GUAM AGRICULTURAL EXPERIMENT STATION

RESEARCH REPORT II

UNIVERSITY OF GUAM
COLLEGE OF AGRICULTURE AND BUSINESS
1976 - 77 ANNUAL REPORT

FOREWORD

We are pleased to present our 1975-76 Annual Report. This is the Second Annual Report of the University of Guam Agricultural Experiment Station.

Studies in the U.S. Mainland have shown that on the average it takes about seven and one half years before benefits can be reaped from agricultural research. Returns on such research run anywhere from 36 to 46 percent of investment.

The Guam Experiment Station is still in the developmental stage. Because we have been concentrating on applied research, however, more and more of our farmers are beginning to appreciate the importance of our work in the Experiment Station.

In 1976 we modified some of our research projects in order to accomodate pressing immediate needs. Also, new research projects were initiated because of this need.

It is hoped that in 1978 the research program of the Experiment Station would be expanded to include projects in the animal science area. More specifically, we hope to have research projects in either swine breeding or swine nutrition or both. Our research capability has been increasing largely through the recruitment of personnel (both professional and subprofessional) and acquisition of facilities and materials. It is hoped that in 1978, progress in our research programs will continue at a much faster rate than in 1977.

WILFRED P. LEON GUERRERO
Dean/Director

Front and back cover photo—Ed Gould

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INTRODUCTION

The primary mission of the Agricultural Experiment Station is conducting research for the advancement of agriculture on Guam. So far, it has progressed in three major disciplines; Horticulture, Soils and Entomology. Research in Plant Pathology, Pomology and Animal Science will be started in 1978.

A Horticulturist is conducting varietal trials of Chinese cabbage and eggplants to select varieties suitable for the environmental conditions of Guam. His future plans are to screen different varieties of all vegetables grown on Guam and to recommend the ones best suited to the farmers of Guam.

A Soil Scientist is entrusted with all research work pertaining to soils. A modern soil research and testing laboratory has been developed. Initial endeavors include assessing the fertility status of agricultural soils of Guam and a joint effort with the Guam Water Resources Center to determine the possible effects of agricultural practices on the fresh water lens in Northern Guam.

Entomologists are entrenched in developing integrated pest management programs for vegetable, fruit and ornamental crops grown on Guam. Initial efforts include utilization of natural enemies and screening for insect resistance in cruciferous and solanaceous crops, corn and bananas and suppression of poinciana looper and phytophagous mites by utilizing biocontrol agents.

HORTICULTURE

Farmers on Guam grow mostly fresh vegetables to meet the local market demand and avoid growing crops that could be imported by ship from neighboring countries. The reason for this is that the importation of fresh vegetables by air freight increases the cost on landing and the market for local production becomes comparatively lucrative. However, a lower per acre yield is one of the problems faced by the farmers. The problem is complicated by absence of information on a standard variety in each vegetable crop that can be recommended for the climatic, edaphic, faunastic and cultural conditions of Guam. In this situation farmers obtain seeds of different varieties of each crop from all available sources and try them in their fields.

To help the farmers in identifying a best variety in each vegetable crop grown on Guam, our Horticulturist has started screening different varieties of vegetable crops in our experimental station. To start with, he has experimented with Chinese cabbage and eggplants during 1976 and he will be expanding his research in varietal screening to cover all the vegetable crops grown on Guam.

I. CHINESE CABBAGE VARIETAL SELECTION

Chinese cabbage is one of the most popular vegetables consumed on Guam. It is grown as a potherb and also as a salad plant. It requires rich soil and an abundance of moisture. Because Chinese cabbage is considered a cool season crop, it is necessary to screen and determine heat-tolerant varieties that will grow in the tropics. The objective of this project was to select adaptable varieties under the environmental conditions of Guam.

1. Varieties:

Seeds of Chinese cabbage were obtained from commercial companies in Japan, the Asian Vegetable Research and Development Center in Taiwan, and the South Pacific Commission. The experiment was conducted during the 1976 dry season to evaluate the effect of climatic factors on the performance of Chinese cabbage varieties. Thirty-three varieties of Chinese cabbage were included in this trial. They are; Tainung 40 day, Dark leaf late, Chang Puh early, Chang Puh medium early, Chang Puh late, AVRDC acc. 114, Super early No. 1, Lebafeet leaf, AVRDC acc. 127, Hsia Sheng 35 days, Wu Chao Chia, Ta Feng No. 3, Ta Feng autumn baby, Tieh Sheng early, Hsia Sheng early, Chin Lu, Yung Ching 30 days,

Hsi Fu early, Tropicana, Saladeer, Wong Bok, Pe Tsai, W.R. 50 days, W.R. 60 days, W.R. 70 days, Early Top No. 16, Tropical Pride No. 13, Chinese King No. 14, Oriental King No. 18, Kyoto No. 3, Matsushima No. 6, South China earliest, and Pak Choi.

2. Design:

The experimental design used was a randomized complete block with 3 replications. Each experimental plot was a single row of 26 feet long with 2 feet between rows and 3 feet within the rows. Rotary tiller and garden hoe were used for weed control. Dithane M-45, Dibrom 8 E, Thuricide, and Sevin 50 were used for controlling disease and insect problems.

Chinese cabbage was harvested when heads were fully developed on heading varieties. Non heading varieties were harvested when plants were at the full size.

Different varieties of Chinese cabbage.

3. Yield:

Environmental factors like high day and night temperatures were limiting Chinese cabbage production by causing bolting and/or not forming a head. Of the thirty-three varieties, sixteen varieties did not form heads and seventeen varieties formed heads.

Yields of heading varieties ranged from 4.40 to 8.55 tons per acre or from 1.21 to 2.37 pounds per head. The promising heading

varieties were Chang Puh early, Wu Chao Chia, Ta Feng No. 3, Tropicana, Ta Feng autumn baby, Tieh Sheng early, and Saladeer. However, these heading varieties were somewhat susceptible to bacterial soft rot disease, caused by a soil-living bacterium, *Erwinia caratovora*. The affected plants usually were mushy, slimy, with cheese rot 'odor and leaves became watery and soft and turned light to dark brown.

Yields of nonheading varieties ranged from 2.38 to 8.59 tons per acre or 2.14 to 2.38 pounds per plant. Wong Bok and Pe Tsai were the best quality in appearance and texture among the non heading varieties.

II. EGGPLANT VARIETAL SELECTION

Eggplant is one of the most popular vegetable crops grown by home and market gardeners on Guam. The use of improved varieties will contribute to raising the existing production level as well as stimulating consumption, because of their better quality. Before recommending new varieties, they need to be tested to evaluate their quality, yield and adaptability under the environmental conditions of Guam. This eggplant varietal test is in its second year. Five of the desirable varieties from the 1975 trail and four new varieties were included for the 1976 experiment.

1. Varieties:

This experiment was also conducted during the 1976 wet season to evaluate the effect of climatic factors on the performance of eggplants. Nine varieties of eggplants were included in this test, namely; Black Torpedo; Long Tom No. 4; Kitsuda Chunaga; Kisshin Improved; B-1, Black Diamond; Long Beauty; Okitsu No. 2; and Ma Chih. Seeds were sown in Jiffy-7 pellets and one month old seedlings were transplanted in the field. Jiffy-7 pellets were used to avoid transplanting shock or setback problems to the seedlings. A randomized complete block design with three replications was used. Each experimental plot was a single row of 50 feet long. The spacing adopted was 3 feet between rows and 5 feet within the rows. Rotary tiller and garden hoe were used to control weeds. Dithane M-45, Dibrom 8E, Diazinon 500 E C, and Malathion 50 were used to control disease and insect problems.

The fruit was harvested at the best edible stage. Harvesting period lasted for about two and one-half months from the time of first harvest.

2. Marketable Fruit Yield:

Black Torpedo with a production of 20.98 tons of fruit per acre significantly outyield the rest of the eight varieties. The production of Black Torpedo was two times higher than that of B-1. There was no significant difference in yield among Long Tom No. 4, Kitsuda Chunaga, Kisshin Improved, B-1, Black Diamond, and Long Beauty. Okitsu No. 2 with 6.87 tons and Ma Chih with 5.84 tons per acre were the lowest.

3. Non-marketable Fruit Yield:

The cottony rot disease caused by a soil inhabiting fungus, *Phytophthora paracitica* caused most of the non-marketable fruit. A cottony mold grew abundantly in the diseased fruit especially during the wet season. The disease was more frequently noticed in fruit that had contact with the soil surface. Black Torpedo was least susceptible to fruit rot, with 8.39 percent of non-marketable fruit out of the total fruit production. The variety most susceptible to the disease was Ma Chi having 33% non-marketable fruit.

Eggplant experimental plot.

Five long varieties of eggplant fruit: Machi (upper left); B-1 (upper right); Long Tom No. 4 (lower left); Black Torpedo (bottom center); Long Beauty (lower left).

4. Shape and Size of Fruit:

Three types of fruit shapes were found in this experiment. They were; long, half-long, and oblong. Long types of fruit were Black Torpedo, Long Tom No. 4, B-1, Long Beauty, and Ma Chih. Half-long types of fruit were Kisshin Improved and Black Diamond. Oblong types of fruit were Okitsu No. 2 and Kitsuda Chunaga.

The fruit size of Ma Chih, with 13 inches, was the longest and Okitsu No. 2, with 4.5 inches, was the shortest. Black Torpedo, B-1 and Long Tom No. 4 ranged from 8.0 to 10.5 inches and were the next longest varieties.

Based on the appearance, texture and yield, Black Torpedo, Long Tom No. 4, Black Beauty and B-1 were the promising varieties as per the results of the experiment conducted during the wet season of 1976.

SOILS

Although subsistence farming has been in existence for a long time in Guam, no efforts were made towards assessing the soil fertility status of its soils. With the establishment of the Guam Agricultural Experiment Station in 1975, a modern Soil Testing Laboratory was in operation towards the end of the year. The principles of Soil Testing were used to assess and delineate soils with regard to fertility.

ASSESSING THE SOIL FERTILITY STATUS OF GUAM'S AGRICULTURAL SOILS

Over 200 soil samples from all over Guam were processed and analyzed. Drastic delineation of soils with regard to fertility is very apparent based on parent material alone. The classification of Guam soils will be updated using the U.S. Soil Taxonomy method with the possible hiring of a pedologist in late 1977.

The pH for Guam soils ranged from a low of 4.74 to a high of 8.32. Soils developed from limestone exhibited pH levels in excess of 7 with a mean of 7.60. Soils developed from volcanic rocks had a mean pH of 5.89.

Three extractants for phosphorus (Mehlich-0.05 NHCl, 0.025N H_2SO_4; Bray-0.03N NH4F, p. 025N HCl; and $NaHCO_4$-0.5M Na HCO_3, pH 8.5) were tested. No marked differences were noted among extractants in soils of low native extractable phorphorus. Ten-

tative data, however, show a preference in the use of NaHCO3 for all soils of Guam.

Field and pot experiments were carried out to correlate soil test results with yield. For soils testing lower than 10 ppm extractable P, increased yield was noted when 300 kgms P205 per hectare was added.

Potassium, calcium, magnesium, and sodium were extracted using normal ammonium acetate at pH 7. The data gathered do not indicate any deficiency of these elements.

Soil organic matter was analyzed using the Walkley and Black method. Organic matter content ranged from 1.67 to 15.20 % with an average of 5.99%. Most samples were from previously uncultivated soils which accounts for the high organic matter content. Nitrogen recommendations at present are based on soil type, cultural practices (i.e., addition of manure etc.), and the specific nitrogen need of the plant being grown.

ENTOMOLOGY

Entomology research work at our station is primarily geared towards integrated pest control. Our entomologists are concentrating on non-chemical means of control, such as the use of parasites and predators, resistant varieties, environment manipulation etc. Their main aim is to reduce the number and dosage of insecticide applications as much as possible, to increase agricultural crop production, to lessen the cost of cultivation, to reduce environmental contamination, to enlarge the margin of safety and to attain self operating and long lasting insect control measures.

The current entomology research projects include two Hatch projects; one for studies on insect pests of cruciferous vegetables on Guam, and the other for studies on the biology, host preference and natural enemies of the Philippine lady beetle. Also included are a Regional Research Project (W-84) for biological control of phytophagous mites and the poinciana looper and an informal project with Dr. Gracen of Cornell University to screen corn varieties for Asiatic corn borer resistance.

I. PESTS OF CRUCIFEROUS CROPS

1. Host Preference Studies:

Cruciferous crops include cabbage *(Brassica oleracea* L. var. *capitata)*, Chinese cabbage *(Brassica pekinensis Rupr.)*, cauliflower *(Brassica oleracea* L. var. *botrytis)*, broccoli *(Brassica oleracea* L. var. *italica)*, Brussels sprouts *(Brassica rapa* L.) and radish *(Raphanus sativus* L.). All these crops are attacked on Guam by diamondback moth *(Plutella xylostella* (Linnaeus)), cabbage webworm *(Crocidolomia binotalis*; Zeller), cabbage borer *(Hellula undalis*; F.), cutworm *(Spodoptera litura* F.) garden looper *(Chrysodiexis Chalcites* Esper), turnip aphid *(Hyadaphis erysimi* Kltb.) and fleahopper *(Halticus tibialis* Reuter).

During the dry and wet season of 1976 two trials were conducted to evaluate the host preference of the cruciferous crop pests on Guam. The varieties used were:

head cabbage	-K-K Cross
Chinese cabbage	-Wong Bok
turnip	-Shogoin
broccoli	-Cape Queen
kohlrabi	-Prima
Brussels sprouts	-Jade Cross
radish	-Tama Cross

The results of the trials are shown on pages 12 and 13.

A high percentage of infestation of *S. litura* was found on head cabbage followed by kohlrabi in the dry season and during the rainy season the infestation was high on head cabbage, kohlrabi, Brussels sprouts and broccoli. Radish was the most preferred crop by the *H. undalis* in both the seasons. However, it also infested a high percentage of Chinese cabbage plants during the rainy season. *C. binotalis* was encountered only during the dry season. It preferred Chinese cabbage and turnip and when these two crops started to wither it moved to broccoli and Brussels sprouts. *H. erysimi* also occured only the dry season and its infestation was high on Chinese cabbage, turnip, kohlrabi, and radish. *C. chalcites* was encountered only in the rainy season and its preference was head cabbage, broccoli, kohlrabi and Brussels sprouts. *H. tibialis* occured only in the rainy season and it preferred Chinese cabbage the most.

2. Biological Control of Cutworm

Spodoptera litura is a polyphagous pest. It also infests cruciferous crops. It destroys the seedlings when the infestation occurs immediately after transplanting and it ruins the market value of the crop if the infestation takes place in near mature stages of the crop. In recent surveys of a cabbage field at Mangilao, Guam, an egg parasite and two larval parasites (one ecto and another endo) were recovered.

AES entomilogists are in the process of conducting further surveys for the recovery of natural enemies of not only *S. litura* but also of other pests, so that these natural enemies could be utiltized in an integrated pest control program.

3. Insect Resistance Studies

Experiments are under way for screening insect resistant varieties in head cabbage and Chinese cabbage. Commercial varieties that are adapted to tropical conditions are being screened in the case of head cabbage. Chinese cabbage trials are being conducted in cooperation with the Asian Vegetable Research and Development Center, Taiwan.

II. PHILIPPINE LADY BEETLE STUDIES

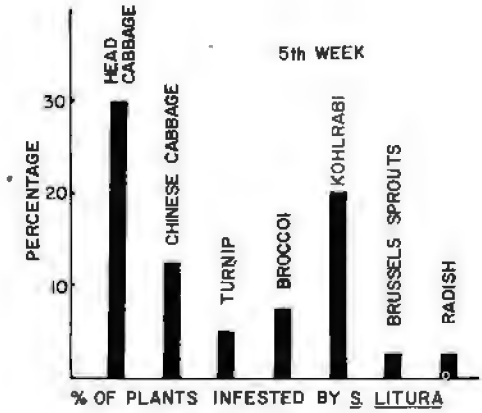
The Philippine lady beetle is a pest of tomatoes and eggplants. The larvae and adults feed on the foliage. Life history and the larval development on eggplant, tomato,*Solanum nigrum* and *Solanum guamese* were studied.

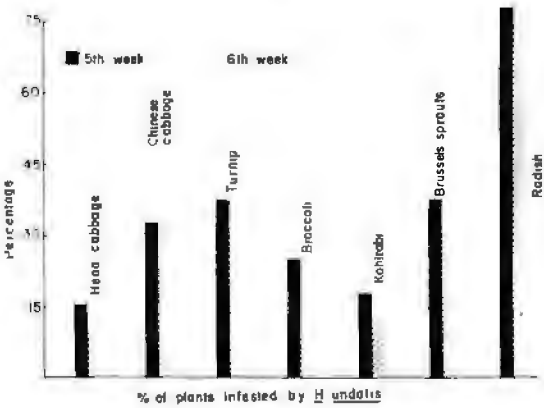
Attempts are being made to introduce and establish a larval parasite, *Pediobius foeolatus* from the U.S. mainland for natural control of the Philippine lady beetle.

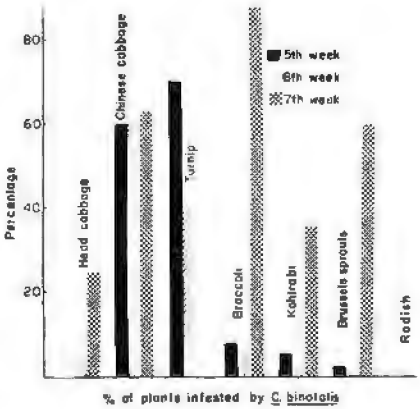
III. BIOLOGICAL CONTROL OF PHYTOPHAGOUS MITES (W-84)

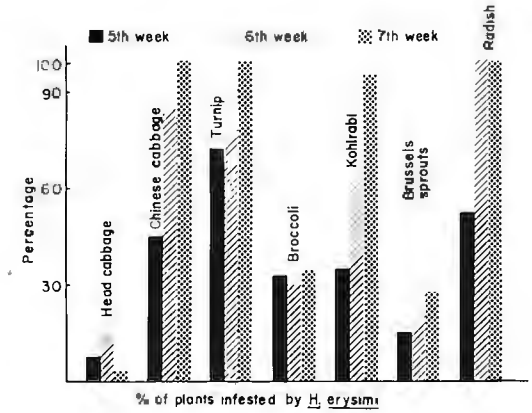
An extensive survey was conducted for collection and identification of phytophagous mites on Guam during 1976. The tumid spider mite, *Tetranychus tumidus* and the broad mite, *Polyphagotarsonemus latus* were found to be the two serious pests of vegetable crops.

Two predaceous mites, *Phytoseiulus persimilus* and *Metaseiulus occidentalis* were received from University of Hawaii. *P. per-*

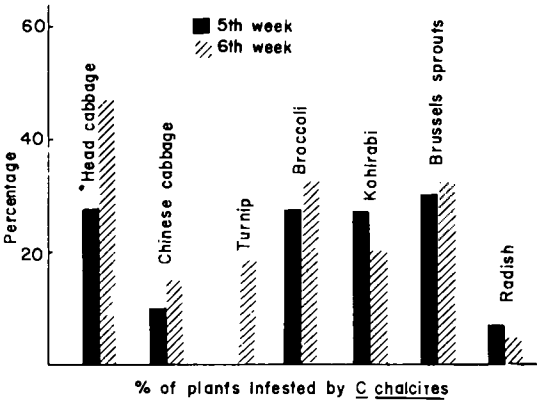


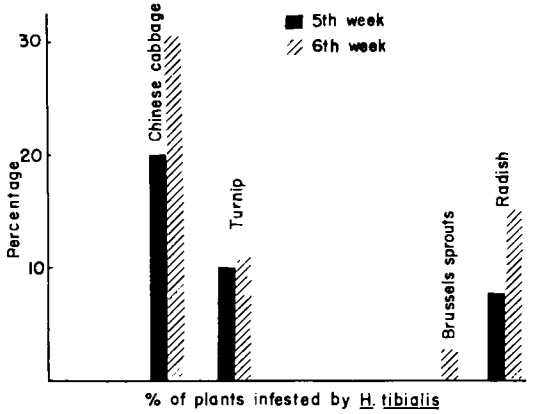


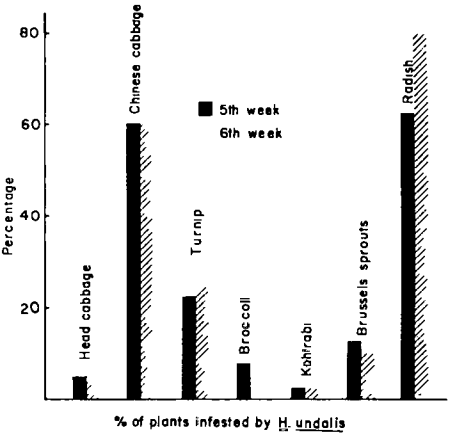


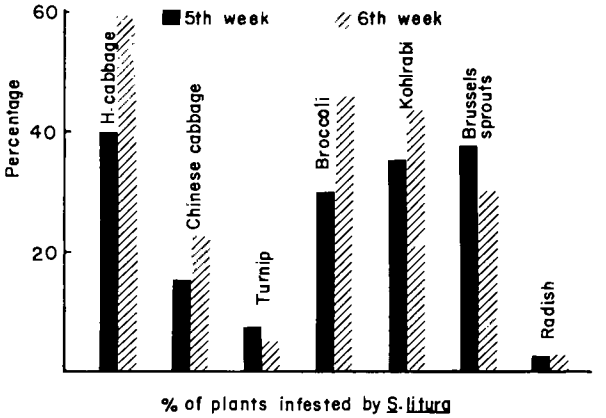


Percentage of various crop plants infested by pests during the dry season.









Percentage of various crop plants infested by pests during the rainy season.

Spodoptera litura larva with ectoparasites (two views).

Cabbage borer, Hellula undalis (two views).

similus has been field released for the control of *T. tumidus* at three different locations on Guam. Further, requests have been received from Saipan and Palau for a supply of these predaceous mites.

A field experiment is in progress to evaluate the resistance of commercial eggplant varieties to the broad mite. Out of the 9 different varieties of eggplants tested, local long green, Black Torpedo and Waimanalo long seem to be tolerant to *P. latus.*

Cut worm, Spodoptera litura.

Flea hopper, Halticus tibialis (two views).

Garden looper, Chrysodiexis chalcites.

Diamondback moth, Plutella xylostella.

Cabbage webworm, Crocidolomia binotalis.

Poinciana looper, Pericyma cruegeri (Flame tree looper).

Bean plant affected by tumid mite, Tetranychus tumidus.

Predatious mite, Phytoseilus persimilus.

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