琉球列島における園芸の将来性

Horticultural Possibilities in the Ryukyu Islands[1)]

By

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The word Horticulture implies many things aside from its root meaning garden-culture. Its meaning and implication goes farther than that since it involves not only growing of fruits, vegetables, flowers, shrubs and trees, but also, handling, storing, processing and marketing of all the products of Horticulture. Furthermore, the basic problems in production are many and varied, comprising soil management, fertilization, pest control (insects, diseases and weeds), harvesting and many others.

General Agricultural Aspects

During the past decade many changes have taken place in Okinawa. Indeed many industries have sprung up which have improved the general economy here, however, agriculture has not advanced as rapidly in comparison and is still lagging behind in progress. Probably the chief reason for this lag in agriculture lies in the habit of farmers to grow only certain crops such as rice, sugar cane and sweet potatoes on the same land year in and year out. Although, these crops are the "staff-of-life" they do not provide variety of diet and interest in farm culture so much needed among the people. Important factors such as crop diversification, rotation, fertilization, variety improvement and pest control are still new concepts to most farmers.

The demand for fresh and processed Horticultural crops in Okinawa and surrounding areas in the Far East is much greater than the supply, so it will take several decades to close this gap. Each day, more people become familiar with and consume more old and new Horticultural varieties. Consequently, every effort will have to be expended in the future to increase the supply of vegetables and fruits. Along with the production of Horticultural crops, the processing industry must be developed to preserve the quality in these essential human foods for markets in this area.

At present a certain amount of cabbage and tomatoes are grown in Okinawa ; however, more horticultural varieties of vegetable, fruits,

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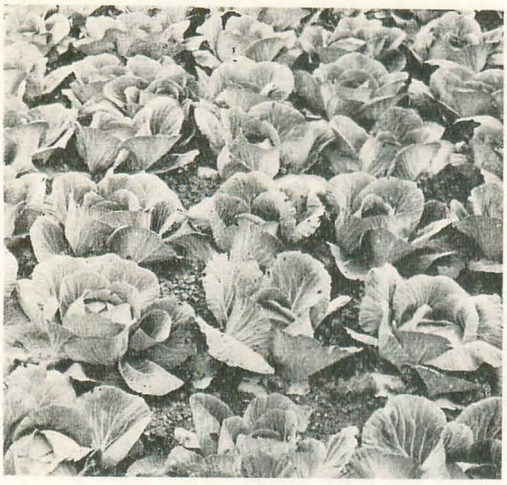

Fig. 1. Section of a field showing the uniform and satisfactory growth of cabbage during the colder season of the year. Successive plantings can be made from September to March.

flowers and ornamentals need to be brought into the cultural pattern in the future to bring about a diversified type of agriculture (Fig. 1). This is essential not only to improve the economy in the Ryukyu Islands but also to enhance the dietary habits and health of the people. The climate here is ample in sunshine and rain fall, for twelve months of the year so that many horticultural crops rich in essential food elements and vitamins can be produced.

Soils are Adaptable to Horticultural Crops

Most of the soils in Okinawa now under cultivation are suitable for production of Horticultural crops; however, they have been under cultivation for centuries and are low in essential minerals and of poor structure. In general, the soils have a certain amounts of clay in them varying from the so-called Shuri clay which is a heavy clay soil to that of Ishikawa loam which is a lighter soil type. The lowlands are very suitable for rice production for which they are now used. The up-land soils just described adapt themselves readidly to most horticultural varieties, especially so, if the structure is improved by use of manure and green manure crop in the rotation.

Since agricultural land is at a premium, it appears unlikely that the farmer will grow a crop and plow it under in order to improve the soil. Anything produced always finds immediate use either for animal or human food or both. However, the farmer may be persuaded to set aside a small portion of his land for annual soil improvement as a part of a crop rotation system.

The soil also could be improved by more efficient use of crop residue. At present, as has been the custom in the past, the crop residue is piled and burned with the belief that the ash is good for the soil and also that the crop pests are destroyed. Both of these reasons are partly true; however, much of the fertilizer value especially the nitrogen is lost by this method. A more effective use of crop residue would be to compost them. Thus many of the insects and diseases harbored in the crop residue would be destroyed, and

fertilizer value would be increased. Correct use of insecticides and fungicides on the growidg crops would reduce or eliminate the pest problem.

Encourage Use of Commercial Fertilizer

The fertility of the soil could be improved greatly by more extensive use of major and minor nutrient elements found in commercial fertilizer. Mineral deficiency symptoms are found in most crops now cultivated in Okinawa. This is brought about here by the rather high rainfall and temperature which contribute to the rapid loss and decomposition of nutrients in the soil. This is especially true for the nitrates and potash which are apparently leached from these soil types at a rapid rate. Consequently the soils will have to be replenished with nutrients to take the place of those lost by continuous cropping, leaching and run-off.

The unbalanced soil nutrient condition thus can be corrected by liberal use of commercial fertilizer. It is a known fact that by proper placement and timing of fertilizer applications, crop yields can be doubled. Indirectly, with increased plant growth, soil structure also is improved by greater root penetration. Furthermore, by a sound soil fertility program, the quality of the crop produced is improved.

Need of Better Tillage Practices

The tool most commonly used for tilling the soil in Okinawa is the 2 or 3-pronged hoe. With this hoe the farmer slowly and laboriously works his fields between each crop to a depth of one foot or more. He also uses the same hoe to dig root crop from the soil and to make the deep furrows for planting of sugar cane. In some cases the soil is tilled with plows and drags drawn by cows, horses or caribou. This method is more efficient and faster than the use of the hoe alone.

The methods of working the soil need to be changed or improved in order to make most efficient use of available land. Much land in Okinawa is lying idle for periods of weeks and months while the farmer is either harvesting or preparing to plant some other crop elsewhere. In effect this reduces the capability of all land here by as much as 20 to 30 per cent. In other words, if the land was tilled, fertilized and planted immediately following harvest, at least another crop could be grown annually on the same land.

Thus by more efficient use of animal power and/or small tractors, garden tractors, rotatillers and many other up-to-date implements, crop production could be speeded up and the land used more efficiently and effectively.

Crop Rotation Needed

Fig. 2. A field of young carrots grown as a demonstration at the Nago Agricultural high school. Carrots were sown in February and the photo taken in April.

The present system of growing crops in Okinawa varies with the location of the fields. On the steep slope-terraces, sweet potatoes are grown continuously with the exception of an occasional crop of cabbage. On the more level up-land soils, sugar cane is the main crop grown year after year with perhaps a crop of soybean or sweet potato grown on part of the land without any thought to a crop rotation pattern. The rice paddy land produces two crops of rice annually and usually it is not adapted for a rotation system.

The cultivated upland is suitable for a crop rotation program which in the future would benefit the farmer by production of better quality crops and higher yields. The obstacles to obtain this goal are many but are not insurmountable. Some of the problems are: 1) Each farmer usually owns only a small parcel of land which is too small for further sectioning. 2) There is lack of information on procedure and material on the farmer's part. 3) The farmer is accustomed to grow and consume only a few crops, making a change to a new system rather slow.

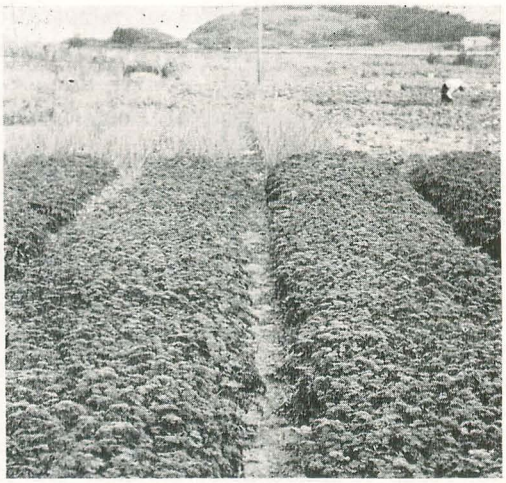

Fig. 3. Parsley (*Petroselinum hortense*) Planted in beds during the fall and winter months for successive harvest. This crop is high in iron and vitamin A and C.

Many of the vegetable crops will produce satisfactory yields in Okinawa and will fit into the rotation pattern provided they are planted at the proper time in relation to seasonal response of the particular crop. For example, snap beans planted first part of March will yield a good crop in about 6 to 8 weeks and table beets sown in November

and December will produce large quantities of beets by March and April. Sweet corn grows well in the spring and early summer as well as early and late fall. Numerous vegetable members in the cabbage family (cabbage, broccoli, cauliflower etc.) thrive and produce well from October through May. Carrots likewise are very productive the year around (Figs. 2, 3, and 4). In order to obtain maximum yields, each crop should be grown during the season most favorable for its development in the rotation system. A schedule for planting and harvesting of each successive crop in the rotation pattern needs to be worked out in advance of planting.

Fig. 4. Sanp beans grow tall in Okinawa as shown by this climbing bean variety which is very productive and of good quality. They were planted in March and picture taken in May.

Expansion of Horticultural Crops Needed

Vegetable Crops The production of vegetable crops as a means of diversifying agriculture has great possibilities. Although the culture and consumption of fresh vegetables has increased steadily during the past 10-year period, there is room and a great need for further developing and improving the culture of these crops.

Some of the crops which are suitable to grow during the cooler season of the year, October through April, are: Cabbage, Cauliflower, Broccoli, Kale, Collards, Radish, Beet, Carrot, Onion, Celery, Chinese Cabbage, Lettuce and Spinach.

The crops adapted for culture during the warmer season are: Snap Beans, Lima Beans, Soybeans, Sweet corn, Tomato, Eggplant, Okra, Pepper, Cucumber, Squash, Muskmelon and Watermelon etc. Some of these will also grow well during the cooler season.

Crops of the perennial types like Asparagus and Rhubarb should be tried although the climate may not be suitable for extensive production of them. The production of white potatoes needs to be increased since some of the soils are very suitable for their culture.

Fruit Crops Many fruits can be grown in this warm climate which resembles that of Florida. Small citrus plantings are located in a few sheltered areas as are other crops like Banana, Papaya and

Tea. The culture of these crops could be improved and increased by careful selection of site, by use of adaptable low-growing varieties, by better cultural care such as pruning, spraying and fertilizing, and by use of typhoon-breaks made by planting hedges or other wall constructions.

Crops which are low-growing are easy to care for and do not suffer as much from strong winds. The strawberry is an example. This crop would adopt itself well on the mountain slopes where the step- or terrace-type of culture is now used for sweet potatoes. Generally speaking, any soil which will produce root crops such as potatoes, carrots etc. is also adaptable for growing of strawberries. The main prerequisite is that the soil is not too heavy and that it is well drained. Strawberry varieties which are grown in southern United States should be introduced and tried here since they would be day-length adaptable.

Fig. 5. Plant nutrition is one of the many research projects now in effect by staff members of the University of the Ryukyus. Here molybdenum is tested as a foliar spray on pineapples.

The pineapple industry in Okinawa has been in a developmental stage for a number of years. At the present time, much land is being cleared and planted to pineapple in the area of the Motobu peninsula. Pineapple growing is one of the many specialized horticultural adventures which requires some fundamental understanding about its culture prior to planting and production. Much work is needed in re search and extension to guide this industry to a successful venture that it can become in the future (Fig. 5).

Flowers and Ornamentals Although many flowers grow profusely in Okinawa, there is a need for special attention to kinds and varieties, culture and care, and most of all an organized marketing program. Cut flowers are grown and sold everywhere in Okinawa; however, there is little attention devoted to flowers for special occasions such as corsages, table center pieces, and other flower arrangements. Flowers for decorations now are brought in from other countries, mainly because certain types or kinds are not available locally to suit the special arrangement.

Flowers of most any kind and description can be grown the year around in Okinawa without the expense of heated greenhouses and other special equipment. However, during the colder season some of the tender varieties need greenhouse culture to protect them from excessive rain and wind, whereas other types can be field grown. For example, Orchids, Gardenias and some types of lilies etc. will need extra attention to bring them into flowering for certain occasions. Other types grow in the field from time to time such as the Easter lily which can be found growing wild along the mountain slopes during April and May. To make flower production a paying business venture here, special training in floriculture urgently is needed.

Fig. 6. A propagation bed of *Sansevieria*. This plant is increased merely by sticking leaves in the ground which then root in a short time and are ready to be potted or used in ornametal plantings.

Ornamental horticulture has a bright future here with the developments of home and industry. Everyone will be in need of shrubs and flowers to make the home surroundings beautiful and Okinawa a more pleasant place to live. With this interest in beautification of the villages and cities, the nursery industry will grow and expand each year. Plant propagation here by seed and vegetative means is easy since the climate is very suitable for growth and multiplication of most ornamental species (Fig. 6).

A Plant Breeding Program Needed

Many of the varieties of fruits, vegetables and flowers are not adaptable for this climate and consequently will not produce maximum yields that they would in other areas. However, they should be tested here to find out whether or not they are suitable to grow here for a more diversified crop production program. These Horticultural varieties introduced here should also be used with local varieties in a sound plant breeding program to develop new and productive varieties. At present there is no such program in effect. The most productive varieties are those which are developed locally because they then respond to local soil conditions, temperature, moisture and daylength.

Other Problems and Solutions

The obstacles and problems confronting anyone who ventures into the culture of any crop are numerous; however, with the application of new methods in the production of Horticultural crops, these problems are greatly minimized. The solution to present and future problems which are bound to develop can be found in fundamental and applied research. No problem is so large that it eventually won't succumb to research.

The Agriculture Department of the University of the Ryukyus has its future ahead and is challenged to develop Horticulture to a high level it is sure to attain through careful research and a vigorous extension program. A sound Horticultural research program is now under way at the University (Fig. 7). As more land, well trained men, modern equipment and other facilities become available, this program will gain in speed, quality and prestige.

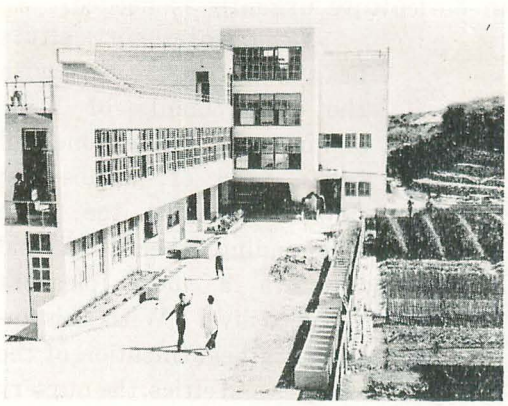

Fig. 7. The agriculture building at the University of the Ryukyus and some research activities under way in soil fertility and pest control.

Some of the immediate problems that confrout the farmer are crop pests of various sorts. For example nematodes are very prevalent as seen from the damage caused by them on various vegetable crps. The root-knot nematode (*Meloidogyne sp.*) is greatly reducing yields of tomatoes, peppers, cucumbers and other crops. Control of this nematode has been obtained in preliminary tests here using "Mylone" 3,5-dimethyltetrahydro -1,3 -5, 2 H-thiadiazine-2-thione) as a soil fumigant.

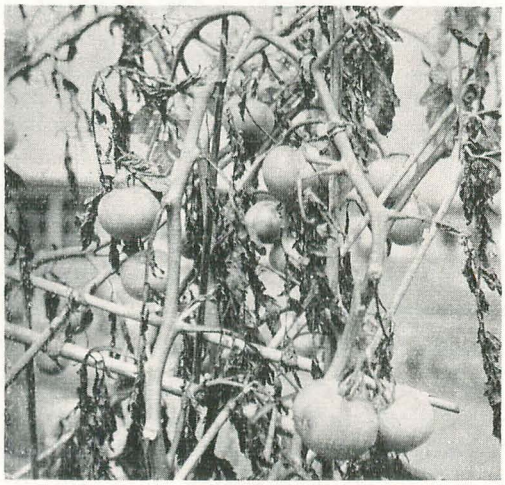

Fig. 8. Tomato plant badly infected with a fungus disease, *Fusarium*-Wilt. Varieties resistant to this disease should be grown.

Numerous diseases caused by fungi are found on sweet potato,

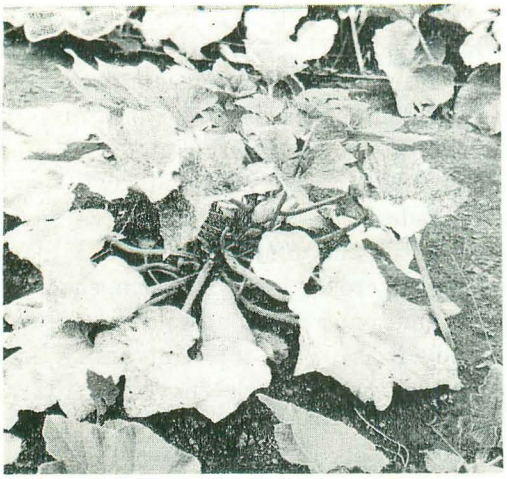

Fig. 9. Powdery mildew covering the leaf surfaces of summer squash. The leaves soon withers and the plant is defoliated.

tomato, melons and other crops; however, with correct use of new organic fungicides and use of resistant varieties, these diseases could be reduced (Fig. 8). Powdery mildew, owing to a favorable climate condition, is found on and damages many crops (Fig. 9). Insects also cause untold damage to all crops grown in the Ryukyu Islands. To combat these pests, a sound and accelerated research program is essential. Along with research, field demonstrations are needed to show farmers how to increase crop production in the future.

Summary

1. Horticulture has a bright future here since it can become one of the major enterprises of the Ryukyu Islands. However, much enthusiasm and expert leadership is needed to expand and develop the production of fruits, vegetables, flowers and ornamentals on these Islands. The production potentialities of the soil and the climate found here are enormous as are the demands for these essential products.

2. The Ryukyu Islands are endowed with a twelve-month growing season as compared to a three month growing season of many other parts of the world. Essentially this means that one acre of land in Okinawa annually can produce 3 to 4 times as much as an acre of land in the Scandinavian countries for example. Many of the vegetable crop varieties mature in about three months or less so that several crops can be grown in succession. Other advantages in crop production here are: 1) abundant rain-fall, sunshine and optimum temperature for growth, 2) ample local labar for production, processing and marketing, and 3) increasing annual demand for Horticultural products.

3. The production problems can be met by application of present day knowledge of soil fertility, crop rotation, tillage methods, variety adaptation and pest control. However, there are many detailed problems in production which have to be solved locally by research in the laboratory, the greenhouse, and the field. Research in plant nutrition, plant breeding, variety adaptation and crop rotation is

urgently needed.

4. The University of the Ryukyus during its first seven years has established sound agricultural research and extension programs. However there is much yet to be accomplished in these programs if horticulture or agriculture in general is to flourish as a leading enterprise in the Ryukyu Islands. The research findings will have to be applied. During the next decades, the farmer will have to be shown right out in the field how to till and fertilize the soil, plant new and different varieties, rotate his crops, build typhoon shelters, improve soil condition, control pests and many other up-to-date cultural methods. The possibilities are here ; it is up to the University and the people to develop them to make these islands the horticultural center of the Far East.