GUAM AGRICULTURAL EXPERIMENT STATION

RESEARCH REPORT I

UNIVERSITY OF GUAM

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

1974-75 Annual Report

(front picture)
Gathering Data & spraying the tomato field with pesticide.

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1974-75 ANNUAL REPORT

AGRICULTURAL EXPERIMENT STATION

INTRODUCTION

Calendar year 1975 marks the first full year of operation for the University of Guam Agricultural Experiment Station. Despite our infancy, tremendous studies were made toward the development of Guam's first Agricultural Experiment Station since 1933. Since that year, island farmers received minimal support from research organizations.

In recent times there has been an increased concern for the production of food and fiber. As the world population continue to increase and natural resources decrease, this concern becomes understandable. Locally, Government of Guam has adopted a position encouraging an agricultural economy for the island. And, while the local position has deeper implications than economic returns, it nonetheless supports local agricultural production and agricultural research.

The Experiment Station is literally being developed from point zero. Thus, in its short time of existence much effort was devoted toward program planning, establishment of adequate facility for our scientists, recruitment of personnel, acquisition and installation of scientific equipment, establishment of procedures and the likes. Construction of a permanent laboratory facility at Inarajan is well underway. Plans call for the completion of the Laboratory in April 1976.

A determination was made that in the early stage of the Agricultural Experiment Station development much emphasis should be placed on initiating research projects focusing on vegetables. This determination was based on extensive discussion with Extension personnel, farmers and others interested in the development of the island's agricultural industry.

While the development of the Agricultural Experiment Station is still at the embryonic stage, there is a feeling of optimism both among farmers and scientists that the Station can and will contribute toward the agricultural development of the island. The Station is being developed with the assumption that in the not too distant future, much of the island's food could be produced locally.

On the next few pages of this publication the reader will find highlights of research endeavors at the Guam Agricultural Experiment Station. One will note that projects are directed toward solving immediate island problems ranging from soils to horticulture to pest.

W P. Leon Guerrero

WILFRED P. LEON GUERRERO
Dean/Director

BACKGROUND

President Abraham Lincoln in 1862 signed the "Morrill-Nelson Land-Grant Act" which gave birth to the nation's land-grant universities. Under the provisions of this law, grants of federal land were offered to each State which would agree to establish at least one college with an emphasis on agriculture, home economics and the mechanical arts. It was the nation's first attempt to provide higher educational opportunities for all citizens. Today, there is at least one land-grant college or university in each of the 50 States, the District of Columbia, Puerto Rico, the Virgin Islands and Guam.

The University of Guam became a member of these land-grant institutions in June 23, 1972 with the passage of the Educational Amendments Act of 1972-P.L. 92-318. The Federal Government contributed a $3,000,000 endowment to the University of Guam, instead of granting land to Guam.

The University of Guam appointed its first Dean/Director Dr. Wilfred P. Leon Guerrero to head its land-grant program in November, 1973. On March 6, 1974, the Board of Regents of the University approved a resolution creating the College of Agriculture and Life Sciences which embraces the main features of the land-grant program at the University of Guam. Its goal is to serve the agricultural sector of the economy as well as other disciplines through Resident Instruction, Research and Extension in the Territory of Guam and the surrounding Pacific regions.

The Agricultural Experiment Station is the Research (Hatch Act) component of the Land Grant programs and, as such, is primarily involved in obtaining specific fundamental knowledge which is needed to develop practical solutions to problems facing agriculture and the consumer on Guam. Research emphasis was placed solving agricultural problems, as well as investigating potential alternative crops and methods to further enhance agricultural development on Guam.

Professionals, lay people and farmers agreed that highest priority be given to research dealing with food production and marketing. Also there seemed to be a consensus that vegetable crops be given early attention.

The initial team of scientists were primarily concerned with research on the production, economics, and marketing of horticultural crops.

The team consisted of a plant scientist, an entomologist, and a soils scientist. The Plant Scientist was employed during most of fiscal year '75 and had conducted variety trials on Chinese cabbage, head cabbage, and eggplant even though land, equipment and field labor have not been adequate. Additionally, a biologist conducted a research on the coconut crab.

The Inarajan facility should be occupied during FY'76. It is anticipated that the plant scientist will broaden his research to include a wider selection of crops in variety trials.

SITUATION

1. Geography and Climate

The U.S. Territory of Guam is located at lat. 13° 28'N., long. 144° 45'W., and lies approximately 6,267 miles west-southwest of San Francisco, 3,729 miles north of Sydney, 1,689 miles south of Tokyo, 2,161 miles east of Manila, and 2,260 miles southeast of Hong Kong.

The island's total land mass of slightly over 212 square miles is blessed with a tropical climate. Average monthly temperatures range from 74 degrees during the coolest months of late winter to the mid-80's in the summer and fall. Annual rainfall averages over 80 inches (could exceed 100 inches in any given year), with most of it falling during the months of July through November. An average monthly rainfall of less than 5 inches can be expected from February through April.

2. Geology and Vegetation

Two geologic provinces dominate Guam and are largely responsible for the resulting soil types found. Except for several volcanic outcrops, the northern half of the island is basically an elevated limestone plateau endowed with porous rock soils and rich variety of mixed broad-leaved evergreens. In contrast, the southern half is largely comprised of denuded hills dominated by savanna grassland (slopes and ridges) and scattered woodlands and wet volcanic ravine forest laced with streams. Soil profiles in the south are also generally better than in the north for growing fruits and vegetables.

3. Population and Economy

Guam's young (median age below 16 years) multicultural population of nearly 100,000 is concentrated at the central and northern parts of the island. The Guamanian of today is American, but with ethnic ties that include American, Asian South Seas, and European influences. The native Chamorro language is widely spoken, although practically everyone is fluent in English.

R-0001 RESEARCH ADMINISTRATION PROJECT

The Research Administration Project was established to support an Agricultural Experiment Station at the University of Guam for the purpose of conducting agricultural research and other related areas in the Territory of Guam.

General administrative procedures included the following: recruitment of an Associate Dean, a plant scientist, an entomologist, a soil scientist, a biologist, a gardener (field technician) and a secretary.

Identification of problem areas for planning the research needs of the territory were made.

Although the acquisition of the land in Inarajan for the Experiment Station was made in 1973, it was not until November of 1975 that the ground breaking ceremony took place. It is anticipated that the facility will be occupied during the later part of FY '76.

Scientist employed by the AES were assigned originally to do research on a problem already covered by an approved project. Since then, the Cooperative State Research Service (CSRS) has approved 6 research projects and a Regional Research Project.

The Guam AES acknowledges the work of Dr. E.V.Smith, Auburn University Dean Emertius for all his assistance in setting up the necessary mechanics needed for the Agricultural Experiment Station.

Ling Duenas

MRS. LING DUENAS
Assistant Director

R-0004 IMPROVEMENT OF THE WATERMELON AND EGGPLANT VARIETIES GROWN ON GUAM

INTRODUCTION

Eggplant is one of the important vegetable crops consumed on Guam. It is necessary to determine the adaptability and screen varieties which may have economic potential and may be suitable to grow under environmental condition of Guam. The objective of this project was to screen varieties with higher yielding ability, disease and insect resistance and better quality.

MATERIALS AND METHODS

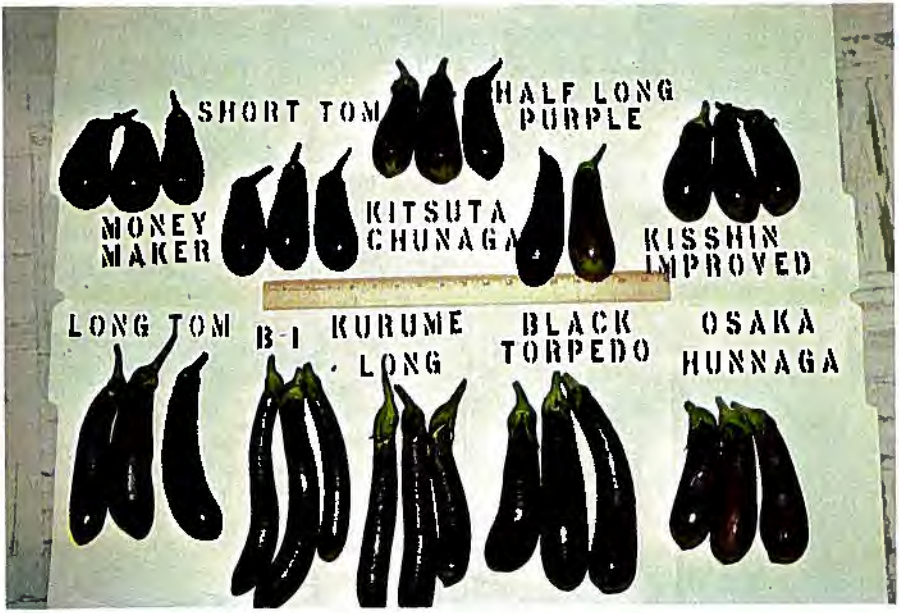
Ten varieties of eggplant: Long Tom no. 4, Short Tom no. 1, Kurume Long, Osaka Honnaga, Kitsuta Chunaga, Kisshin Improved, Money Maker, Half Long Purple, Black Torpedo and B-1 were sowed in Jiffy-7 pots and transplanted one month later to the field. A randomized block design with three replications was used. Each replication consisted of a row 50 feet long with plants space 4 feet between the row and 2 feet in the row.

RESULTS

Variety	Fruit			Yield (tons/a)
	Weight (lb.)	Width (in.)	Length (in.)	
Long Tom no. 4	0.35	2.1	8.8	10.27
Short Tom no. 1	0.33	2.2	6.1	9.12
Kurume Long	0.41	1.9	9.8	7.81
Osaka Honnaga	0.51	2.2	8.5	8.80
Kitsuta Chunaga	0.36	2.2	6.2	9.88
Money Maker	0.36	2.2	6.0	9.36
Half Long Purple	0.37	2.1	6.9	8.98
Black Torpedo	0.50	2.2	8.9	11.56
B-1	0.33	1.7	9.5	9.45
Kisshin Improved	0.40	2.2	6.7	9.78

From the above table two types of eggplant had been observed according to width and length of fruit: Long type-Long Tom no. 4, Kurume Long, Osaka Chunaga, Black Torpedo and B-1; Oblong type-Money Maker, Short Tom no. 1, Kitsuta Chunaga, Half Long Purple and Kisshin Improved.

In this trial the yielding ability of Long Tom no. 4 and Black Torpedo was the two highest, Kitsuta Chunaga and Kisshin Improved is the next highest, and Kurume Long was the lowest of the ten varieties. Considering the yielding ability, appearance, and texture Long Tom no. 4, Black Torpedo and B-1 might be the more promising varieties.



Different types of fruits are shown from 10 varieties of eggplant

R-0005 VARIETAL SELECTION FOR IMPROVEMENT OF CHINESE CABBAGE GROWN ON GUAM

Chinese cabbage is one of the most popular vegetables consumed on Guam. Chinese cabbage is considered to be a cool season crop. Therefore, it is necessary to select heat-tolerant varieties in order to grow in the tropics. The objective of this project was to screen varieties which may adapt to the environmental condition of Guam.

MATERIALS AND METHODS

Two experiments were conducted during 1975.

Experiment 1. Seed of five varieties of Chinese cabbage: Tropicana, Saladeer, Wong Bok, Pe Tsai, and Michihli were directly sowed in 60 feet single-row plot with 3 feet between rows and 2 feet in the row. A randomized complete block design with five replications was used.

Experiment 2. Seed of 23 varieties of Chinese cabbage: Tainung, Dark Leaf Late, Nagoaka Test 8, Unknown Local, Summer Jew, Tropicana, Saladeer, Tropical Pride, Chung Puh Late, Chung Puh Medium Early, AVRDC acc. 31, AVRDC acc. 114, AVRDC acc. 115, AVRDC acc. 126, AVRDC acc. 140, AVRDC acc. 161, AVRDC acc. 162, AVRDC acc. 163, AVRDC acc. 167, AVRDC acc. 176, Michihli, Wong Bok, and W.R. 60, were provided by Asian Vegetable Research and Development Center and

South Pacific Commission. Seeds of the Chinese cabbage were directly sowed in 10 feet five-row plot with 1 foot between rows and 1 foot in the rows. A randomized complete block design with three replications was used.

RESULTS

The results of experiment 1.

Variety	Yield (tons/a)	Bacterial Soft Rot(%)
Tropicana	11.26	36
Saladeer	9.56	24.6
Wong Bok	10.38	0
Pe Tsai	9.71	0
Michihli	8.07	0

In this trial the yielding ability of Tropicana was the highest and Michihli was the lowest of the five varieties. Wong Bok was the next highest yielder. There were no significant differences between the yields of Pe Tsai and Saladeer. The varieties of Tropicana and Saladeer were proved to be highly susceptible to disease of bacterial soft rot. However, Saladeer was less susceptible to this disease than Tropicana.

A testing and tasting evaluation was conducted by our Extension Home Economists. The results showed that Wong Bok was rated the best quality of the five varieties in palatability and appearance both raw and cooked. Saladeer, similar to Romaine lettuce in appearance and texture was found to be very good raw in tossed salad.

The results of experiment 2.

This experiment had found out most of these varieties exhibiting good heading and some poor heading. The breakdown into heading and non-heading varieties are shown as follows:

a.) Heading varieties: Tainung, Dark Leaf Late, Nagaoka test 8, Unknown Local, Summer Jew, Tropicana, Saladeer, Tropical Pride, Chung Puh Late, Chung Puh Medium Early, AVRDC acc. 31 AVRDC acc. 114, AVRDC acc. 115, AVRDC acc. 126, AVRDC acc. 140, AVRDC acc. 161, AVRDC acc. 162, AVRDC acc. 163, AVRDC acc. 167, and AVRDC acc. 176.

b.) Non-heading varieties: Michihli, Wong Bok, and W.R. 60.

Dr. Lee at the experimental Chinese cabbage plot

Bacterial Soft Rot Disease

R-0010 COCONUT CRAB

The coconut crab project was initiated to investigate the biology and feasibility of culture of the coconut crab Birgus latro. The choice of this organism was based primarily on its high marketability of Guam, there being little known of its ease of cultivation.

The coconut crab is virtually unique among potentially cultured animals in that it spends its early life in the sea and its juvenile and adult life on land. Considering the probable difficulty in rearing the aquatic larval states, it was felt that the most potentially productive approach would be to concentrate on the terrestrial stages. The goal, then, for developing a scheme for cultivation of the coconut crab would be to find methods for collecting large numbers of juveniles, and holding and feeding them until they grow to a marketable size.

Specific research goals were as follows:

1.) To find methods for collecting large numbers of juveniles,

2.) To develop holding techniques for juveniles and adult crabs,

3.) To test various types of foods to determine which are most effective in promoting growth,

4.) To measure natural rates of growth in wild crabs to determine if growth in the laboratory is an improvement over that in nature, and

5.) To assess natural rates of recruitment to the coconut crab populations; that is, what is the rate of addition of new juveniles to the populations of terrestrial coconut crabs on Guam?

As there has been no previous work on any of these specific problems, our research on this project has had to start essentially from scratch.

Juvenile Abundance

It was known from the work of Ernst Reese of the Hawaii Institute of Marine Biology that junvenile coconut crabs (in the glaucothoe stage) come onto land wearing a small snail shell and are almost identical to their close relatives the terrestrial hermit crabs of the genus Coenobita (Birgus latro and the hermit crabs of the genus Coenobita belong to the same family, the Coenobitidae, and the coconut crab presumably evolved from a Coenobita-type ancestor which carried a snail shell throughout its life). Throughout 1975 collections of very small shell-bearing coenobitid crabs were made and although hundreds were examined microscopically, all could be referred to one of the four species of Coenobita that live on Guam. No small shell-bearing coconut crabs were found. This indicates either that very few young coconut crabs are recruiting to Guam's natural populations or that those that are recruiting very quickly adopt a cryptic, perhaps underground, existence until they grow to a greater size.

Holding and Feeding

Previous work by Gene Helfman (MS thesis, Department of Zoology, University of Hawaii) and others indicated that coconut crabs are very aggressive and that it is inadvisable to keep more than one of them in a single container of limited size. Accordingly, experimental crabs have been kept individually in plastic, glass, or wood terraria with soil or sand as a substrate. Initial feeding experiments involved a comparison of the following four diets: (1)vegetables,(2)coconut and vegetables,(3)African land snails and vegetables, and(4) commercially prepared dried pet food and vegetables. The crabs appeared to feed well on the vegetables, coconut, and snails, but not on the dried pet food. The pet food, coconut, and the snails (once they had been crushed and killed by the crabs) attracted ants and it became necessary to isolate each terrarium in pans of water. Although feeding appeared to be good with several of the foods, molting was very infrequent and growth per molt was negligible. For reasons not yet clear, molting rates have declined over the course of the year. The lack of growth of the crabs precluded any comparison of the relative values of the various foods. The low molting and growth rates may be normal for coconut crabs; nothing is yet known of their rates of molting and growth in the field. However, it may be that the small enclosed containers are so different from their natural environment that the normal habits of the crabs have changed. Another possibility is that the constant disturbance of the crabs when they are fed and given water, and when excess food is removed, may be inhibiting their normal molting rhythms. Thirdly, it may be that growth during molt is negligible due to inadequate water supply, as marine crabs grow by absorbing large amounts of water during their molting period when their bodies are soft. Of course coconut crabs in the wild probably do not have access to much water when they are molting, but they may also grow slowly.

Two avenues are presently being investigated to solve these problems. A large (20' x 20') enclosure has been constructed in an area of more or less natural vegetation behind the University of Guam Marine Laboratory. This should be large enough for several crabs to occupy without being forced into aggressive confrontation with one another. At the present time completion of the pen is pending acquisition of some materials. An experimental container has been built which is designed to hold crabs individually, but it is provided with a flow-through water system which allows the crabs access to as much water as they want. Further modifications on this are being made and if it looks potentially successful, several of these will be constructed.

Natural Rates of Molting and Growth

Growth in the wild can be measured by measuring and marking an animal and then catching the animal at some later date and measuring it to find out how much it has grown over that time

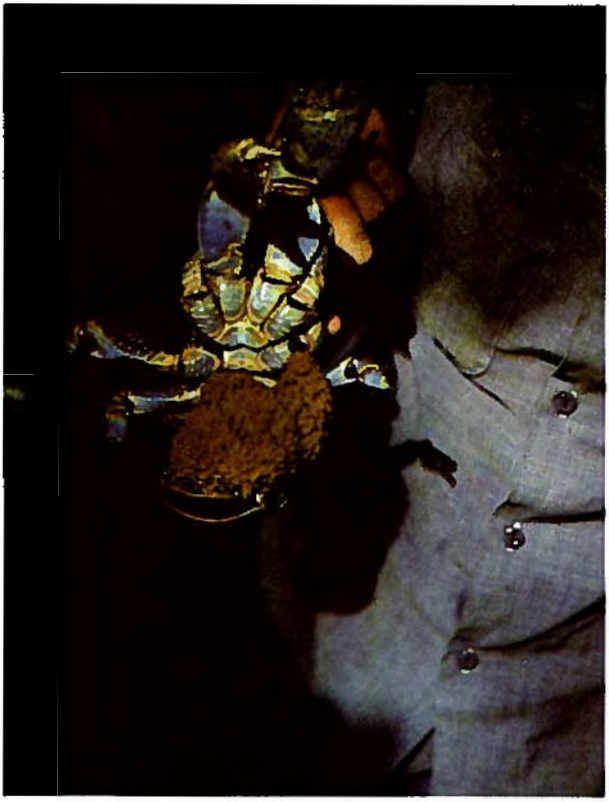
interval. Crabs, however, shed their exoskeleton whenever they molt and grow and so no tag attached externally will remain through the molt. A tag has been developed for use on lobsters that is inserted through the exoskeleton and anchored to the underlying musculature. This has been shown to remain through a molt in lobsters. A number of these tags have been obtained and they will be used on wild crabs as soon as they are tested on a captive population. It must be ascertained that the tags don't kill the coconut crabs or lead to infections and that the tags are retained through the molt. Completion of the large enclosure will allow the tagging experiments to be performed.

A second method of getting information on molting rates in the field is based on some physiological changes that occur during the molt cycles of crustaceans. Typically these are changes in the amounts and kinds of proteins and other constituents of the blood of crabs just prior to during, and immediately after the molt period. Attempts are presently being made to detect these changes in the blood serum through the use of electrophoresis. It is hoped that once techniques are developed to detect these changes, blood samples from natural populations of crabs could be analyzed to determine the percent of the population which are about to molt or have just molted at any given time. If molting is associated with seasonal or other periodic changes, this should be detectable. This particular study has the aid of Mrs. Alicia Masterson, an MS candidate in Biology, who is doing this study as her Master's thesis research projects.

Removal of blood sample for serum analysis

Natural Rates of Recruitment

Our inability to find very small shell-bearing coconut crabs (described above) strongly suggests that recruitment is very low on Guam. Further evidence to support this has come from observation on the egg hatching behavior of terrestrial Coenobita hermit crabs. In these crabs, the females bring the eggs down to the ocean where they hatch upon contact with sea water. Observations to date indicate that this hatching is a highly rhythmic phenomenon, occurring almost exclusively during the hours of high tide, at night, during the period of the new moon (publication on these observations is forthcoming once verification can be accomplished; a search of the literature has failed to show any previous publication dealing with this phenomenon). Coconut crabs may show this same periodicity in egg hatching as almost every female crab observed on the islands of Asuncion and Guguan, in the northern Marianas, was carrying eggs or had just released eggs, and were on or close to the beach. The period of time when these observations were made was during the time of the new moon. However, on Guam, although thousands of Coenobita females laying eggs have been observed not a single coconut crab has been seen doing this during our observations. Thus, it appears that the number of larval coconut crabs being produced on Guam is small.



Female Coconut Crab with eggs

Future of Coconut Crab Culture on Guam

Although presenting problems, the keeping of coconut crabs in captivity should be possible. Somewhat more difficult may be providing conditions which are conducive to survival and rapid growth. However, the major hurdle in cultivating coconut crabs on Guam is getting sufficient numbers of small crabs to raise. This problem can best be overcome by hatching the eggs and rearing the larval in the laboratory. This is a rather major undertaking (it has been done by Reese and Kinzie, but only on a small scale), and at present the amount of work involved is not warranted by the potential benefit. The time and effort involved would probably be better invested in an animal whose culturing techniques have already been investigated and would need only adaptation for conditions on Guam. This assessment may change as more information is accumulated about the coconut crab, but present plans are to follow through on the large enclosure, carry out the tagging experiments, and continue with the electrophoretic study (with the help of Mrs. Masterson). The Coconut crab project will be terminated at the end of spring.

Steve Amesbury on Pagan Island during a survey of Coconut Crab population in the Northern Marianas

R-0011 INITIAL SOIL FERTILITY SURVEY OF GUAM AGRICULTURAL SOILS.

Previous studies on Guam soils have been mainly along the lines of geology, genesis, and classification. Although agriculture has long been practiced in Guam, no research has ever been conducted on soils for betterment of plant growth.

Guam is well within the belt of tropical soils, and although the soil forming processes are predominantly lateritic, the Island has no significant areas of true laterite soil (ground-water laterite). Regosols, lithosols, latosols, and lithosolic latosols are the great soils groups most extensively represented in Guam.

Lateritic soils in Guam are found in two characteristic modes of occurrence, first as patchy remnants of red friable soil on weathered volcanic rocks chiefly in the Southern half of the Island, and second, as thin red soil on scattered pockets of depressions on limestones, chiefly in the north plateau.

For any agricultural endeavor, the availability of water is of paramount importance. The hydrology of Guam presents an interesting contrast between limestone and volcanic areas. In northern Guam, rainfall infiHrates so rapidly that there is almost no run-off, and perennial stream systems have no opportunity to develop. Volcanic rocks in southern Guam have relatively low permeability and resulting in a surface deeply channeled by numerous streams and eroded into peaks, knobs, ridges, and basins due to rainfall run-off.

With this background of tremendous diversity of soils, at a time when the Government of Guam's official policy is to promote agriculture as a fundamental economic activity, the soils arm of the Guam Agricultural Experiment Station started out in 1975.

Before any meaningful research work can be done on soils, a good chemistry laboratory has first to be established. Starting from scratch, an operational soils research and testing laboratory was realized by November. Among the sophisticated equipment

The AES Soil Research and Testing Laboratory has a Perkin-Elmer 305B Atomic Absorption Spectrophotometer (shown here with Chemist Joe Cruz).

acquired is a Perkin-Elmer 305B, Atomic Absorption Spectrophotometer. This laboratory is the only one of its kind in the Marianas if not the entire Western Pacific.

While equipment acquisition was going on, over a hundred soil samples were processed in the lab and analyzed using a Hellize and Truog Combination Soil Tester and a Beckman pHasar I digital pH meter. The samples were numbered and stored for subsequent more thorough analysis.

Preliminary data gathered showed that all soils analyzed were found to be low in phosphorus (under 10 ppm P in soil). Average pH values were 7.60 for Northern Guam soils and 6.57 for Southern Guam soils. Organic matter values ranged from 0.96% to 5.49% for Southern soils and 4.93% to 15.2% for soils from the North.

A field experiment on phosphorus was started in Northern Guam. Phosphorus levels were 0, 75, 150, 300, and 600 kilogram per hectare. Tomato variety No. 18 from the Asian Vegetable Research and Development Center was used. A positive response to added phosphorus has been observed with heavy fruit setting occuring at the 300 and 600 kgm P levels. Similar experiments in Southern Guam with identical pot experiments for correlation studies will also be initiated.

A joint research project on the quality of percolate below the root zone of selected agricultural crops in Northern Guam was initiated with the Guam Water Resources Research Center. There is a definite need to know the effect of agriculture on the quality of ground water in permeable limestone of Northern Guam. This research will hopefully provide scientific basis for advice on how agriculture should be managed in Northern Guam.

Setting up a field experiment on phosphorus response of Guam clay loom in Northern Guam-Ramon San Agustin farm, Ysengsong, Dededo

R-0013 STUDIES ON THE BIOLOGY, HOST PREFERENCE AND NATURAL ENEMIES OF THE PHILIPPINE LADY BEETLE

This project was approved by the CSRS on August 13, 1975.

Biology of the Philippine lady beetle on tomato has been completed. A host presence study has also been completed and the data is in the process of analysis.

A larval parasite, Pediobius foveolatus was imported from Delaware and field released. Laboratory culture of this parasite will be maintained.

Mr. Joseph Duenas is studying the efficacy of a local parasite on this beeetle in the laboratory.

Some eggplant seeds supposed to be resistant to lady beetles have been received from India. A field trial using these seeds is awaiting the field preparation.

Philippine Lady Beetle, Epilachna Philippineneis feed on eggplant leaf

R-0014-INSECT PESTS OF CRUCIFEROUS VEGETABLES IN GUAM.

This project was approved by CSRS on August 13, 1975.

Two insecticidal field trails were carried out on Wong Bok to test the efficacy of the insecticides against different cruciferous pest. The results were analyzed and submitted for publication in the journal, 'Tropical Agriculture'.

Five different kinds of parasites of diamond backmoth were imported from Commonwealth Institute of Biological Control, India and Hawaii Department of Agriculture and field released. Laboratory cultures will be maintained.

A local parasite of the diamond backmoth has been recorded for the first time on Guam.

Mr. Thomas Blas, student majoring in agriculture, is continuing the study of biology of the cabbage webworm.

Some varieties of Chinese cabbage seeds were received from Asian Vegetable Research and Development Center, Taiwan for testing insect resistance on Guam.

Diamond back—moth larva and cabbage aphid on a cabbage leaf

Chinese Cabbage insecticidal trial with Dr. Muniappan, Project Leader

REGIONAL RESEARCH PROJECT: W-84 (REVISED)

A research project for introduction and study of predaceous mites and for the biocontrol of the flame tree looper has been submitted and approved by the Committee of Nine and the Cooperative State Research Service.