisiana State Univ.
18. Vining, K. C., and J. F. Griffiths. 1985. Climatic variability at ten stations across the United States, J. Climate and Appl. Meteor. 24:363-370.
19. Wigley, T. M. L. 1985. Impact of extreme events. Nature. 316:106-107.
20. Wilbur, H. S. 1929. Loyalists in East Florida. Fla. State Hist. Soc. 1:68-69.

Proc. Fla. State Hort. Soc. 98:46-48. 1985.

CITRUS TREE LOSSES FROM 1983 AND 1985 FREEZES IN FOURTEEN NORTHERN COUNTIES

HARRY M. WHITTAKER,
Agricultural Statistician Supervisor
Florida Crop and Livestock Reporting Service
1222 Woodward Street, Orlando, Florida 32803

Abstract. **Florida's Citrus Industry suffered the greatest tree losses of the century during the Dec. 1983 and Jan. 1985 freezes. These freezes seriously curtailed all citrus production in Florida, previously the world's largest producer of citrus products. These freezes also played havoc with the Crop and Livestock Reporting Service's citrus forecast projections. A reliable citrus forecast depends upon accurate assessment of tree age, type, and numbers. In an attempt to measure tree loss, this office began a survey in the spring of 1985 of the fourteen Upper West Coast and Upper Interior counties where damage was most severe. Prior to these freezes there were more than 275,000 acres of commercial citrus in these 14 counties. Fieldmen visited each separate block and determined the percentage of live trees of each age group and type of citrus. All trees set before 1984 were counted and included in this report. Many growers and caretakers helped by giving tree counts and variety identification.**

The northern portion of the Florida Citrus Belt has suffered severe acreage and tree loss as a result of catastrophic freezes in Dec. 1983 and Jan. 1985. In Mar. 1984, growers and other citrus related organizations began asking the Florida Crop and Livestock Reporting Service for a report on the acreage lost during the first of these freezes. In the aftermath of the 1985 freeze, these organizations, Citrus Crop Estimates Committee; Florida Citrus Mutual; Department of Citrus; Florida Citrus Processors; University of Florida; and several large independent growers, had an even greater desire to know the extent of the freeze losses.

Total Florida citrus acreage as of Aug. 1985 is no more than 642,856 acres. This is the smallest number of total acres in Florida since Dec. 1956 when there was 603,060 acres. By 1965 there were 858,082 acres and in Dec. 1969 there was the all time high acreage for all citrus in Florida at 941,471. The current acreage is 24% less than was reported in the Jan. 1982 census. The 1984 and 1985 set trees were not considered in this report so as to make the data comparable to the 1984 Commercial Tree Inventory. Neither time nor aerial photography was available in 1985 for a complete acreage update.

The counties most severely affected by the freeze were Hillsborough, Pasco, Hernando, Citrus, Lake, Orange, Sumter, Seminole, Volusia, Marion, Alachua, Putnam, Flagler, and St. Johns (Fig. 1). It was clear that each separate variety or age block would have to be visited in order to provide the citrus industry with sound, reliable information. We had all read reports on various surveys, observations, and quotes from newspapers and there was a distinct need for a block by block report.

Methodology

The Florida Crop and Livestock Reporting Service has each block of citrus in the State of Florida identified as to variety, year planted, spacing between rows, and number of trees and acres. This information is indexed by section,

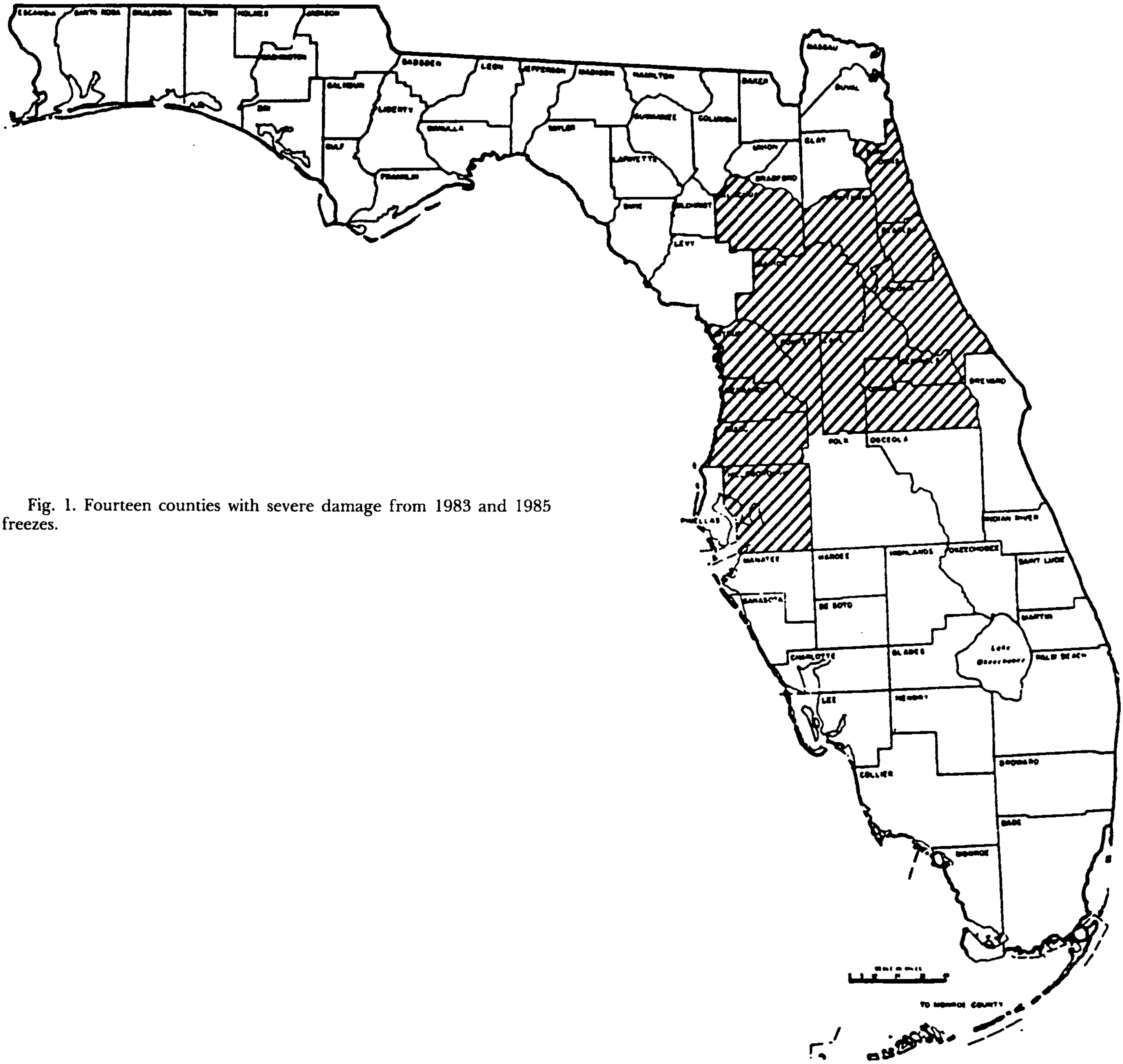

Fig. 1. Fourteen counties with severe damage from 1983 and 1985 freezes.

township, and range and delineated on aerial photograph enlargements. This tree census program began in 1965 when aerial photography was first used as a survey technique and has been subsequently updated every 2 years. A hired aerial contractor photographs the entire citrus production area of the State, flying along specified flight lines at an altitude of 15,000 feet. The result is a set of overlapping contact prints showing 9 square miles each. The office staff then reviews these prints, comparing each with the matching print from 2 years previous. Citrus groves that appear different are questioned and fieldmen are dispatched to these areas to determine the exact nature of the change; namely, the number of trees lost or gained, the change, if any, in spacing, or identification of a previously unidentified grove.

Five full time tree census employees visited 86,333 different variety blocks in 2,334 land sections to determine the percentage of trees alive in each block. Each separate grove or block of citrus was judged dead or alive by the growth in the scaffold of limb division of the trees. In addition, if a grove had shown no signs of cultural care in more than a year it was considered abandoned. If any portion of a block was still alive, the block was either counted or sampled to determine the percent of the original tree number still living. In many instances, this work was aided by the growers and caretakers who provided recent tree counts or other information concerning new resets.

Results and Conclusions

The total citrus acreage for the 14 northern counties peaked in 1968 at 374,859 acres (Table 1). Currently, there are only 58,973 acres remaining in these counties and several thousand of those considered to be alive are question-

Table 1. Total citrus acreage in freeze damaged counties which were not enumerated independently during 1984 census.

County	1966	1968	1970	1972	1974	1976	1978	1980	1982	1984	1985
Citrus	1,831	2,343	2,222	1,536	1,447	1,379	1,280	1,260	1,256	*	35
Hernando	9,242	9,360	9,150	6,998	6,604	6,717	6,554	6,765	6,471	*	126
Hillsborough	59,276	60,729	59,727	42,912	40,397	39,750	38,163	37,976	37,631	*	24,111
Lake	139,868	143,153	142,796	132,674	129,570	126,016	123,246	122,777	117,730	*	12,183
Marion	14,436	14,342	13,988	11,784	11,223	11,327	11,272	11,484	11,396	*	198
Orange	65,817	68,005	65,961	60,567	56,320	54,007	51,174	50,672	48,547	*	16,670
Pasco	40,420	42,701	42,331	36,785	35,940	34,286	33,367	33,314	33,425	*	2,949
Putnam	5,113	4,944	4,709	3,440	3,329	3,041	2,692	2,631	2,464	*	4
Seminole	12,835	13,418	12,067	10,969	9,120	8,276	7,635	7,202	6,823	*	1,360
Sumter	2,413	2,443	2,379	1,771	1,677	1,760	1,760	1,772	1,593	*	62
Volusia	12,521	12,850	12,324	11,682	11,171	10,728	10,227	10,143	9,810	*	1,275
Others 1/	477	571	541	484	481	474	426	398	390	*	0
Above Totals	364,249	374,859	368,195	321,602	307,279	297,761	287,796	286,394	277,536	177,482	58,973

1. Combined data for Alachua, Flagler, and St. Johns counties.

able at best and may be abandoned when visited during the 1985-86 tree census survey.

Lake County, by far, suffered the greatest acreage loss of all counties in Florida. There were 143,153 acres of all types of citrus in 1968 and now there are just 12,183 acres of trees in commercial production with a 1983 or older plant date.

The smallest percentage loss of acreage occurred in Hillsborough County, the southernmost of the 14 counties included in this survey. Most of this county's loss was concentrated in the northern and northwestern area. As of July 1985, there were 24,111 acres of all citrus in that county. That is a 60% decrease from the 60,729 acres reported in 1968.

In the 1968 record year, Alachua, Flagler, and St. Johns counties collectively totaled 571 acres, only 0.06% of the State's citrus acreage. As of the 1985 survey, these three northern counties showed a complete loss of all commercial citrus.

Proc. Fla. State Hort. Soc. 98:48-52. 1985.

SATELLITE THERMAL IMAGERY ESTIMATION OF AIR TEMPERATURE IN GROVES DURING ADVECTIVE FREEZES

J. DAVID MARTSOLF AND PAUL H. HEINEMANN
University of Florida, IFAS
Fruit Crops Department
Gainesville, FL 32611
JOHN L. JACKSON
Cooperative Extension Service, IFAS,
Tavares, FL 32778

Additional index words. climatology, remote sensing, networking, citrus.

Abstract. **Four major freezes have occurred in Florida during the last 5 winters. The 2 most recent freezes, Dec. 1983 and Jan. 1985, were advective freezes and are frequently referred to as the worst freezes of this century. Thermal maps developed during and following these freezes from infrared sensings made by GOES were used extensively to document the relative severity of these freezes. The satellite thermal maps indicated higher temperatures than those measured by thermometers in groves. The mechanism responsible for this difference is termed thermal inertia (TI, which also indicates temperature increase). In Lake and Orange Counties, TI values for the 1983 and 1985 advective freezes averaged from 2.4 to 7.8°F. Satellite-sensed and grove temperature observations were compared to indicate the areas in which the 1985 freeze was colder than the 1983 freeze, and the magnitude of these differences. A simple model is suggested for estimating the magnitude of TI and using such procedures in programs designed to automatically estimate grove temperature from satellite during future advective freezes.**

Florida Agricultural Experiment Stations Journal Series No. 7220.

The term "thermal inertia" (TI) was introduced recently as an explanation for the tendency for temperatures sensed by the GOES satellite to be higher than ground temperatures in citrus groves during the Dec. 1983 freeze (6,7,14). Prior to this freeze, excellent agreement between satellite-sensed temperatures and those measured by conventional instruments had been reported during clear, cool, nocturnal conditions in Florida (1,2,3). County extension citrus specialists acquired satellite data in real time and documented the agreement of such data with grove thermometer data during the frosts and freezes of 1981 and 1982 (9,13,15). These data were disseminated as black and white symbols maps (9,13), color prints of the TV images (6,9,10), and as color TV displays on the Satellite Frost Forecast System (SFFS) (7,11,12). Prior to the 1983 freeze, satellite thermal maps of Florida were considered to be very accurate documentation of the temperature distributions and they provided greater detail than had been possible before the 1977 freeze. However, thermal map interpretation of the advective freeze of 1983 presented problems due to both TI and cloud cover (6,7,14).