

Certification Committee. As a follow-up to that report I am happy to inform you that the State Plant Board now has in operation an active citrus budwood certification program and we should have certified trees available from commercial nurseries in the next three or four years.

In the early years of our Society interest was centered largely around citrus production problems. As the years went by new sections, with separate programs, were added until today we have the five sections. Our scientists and research workers have solved many of our problems and Florida is now the largest citrus producing area in the world and the winter vegetable garden of the United States. There is still one particularly knotty problem which needs a great deal of study. The little matter of obtaining satisfactory returns for our products. I believe the time has come when this Society should "put its shoulder to the wheel" and assist in the formulation of better methods for harvesting, packing and marketing our fruits and vegetables. It is not enough to grow them successfully, we must market them in such a manner that we are assured of a profitable return.

I think our Society can be justly proud of the part it has played in the activities of the Florida Agricultural Council. Our delegation, composed of Mr. Dexter Sloan, Chairman, Mr. George Wedgeworth, Mr. Kingswood Sprott

and Mr. Frank L. Holland, assisted in preparing the agricultural budget and obtaining an increase in appropriations amounting to nearly two million dollars for the biennium. In addition, the legislature approved a sum of over two and one-half million for new buildings. These much needed appropriations were obtained through the united effort of our agricultural interests plus the help and sympathetic understanding of our late Governor, Dan McCarty.

I would like to take this opportunity to express my appreciation to my fellow officers and members of the executive committee for their complete cooperation and assistance in managing the affairs of the Society throughout the year. I particularly wish to commend our Secretary, Dr. Ernest L. Spencer, for his untiring efforts and diligence in performing his share of the work for the Society. Our Editing Secretary, Mr. Lacy Tait and our Publication Secretary, Mr. Ralph Thompson, have done an excellent job in publishing the Proceedings in record time.

We have with us tonight a man who needs no introduction for he has been a member of this Society for many years. We have selected him to represent us as one of our Senators in Washington. We are proud to claim him as a Floridian and confident that he will never betray our trust. It is my privilege to present Senator Spessard L. Holland, Florida's senior Senator, who will introduce our guest speaker for the evening.

COSTA RICA AND ITS AGRICULTURE

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San Jose, Costa Rica

The opportunity of attendance at this meeting of the Horticultural Society is indeed a most gratifying privilege. For me, this visit is in the nature of a homecoming since I can say with all sincerity that here among Florida horticulturists I do feel at home.

Having just returned from two most pleasant years in the Republic of Costa Rica I should like to tell you something of that delightful little tropical country and its agriculture.

Costa Rica is the southernmost of the five Republics comprising Central America. Its area is approximately 20,000 square miles and its topography for the most part is ruggedly mountainous. Presumably nearly the whole of the country was at one time covered with forest; presently perhaps two-thirds of the area is yet wooded, much of it inaccessible to lumbering operations. Two high mountain ranges traverse the country from northwest to southeast, the northernmost a chain of dormant or mildly active volcanoes, some of which are about 12,000 feet high.

The soils of a goodly portion of the area are of volcanic origin and are highly fertile. The

balance of the soils may be grossly classified as alluvial and as laterites of metamorphic and sedimentary origin. The latter generally are of low fertility as compared to the volcanic. Commercial fertilizers are as yet used but little and average crop yields are low on the poorer soils.

As with most other regions of the American Tropics, elevation differences have resulted in three distinct but merging climatic zones; the hot lowlands (*tierra caliente*); intermediate or temperate (*tierra templada*); and the cool or cold highlands (*tierra fria*). Widely varying ecological conditions occur with altitude differences, which affect not only native vegetation but also the nature of the cultivated crops. Many of the latter are adapted to one zone but not to the others. This situation permits production of both tropical and temperate crops ranging from bananas and mangoes to peaches and apples, and rice and sesame to oats and potatoes. Different corn varieties are required for the different altitudes; in the coastal areas corn matures at about four months, while at elevations of some 8,500 feet, believe it or not, 13 months are required. Some 40 different vegetables are grown, most at altitudes of 4,000 to 8,000 feet. Light frosts at the extreme elevations are not uncommon in January and February.

Seasons are determined by rainfall rather than temperature differences. On the Pacific side of the continental divide there are distinct wet and dry seasons each of about 6 months' duration, except in the highlands where there is some rainfall throughout the year. On the Atlantic watershed rainfall is well distributed throughout the year. Amounts vary in the different areas from 45 to 200 inches annually.

The native flora is exceptionally varied and abundant, many species occurring here that are present in both the North and South American continents. They include nearly 1,000 orchid species, some 1,600 trees, 284 grasses, and 88 genera of legumes of which many are trees.

The scenery of the country is superb. Except for some of the coastal areas, the most of the terrain is mountainous and ruggedly rough. Grass, shrubs and trees cover all uncultivated areas and the greenness of all landscapes is most striking. Some of the steep mountain slopes are intensely cultivated, and the innum-

erable irregularly shaped fields—each outlined with living trees as fence posts—present a scenic beauty seldom duplicated.

Much of the country's area is yet undeveloped and difficult of access because of lack of roads which are quite expensive to build. Local plane service connects many outlying regions with San Jose, the capital city, but transportation costs for most agricultural products by air is prohibitive. Narrow-gauge rail lines connect San Jose with seaports on both coasts. One of these lines is electrically powered. Some 8 or 9 hours on the fastest passenger trains are required to traverse the approximate 200 miles from ocean to ocean. A network of good paved highways—which are mostly a continuous series of sharp curves and rather steep grades—connects most of the towns of the heavily populated central regions. The Inter-American highway, *crossing the country from Nicaragua to Panama*, is approximately two-thirds completed and will be of inestimable aid to future agricultural development. Automobiles and trucks are yet comparatively few and there is no traffic congestion except at times on the narrow streets of San Jose. Much of the hauling is by ox-drawn carts of which there are some 15,000.

Some 70 per cent of the country's 800,000 population and most of its agricultural activity, exclusive of bananas, aboca and cacao, are centered on the Meseta Central—a rough plateau some 35 by 60 miles in extent with an elevation range from 2,500 to 5,000 feet. The capital, San Jose, with a population of some 100,000, is located on this Meseta. Thus a small area of the country is densely populated and the rest mostly sparsely settled. The equable climate and the adapted altitudes and soils for coffee of the Meseta, and lack of roads in other areas account largely for the present distribution. Even though Costa Rica's birth rate is the highest in the western hemisphere, its presently uncultivated areas can take care of a greatly increased population.

Costa Rica's economy is almost wholly dependent upon agriculture. Coffee, bananas, cacao and Manila hemp are the leading efforts and principal sources of foreign exchange. A large acreage is devoted to crops for internal consumption which are mainly corn, rice, beans, sugar cane and tobacco. The scope of the plantings and production were as follows according to the 1950 Agricultural census:

	Acreage	Production
Corn	136,000	64,000 tons
Beans	63,000	11,000 tons
Rice	55,000	20,000 tons
Coffee	120,000	45,000,000 pounds
Sugar cane	42,000	
Bananas	65,000	14,500,000 stems
		11 million exported in 1952
Cacao	53,000	10,000,000 pounds
Potatoes	3,600	8,600 tons
Yuca (Cassava)	3,500	7,900 tons
Tobacco	3,500	1,900,000 pounds

A wide range of fruits, comprising some 35 kinds are grown. Some, as the orange, banana and papaya, are available the year round, but most are seasonal in their periods of maturity.

Specialty crops are relatively few in number and the products rather limited in quantity. The African oil palm is now one of the chief sources of edible oil. Rubber (*Hevea*) production is confined to about 2,500 acres, but with disease-resistant and high latex producing clones, which have been undergoing successful test, the area appears to have high potentials. Some 5,000 acres of aboca are in production, with further suitable lands available for expansion. Cinchona plantings have been made in two areas and teak is growing in an experimental way. Most of the country's local cordage needs are supplied by the locally grown and manufactured fiber of the *Cabuya plant (Furcraea cabuya)*. Several kinds of cut flowers are grown for local markets, with some exportation of carnations and gladiolus.

The country is largely self-sufficient in the production of corn for human consumption, rice, beans, beef, sugar, fruits, vegetables and dairy products. Were the incomes of those in the lower brackets stepped up, however, consumption of meat, dairy and poultry products and some vegetables undoubtedly would be appreciably increased. Swine are comparatively few in number, due largely to a lack of grains for feeding. It is apparent that too great a proportion of foodstuffs are imported, the food imports being mainly wheat and flour, oatmeal and other cereals, lard and edible oils and miscellaneous items, all of which are said to constitute over one-seventh of the total imports. Generally, diets are said to be insufficiently varied and inadequate to meet accepted standards.

Coffee, which was introduced about 150 years ago, is the leading crop. Some 120,000 acres are grown and produce an annual income of approximately \$35,000,000. Because of unavailability of suitable lands there now is little

room for expansion unless other crops are taken out of production. The plant thrives best at elevation between 2,000 and 5,000 feet. Varieties are almost wholly the "arabico" and Bourbon or "hybrido," both of the species *arabica*. All the acreage is grown under shade of leguminous trees, chiefly *Inga* and *Erythrina* sp. Bananas and plantains are used extensively for shade, but not as permanent plantings.

The coffee cherries are hand picked (there are from 3 to 13 pickings annually) and processing is by the so-called wet method. The quality of Costa Rican coffee rates with the highest. From planting to harvest the whole of the operation is performed by hand labor. Much of the acreage is on such steep slopes that mechanization of any sort would be exceptionally difficult. Yields have decreased from those of the early days of the industry; currently they are the lowest per acre in Central America. This situation probably is due to both diseases and soil depletion, and also in lesser degree to insect damage. Chemical fertilizers are used sparingly, by no means universally, and spraying for disease control is just now beginning. It is significant that deficiencies of zinc, boron and manganese in coffee were recently identified by the staff of the Ministry of Agriculture, these findings being the first of the kind on this plant anywhere. A serious depletion of exchangeable soils bases, mainly calcium and magnesium, has been found in some areas.

In the highland areas are many dairy herds of Jersey, Guernsey, Ayershire and Holstein breeds. These are pedigreed stock equivalent in breeding to some of the best in the United States. Per capita milk consumption in Costa Rica probably is the highest in Central America, which probably accounts at least in part for the healthy appearance and lively activity of the children—of which, incidentally, there is no shortage.

Dairy and beef cattle comprise some 600,000 head. The latter are mainly "criollos" which are descendants of the cattle brought from Spain in past centuries and probably of similar ancestry as Florida's "native" cattle. They are considerably larger than the Florida native stock and are being improved, as in Florida, by introduction of Brahman sires.

I should like to emphasize that Costa Rica's agriculture is complementary to that of the United States and is not competitive. Improvement of its agriculture helps to assure us of a

greater and probably cheaper supply of products which we need and cannot produce because of climatic requirements.

Costa Rica is indeed rich in its agricultural potentials. But the "practical" methods in use since the 16th century must be supplemented by mechanization and the findings of modern research in order that increased production may be achieved at lowered costs. Most work is done manually rather than by machine. Less than 500 tractors are in use. Most of the plowing is with oxen and nearly all tillage is by

hand labor. Organized agricultural research was initiated by the Costa Rican Government only some three years ago, and the need for investigational work is similar to and as great as that of Florida's. With limited exception, it is to be stressed that the efficient agriculture which Costa Rica must develop is dependent in great measure on an adequate and forceful program of agricultural research, extension and education. Such a program is now established and Costa Ricans may be depended upon to maintain and enlarge it.

SOIL MICROBIOLOGY CONTRIBUTES TO FLORIDA AGRICULTURE

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Thank you for the opportunity to tell you of some of the work we have been doing in soil microbiology in recent years. But first, let me discuss with you briefly the practical importance of soil microbiology to our agriculture and review some of the recent advances in basic soil microbiological research.

Everyone is familiar with germs and the diseases they cause in humans, the lower animals, and plants. The importance of medical microbiology is easily understood and appreciated by everyone, but soil microbiology and the part it plays in crop production are not so well understood. To the layman microbes, germs, or bacteria mean test tubes, microscopes, masks, white-coated laboratory technicians, and sometimes anxiety. This is also probably one of the largest stumbling blocks to the soil microbiologist. He isolates the soil microbes, grows them in pure culture on artificial media, and then expects them to perform the same way in the soil as they do under laboratory conditions.

This is not to say that the pure culture study of soil microorganisms is not necessary nor desirable. However, it would appear that the soil microbiologist needs to reorient himself occasionally. He must study the microbes in

their native habitat—the soil—and devise soil management practices which will produce desired reactions. The soil microbiologist must learn to control soil conditions much as the chemical engineer controls temperatures and pressures, to use catalysts, to stimulate one portion of the soil population while another is checked, to promote desired reactions and depress undesirable products. Until we learn to do some of these things better than at present, soil microbiology will, no doubt, remain less well known than some other phases of soil fertility.

IMPORTANCE OF SOIL MICROBIOLOGY

It isn't necessary to dwell on the importance of soil microbiology to convince anyone of the necessity for our attention to the subject. That has probably been done too well. We find our public disappointed because the science has not revolutionized agriculture as microbiology did the practice of medicine soon after Koch discovered that bacteria can produce disease. However, it will not be considered out of place, I believe, to call attention to the diverse soil population and the activities of the soil microorganisms that may be applied to the maintenance of soil fertility and the economic production of crops.

It staggers the imagination when one considers that the population of the soil microorganisms is more diverse than that of all the animals on the earth. Think for a moment of all the hustle and bustle at the rush hour in a big city—the hum of the motors, the screeching of brakes, the blasts of horns of automobiles,