GUAM AGRICULTURAL EXPERIMENT STATION UNIVERSITY OF GUAM

1987 ANNUAL REPORT

FROM THE DIRECTOR

Our scientists Drs R. Muniappan, D. Nafus and I. Schreiner, has established contacts and have on-going consultation work and research on Biological Control in Oceania. Dr. J.L. Demeterio was involved with the III International Soil Management workshop in Belau, February 2-6, 1987. Thus our efforts transceeds the physical boundary of Guam and covers the entire Oceania.

Spadework in collaboration with the Land Grant Directors of the Marianas, Micronesia, Hawaii and American Samoa were initiated to develop a project addressing the Agricultural Development of the American Pacific. Hopefully, with USDA's approval this project will materialize in 1988.

Our research efforts continue to be applied in mature addressing priorities identified by a committee composed of Research and Extension faculty.

WILFRED P. LEON GUERRERO

Clipping the leaves of *Leucaena leucocephala* (Lam.) de Wit intercropped with head cabbage grown on an alfisol at the Inarajan Agricultural Experiment Station. Photo by Dr. R. Rajendran.

AGRICULTURAL EXPERIMENT STATION

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AGRICULTURAL ENGINEERING

Calvin A. Saruwatari

I. Irrigation Water Requirement Based on Potential Evapotranspiration

Irrigation water requirement determinations require that the data be available or that the assumptions used based on available data be stated. Potential evapotranspiration is estimated by one of several methods and modified for specific crops and growth stages. The modified potential evapotranspiration is reduced by the expected rainfall and this difference is the total irrigation water requirement that must be provided by the irrigation system.

Information on the use of three methods of determining potential evapotranspiration for Guam is currently under study: (a) climatological method: Modified Thornthwaite; (b) energy balance: Modified Penman; and (c) pan evaporation. If it is assumed that the probability of having at least the average rainfall is very high and that all will be effective, the average amount of water that must be provided by the irrigation system will vary between 1,400 to 2,100 gallons/acre/day (2,140 to 3,240 liters/hectare/day) during the "dry" season (potential evapotranspiration exceeds rainfall) depending upon which method is used. If it is assumed that "drought" conditions occur (rainfall is assumed to be negligible), the average amount of water needed rises to 5,100 to 6,700 gallons/acre/day (7,810 to 10,260 liters/hectare/day).

Using a value of 5,000 gallons/acre/ day (7,830 liters/hectare/day) is reasonable for a rough approximation of the daily maximum crop consumptive use for Guam during the "dry" season. This represents a conservative design maximum water requirement since this amount of water is needed only for a period of one month per year. Economic considerations may make the supplying of this amount of water not practical. Further refinements to the calculation are needed give a more accurate total irrigation water requirement determination.

II. Micro-irrigation Research on Guam Series Soils

The Guam Series has been classified as a clayey, gibbsitic, nonacid, isohyperthermic Lithic Ustorthents by the USDA Soil Conservation Service (well drained moderately rapidly permeable soils, very shallow to limestone bedrock, very low available water capacity). Micro-irrigation research on the water requirements of various vegetable crops of economic importance on Guam have been carried out on the Guam Series soils in Inarajan and on private field sites in Barrigada and Mangilao. In a supplemental irrigation field trial on bellpeppers (Probell) in 1984, no significant difference was found when irrigated at a rate of 0.24 gallons/minute (53.76 liters/hour) per 100 feet (30 meters) for up to three hours when the three-day average rainfall did not exceed 0.50 inches (1.27 centimeters). Field trials in 1985 on tomato (Walter) and in 1986 on cucumber (Market King) found no significant difference when the irrigation application rate in addition to rainfall ranged from 60 to 180 gallons/hour (224 to 672 liters/hour) or 0.64 to 1.93 inches/hour (1.63 to 4.90 centimeters/hour) per 100 feet (30 meters).

Based on the field trials conducted, the crops grown on the Guam Series soils showed no significant difference in yield or growth even when the total water applied (rainfall plus irrigation) exceeded 0.50 inches (1.27 centimeters) per day. Studies on the evapotranspiration rate on Guam have indicated a value of 6 millimeters (0.24 inches) per day. If it is assumed that the daily total water requirement must be no less than the consumptive use rate, then the minimum water requirement would be approximately 0.25 inches (0.64 centimeters) per day. Because no significant difference in yield or observed growth was found at a total irrigation rate of 0.50 inches (1.27 centimeters) or more, this would represent the maximum amount of total applied water (rainfall plus irrigation) needed.

AQUACULTURE

S. Nelson

The final year of the project continued to focus on the feeding biology of siganids. Siganids, commonly known as rabbitfishes, are herbivorous fishes from marine and brackish environments of the tropical Pacific and are target organisms for aquaculture development on Guam.

In the first phase of the studies, the feeding preferences of *Siganus spinus* were determined through laboratory assays in which the fish were offered an array of macroalgae collected from the nearshore waters of Guam. As shown in Table 1, the algae were categorized as being of high, medium or low preferences. The highly preferred algal species are of interest in that they are suitable for use as feed in algal-based siganid culture systems. The low preference algae are of interest from an ecological perspective since they are protected from herbivory by defenses either morphological or chemical in nature. The organic extracts of the algal species were avoided by the fish and were tested in conjunction with Dr. Valerie Paul in a separate but related project.

A second set of experiments examined the ability of *S. spinus* to select algal thalli of enhanced nutritional value. Paired sets of thalli were offered to fish with each set including thalli of *Enteromorpha clathrata* which had been enriched through incubation in seawater enriched with ammonia-nitrogen and thalli which had been held in seawater which was not enriched. In feeding trials lasting five to fifteen minutes, the fish were found to ingest significantly greater amounts of the nutrient-enriched algae. These results indicate that the fish are able to select thalli on the basis of nitrogen content and that nitrogen, probably in the form of either proteins or free amino acids acts as a feeding stimulant for herbivorous marine fishes.

Publications

Nelson, S.G. and A.W. Siegrist. 1987. Comparison of mathematical formulations for simulating the photosynthesis-light relations of tropical marine macrophytes. Bull. Mar. Sci. 41:617-622.

Table 1. Feeding preferences of *Siganus spinus*. (N) = number of trials; + = secondary metabolites present; - = secondary metabolities absent; C = calcified.

		Amount Eaten		
Algae	N	±	SE	(%)
Low Preference (<15% eaten)				
Microcoleus lyngbyaceus	10	0	±	0
Avrainvillea obscura (young plants)	5	0	±	0
Chlorodesmis fastigiata	27	0	±	0
Bryopsis pennata	16	0	±	0
Halimeda incrassata	11	0	±	0
Halimeda macroloba	32	0	±	0
Tydemania expeditionis	11	0	±	0
Valonia fastigiata	10	0	±	0
Halimeda opuntia	47	5	±	2
Enhalus acoroides	14	7	±	5
Caulerpa taxifolia (Saipan)	6	8	±	8
Avrainvillea obscura	14	14	±	6
Halimeda discoidea	20	15	±	5
Medium Preference (15-75% eaten)				
Caulerpa cupressoides (Saipan)	6	16	±	16
Sargassum cristaefolium	41	17	±	4
Halymenia durvillaei	17	18	±	9
Halophila minor	15	20	±	8
Caulerpa sertularioides (Guam)	11	27	±	8
Halimeda gigas	9	33	±	12
Caulerpa sertularioides (Saipan)	5	50	±	22
Galaxaura fasciculata	14	57	±	7
Caulerpa racemosa (Saipan)	6	58	±	15
Padina tenuis	45	59	±	5
Asparagopsis taxiformis (Falkenbergia)	8	69	±	6
High Preference (>75% eaten)				
Mastophora rosea	34	76	±	7
Asparagopsis taxiformis	29	78	±	5
Sargassum polycystum	56	78	±	4
Galaxaura oblongata	19	82	±	6
Dictyota bartayresii	18	86	±	5
Acanthophora spicifera	33	88	±	5
Caulerpa serrulata	11	91	±	6
Caulerpa racemosa (Guam)	31	93	±	4
Halodule uninervis	25	94	±	4
Gracilaria crassa	10	95	±	5
Polycavernosa tsudae	10	95	±	5
Galaxaura marginata	27	96	±	3
Desmia hornemanni	16	100	±	0
Dictyota cervicornis	12	100	±	0
Liagora farinosa	7	100	±	0
Laurencia papillosa	17	100	±	0
Spyridia filamentosa	20	100	±	0
Boodlea composita	14	100	±	0
Cladophoropsis membranacea	31	100	±	0
Enteromorpha clathrata	100	100	±	0

ENTOMOLOGY - Biological Control of *Chromolaena odorata*

R. Muniappan & M. Marutani

Chromolaena odorata is a neotropical plant that has become a serious weed in the Mariana Islands. Introduction of the natural enemy, *Pareuchaetes pseudoinsulata* has effectively suppressed this weed on Guam, Rota, Tinian and Saipan. It has also been introduced and established in the island of Aguijan. Shipments of *P. pseudoinsulata* were also sent to Thailand.

Feeding of *P. pseudoinsulata* has been observed to change the color of the leaves of *C. odorata* from Green to yellow. Laboratory experiments feeding yellow and green leaves proved that *P. pseudoinsulata* does not prefer to feed on yellow leaves. When yellow and green leaves were provided in the same container the catepillars did not feed on yellow leaves. When the catepillars were forced to feed on yellow leaves, the growth was slow and they died in two weeks time.

The chemical nature of insect induced changes in *C. odorata* is being investigated.

Also, the succession of plant species on Guam after the control of *C. odorata* is being studied.

Publications

1986. Insects and mites associated with *Chromolaena odorata* (L.), R.M. King and H. Robinson in Karnataka and Tamil Nadu.

1987. Biological Control of *Chromolaena odorata* in Thailand. A study team report submitted to OICD, USDA. 10p.

ENTOMOLOGY - Biological Control of Red Coconut Scale

R. Muniappan & M. Marutani

Red coconut scale, *Furcaspis oceanica*, an endemic species of West Caroline Islands accidentally introduced to Saipan during the World War II. Introduction of the parasite, *Adelencyrtus oceanicus* from Ulithi in 1947, has effectively controlled the red coconut scale on Saipan. Red coconut scale was accidentally introduced to Guam in 1970s. In 1986, it was distributed in Barrigada, Naval Station, Mangilao, Chalan Pago, Ordot, Toto, Mongmong, Maite, Tamuning, Tumon, Agana, Agana Heights, Sinajana, Maina, Asan, Piti, Santa Rita, Agat and two isolated patches in Yona.

A local parasite, *Rozanomvella* sp. has been noted to attack *F. oceanica* on Guam, however, the percentage of parasitism was not high enough to suppress the pest. Necessary arrangements have been made to introduce *A. oceanicaus* from Ulithi to Guam.

Studies on biology of *F. oceanica*, dispersal of crawlers by wind and distribution of crawlers on coconut trees are being studied.

Publications

1987. Red Coconut Scale. Cooperative Extension Service Buletin 2p.

1987. Status of Red Coconut Sale in Micronesia. Presented at the 5th Regional Technical Meeting on Plant Protection. South Pacific Commission Noumea. 5p.

ENTOMOLOGY - Mango Bud Mite

R. Muniappan

A new eriophyd mite has been observed to attack the young dormant buds of mango on Guam. This mite has been described as *Keiferophyes guamensis* Mohanasundaram and Muniappan 1987. Lime sulpher treatment has given better results in controlling this mite over other chemicals tested.

Publications

A new mango bud mite, *Keferophyes guamensis* sp. nov. (Eriophyidae:Acari) from Guam. Internat. J. Acarol. (in press).

Insecticide Control of Mango Bud Mite on Guam, 1987. Insecticide Acaricide tests. (in press).

ENTOMOLOGY - Pest Management

D.M. Nafus & I.H. Schreiner

CORN

Parasites of the corn borer: *Nosema*: is a microsporidian genus which parasitizes insects and species are known to occur in both the Asian corn borer and in the European corn borer. In the European corn borer, *Nosema pyraustae* infections are associated with reduced survival and fecundity. In China, Asian corn borer larvae and adults may be infected with *N. furnacalis* Wenn. To examine for the presence of microsporidians on Guam, mature larvae were collected from corn fields. The malpighian tubules were dissected out of the larvae and examined with a phase contrast microscope for the presence of *Nosema*.

Microsporidians were found in the larvae from Guam. The microsporidians appear to be a species of *Nosema*. The incidence of infection was low; only 6 of 196 larvae were infected. The incidence of infection varied among fields, ranging from 0% to 10%.

Augmentation of predators: Several species of predators are present in corn fields and corn growing as isolated plants is rarely infested by corn borers. To determine whether surrounding the corn with other plants had a significant impact on predator populations, and thus on corn borer numbers, corn was grown as a monoculture and compared to corn intercropped with sweet potatoes. Data on the numbers and species of predators on the corn and the number of corn borers were collected for comparison. In this experiment the sweet potatoes were the principal crop, with a hill of corn substituted for every third sweet potato plant in each row. Each treatment was replicated 4 times.

The populations of certain predators were higher on the corn in the intercrop than in the monoculture (Table 1). Small orb weaving spiders, primarily genus *Neoscana* were significantly more numerous on the corn plants from the time of tasselling onwards. Other kinds of spiders were also present, but not numerous enough to determine trends. The population of spiders per plant increased as the corn grew larger. The number of corn plants which had the fire ant *Solenopsis geminata* on them was nearly twice as high in the intercropped plots, but the difference was significant only at the 10% level. *Solenopsis* were observed to feed on corn borer larvae and pupae on several occasions. The proportion of plants infested with *Solenopsis* increased as the season progressed. The number of anthocorid bugs found on the corn plants was not affected by whether the corn was intercropped or not. Anthocorids were observed feeding on corn borer egg masses, but primarily fed on the corn leafhopper *Peregrinus maidis*. The number of anthocorids decreased after the corn tasselled and *Peregrinus* numbers declined. Despite the increase in predators, no differences were observed in the number of corn borers per plant in the two treatments, and no marketable yield was obtained due to heavy borer damage.

Natural enemy importation: Two parasites were found in Taiwan and imported to Guam. A tachinid (*Lydella* sp.) was collected in small numbers and was heavily parasitized by hyperparasites. No males emerged so this species was not released. About 40 individuals of a second species, *Trichomma cnaphalocrocis* (Ichneumonidae) were released into a field cage. Establishment attempts failed when an ant (*Solenopsis geminata*) attacked the moth pupae. Only a single ichneumonid was recovered.

Alternate hosts of the corn borer: The presence of alternate hosts in or near the field can increase crop damage by improving survival of the pest during periods when the crop is not present. Many alternate hosts of *O. furnacalis* have been listed, but many of the recorded hosts for *O. furnacalis* may be wrong. Until recently there was considerable confusion about the status and identification of the species within the genus *Ostrinia*. Because this confusion, many of the host records for *O. furnacalis* could be for other species of *Ostrinia*.

Asian corn borer eggs were collected from corn fields. Newly hatched larvae were placed singly in vial with a small piece of the host plant to be tested. The host material consisted of sections of young stem (grasses), pieces of fruit (bell pepper) or sections of fresh corn cob. Survival and developmental time were recorded. The wing length of adult moths was measured since size of the adult is correlated with fecundity.

Sweet corn ears were a superior host for the Asian corn borer compared to any of the other plants tested (Table 2). The moths required an average of 25.5 ± 2.7 days to develop from first instars to adults. Most moths pupated after 5 instars, but 15% required 6 instars. The average wing length of the adults was 1.28 ± 0.17 cm.

The next best host of those tested was Johnson grass, *Sorghum halpense*. Survival of the moths reared on Johnson grass was about half that of the ones reared on sweet corn cobs (Table 2), and the resulting moths were quite small. Most of the moths completed their development in 5 instars but 25% required 6 instars. Developmental time was 32.2 ± 3.9 days, significantly longer than the developmental time on sweet corn cobs ($t = 7.482$, $P \leq 0.005$). The average wing length of the adults was 1.01 ± 0.07 cm, significantly smaller than those emerging from the sweet corn ears ($t = 4.113$, $P \leq 0.0005$). We have observed Asian corn borers infesting Johnson grass in the field. The primary feeding sites observed on Johnson grass were the leaves and the stems. The flowering structures showed little evidence of damage.

Few larvae survived on bell peppers. Only two larvae out of 160 were reared to adults. One required 42 days from hatching to develop and the second one 66 days. Asian corn borer larvae are occasionally found in bell peppers in the field on Guam and are potentially a pest. At this time their importance is small compared to the damage caused by *Heliothis* sp. Ten percent of the caterpillars found in field collected bell peppers were *O. furnacalis* and the rest were *Heliothis*.

A single larvae completed development on wild cane, *Saccharum spontaneum*. This larvae required six instars and a total of 39 days to emerge as an adult. The use wild cane as an alternate host of Asian corn borers is important information because wild cane plantings are recommended as wind breaks on Guam.

Two larvae out of 120 developed on *Brachiaria mutica*. They required 52 and 58 days to complete development. During this time they passed through six or seven instars.

Panicum maximum, Eleusine indica, Pennisetum typhoides and *Phragmites karka* did not support any corn borers through their complete developmental cycle.

We conclude that Johnson grass is probably one of the most important hosts in maintaining high populations of corn borers in the absence of corn.

Host Plant Resistance: Inbred lines of both sweet corn and field corn were obtained from Hawaii. Many of the inbreds obtained from were derived from corn with tropical origins. The inbreds included yellows, dents, and half flints. They varied in their daylight sensitivity and maturity.

All inbreds and varieties were rated for resistance to leaf-feeding. A 1-9 scale was used for leaf ratings with 1 being highly resistant and 9 being most susceptible. Leaf ratings were done just prior to the emergence of the tassel. The inbreds were also screened for resistance to tassel-feeding. For tassel ratings a 1-6 scale was used with 1 being highly resistant and 6 being most susceptible. Tassel ratings were done when the tassels began to shed pollen.

Studies were conducted in Harmon, Guam. Natural infestations were used. Each variety was grown in a block all of the other varieties. The blocks were replicated 4 times. Within a block each variety was planted in a row of 20 plants spaced 9 inches apart. Rows were 3 ft. apart. The location of each variety was randomized in each block. In each row 10 plants were rated for resistance.

Several inbreds showed resistance to either leaf feeding, tassel feeding, or feeding on both parts of the plant by the Asian corn borer (Tables 3). At least 13 inbreds hold promise as breeding stock for incorporating resistance into field corn. The best inbreds overall were ANTC-S5, A619, CIM.T-11ES, H60, Hi32, ICA L223, ICA L25, ICA L29, Mo5, and Mp496.

MANGO

Survey of mango shoot caterpillar populations: Continuing surveys of the populations of the mango shoot caterpillar as detailed in the 1986 report have shown that the number of caterpillars per shoot is not correlated with any obvious parameters such as monthly rainfall or the percent of shoots flushing (Figure 1). However the population has become significantly less since July 1987, at which time it is thought that the introduced parasites began to have a significant impact. Heavy damage to the trees was observed up until the July-August 1987 period, after which time there was little damage.

Natural enemies of the mango shoot caterpillar: In July 1987, a total of 1,623 larvae were collected from 10 different villages to determine the status of the released parasitoids. By December 1987, it had become more difficult to find larvae, but a total of 289 larvae was collected to assess the continuing impact of the parasitoids.

Aleoides sp. near *circumscriptus* was first released in July of 1986 and releases were continued approximately every two weeks from August through February, 1987. A total of 453 wasps were released. The wasp is a solitary, internal parasitoid which attacks the first 3 larval instars. Recoveries were made through July 1987 in the villages of Barrigada and Dededo. In July, in Barrigada 7.6 percent of the second instar caterpillars collected were parasitized by this species. No parasites were reared from other instars. In Dededo 0.93 percent of the third instars collected were parasitized by *Aleoides*. Since July, no larvae parasitzed by this species have been recovered, and it may be that the species has failed to establish permanently. Specimens were sent to Paul Marsh of U.S.D.A, who believes that they should be identified as *Rogas* sp.

In October 1986, 45 tachinid flies of the species *Blepharella lateralis* were released in Dededo and Yigo. All released adults came from wild flies collected in India as the fly could not be reared in the laboratory. The flies attack all the larval stages and emerge from fifth instar larvae and the pupae. All the flies were released during October in lots of 3 to 11 flies. In July, 5 flies were reared from caterpillars collected in Piti, which was several miles from either of the release points. In August, 15 of 225 (6.7%) caterpillars from several villages were parasitized by the tachinid suggesting a rapid buildup and spread of this species. In December 3.8% of 289 caterpillars were parasitized. However, if one examined only fifth instar larvae, 13% were parasitized.

In late November 1986 and continuing through February 1987, *Euplectrus* sp. nr. *parvulus* was released. This wasp came from Chidambaram, India. It is a gregarious parasitoid which lays its eggs on the first three instars. Development is rapid: taking from 8-10 days from egg to newly emerged wasps. Pupation takes place under the collapsed larval skin. A total of 858 wasps were released in seven villages in lots ranging from 9 to 128 wasps. In July 1987, wasps were recovered from all release sites and other villages as well. Of the caterpillars collected, 5.6% of the first, 1.2 % of the second, 6.2 % of the third, and 2.2 % of the fourth instars were parasitized by this species. In the December sample, 4.5% of the first, 15.5% of the second, 10.9% of the third and 2.5% of the fourth instar larvae were parasitized by this species.

Because *Euplectrus* prevents the larvae from moulting after it attacks, and *Blepharella* only emerges from last instar larvae or pupae, we were able to construct a life table accounting for mortality of the mango shoot caterpillars to parasitoids. In July a cumulative total of no more than 16.2% of the larvae were killed by parasitoids, but by December, the cumulative mortality had risen to 39.8%.

Surveys for local parasitoids were continued. No parasitoids attacking eggs or larvae were found. *Brachymeria albotibialis*, a species attacking a wide variety of Lepidoptera, was reared from the pupa. It was rare.

Biology of the mango blotch miner: Specimens of larvae and adults of the mango blotch miner were sent to K. Harris of the British Museum, who identified them as a probably undescribed species of *Procontarinia* (Diptera: Cecydomyiidae).

By exposing seedling trees with new flush to blotch miners for 24 hour period it was determined that the mango blotch miner only attacks young leaves which were between 2 and 4 cm in length at the time of exposure. The life cycle of the insect was rapid. The larvae emerged from the leaves within 4 days after the leaves were exposed to attack. Larvae emerging from the leaves were collected and reared in the laboratory on damp peat moss. The pupal period was six days.

Blotch miner population were sampled on a long term basis as detailed in the 1986 annual report. Populations were not seasonal, maintaining similar overall levels throughout the year, but with occasional localized outbreaks. No close correlation could be observed with rainfall, but in on two out of four occasions when the monthly rainfall exceeded 30 cm (12 inches), there was a peak in the *Procontarina* counts observed in the following month (Figure 1).

Trees appeared to differ in their susceptibility to the blotch miner. A set of 16 trees was sampled every time they flushed over a 21 month period, and there were significant differences in the average number of blotch miners per tree. However, because we lack grafted trees, we could not determine whether the differences were due to genetic factors or to site.

CUCUMBERS

Cucumbers (var. Slice Master) werer planted March 5 and August 26. The plants were grown on trellises, in rows 5ft apart. Black plastic mulch was laid on all the rows, and they were fertilized with 16-16-16 at the rate of 100 lbs N/acre. To determine whether cucumber beetles (*Aulacophora similis*) could be controlled with insecticides applied in the soil, granular diazinon was applied to half the rows, whereas the other half were untreated. Each row was then split into three treatments: either Sevin or Dipel applied weekly or no treatment. In the second trial, each row was divided into four insecticide treatments: Sevin, Dipel or Vydate applied weekly or no treatment. Cucumber beetles were counted by walking along the rows and counting all adults visible on the foliage. *Diaphania indica* (melon worm) numbers were estimated by counting the number of worms per leaf on each of 10 mature leaves per subplot. Small arthropods such as thrips and aphids were counted by picking 10 mature leaves per subplot and bringing them in bags to the laboratory where the small insects could be counted under a binocular microscope. All yield was picked and weighed.

In the first trial, the only insects present in any countable numbers were larvae of the melon worm. The number of caterpillars per leaf was considerably lower in this trial than in the one 1986, averaging about 0.5 caterpillars per leaf even in the untreated plots. In this trial, none of the insecticides had any significant effect on melon worm numbers or yield (Table 4).

In the second trial, all insects were very abundant (Table 5). We were unable to control melon flies in any of the treatments, so that the experiment was abandoned prematurely without yield data. Melon worm numbers averaged about 1.5 per leaf in the untreated plots. Sevin and Dipel provided good control of melon worm, but Vydate did not. Melon aphids (*Aphis gossypii*) were significantly reduced compared with the control by all the insecticide treatments. Cucumber beetles were relatively abundant. However, since the experiment had to be abandoned, no data was available to determine whether soil treatment to prevent the beetle larvae from eating the cucumber roots had any effect on yield.

Melon thrips (*Thrips palmi*) were abundant in this trial. None of the insecticide treatments provided any control of these thrips. Vydate, which has been recommended in Hawaii, had no effect on thrips numbers in this experiment.

EGGPLANT

Eggplants were transplanted June 10. The plants were spaced 2 ft apart, in rows 5ft apart. Alternate rows of two varieties were planted: a recently imported purple variety, Ichiban, and the green local variety, probably originally from the Philippines. Each row was divided into three parts receiving different foliar insecticide treatments: either wettable sulfur (8 lbs A.I/ 100 gal water) or sevin (4 lbs A.I/ 100 gal water)+ wettable sulfur (8 lbs A.I/ 100 gal water) or no treatment. Leafhopper numbers were estimated by counting the number of leafnhoppers/ 20 leaves per plot, and the number of the small insects was counted by picking 10 leaves per plot, bringing them to the laboratory and counting under a microscope. For broad mites, young leaves, less than 5cm across were used. For thrips, aphids, and spider mites, mature leaves were used. Since the leaves of the green variety were larger than those of the purple variety, the green variety leaves were cut in half to make the size more comparable.

The number of leafhoppers, *Sundapteryx biguttula*, were significantly fewer on the leaves of the local green variety (Table 6). The amount of hopperburn observed also seemed to be much less in this variety than in Ichiban. Thrips numbers were slightly higher on the green variety, but overall, the number of thrips was low and at that level was unlikely to be damaging the plants. The other insect species were not significantly affected by variety. The foliar treatments significatly reduced the number of *S. biguttula*, and broad mites, *Polyphagotarsonemus latus*. The number of *T. palmi* was slightly higher in the treated plots than in the untreated ones. The number of spider mites (*Tetranychus* sp.) and aphids (*Aphis gossypii*) was not affected by the treatments. Both were present only in low numbers.

LEUCAENA

The coccinellid beetle *Curinus coeruleus* was imported from Hawaii and released at four sites on Guam in March, 1986 for biological control of the leucaena psyllid, *Heteropsylla cubana*. The beetle established at one site but not at the other three. The beetle was only found within an area about 100 meters in diameter from the release point until September 1987. It has now expanded its range to approximately 1 km from the release site.

Routine population samples of the beetle and the psyllid were started in May, 1987. Ten sites are being studied. At present the beetle is still confined to one site. Initially the populations of psyllids in the release area were very low, but in August and September an outbreak was noted (Fig. 2). Beetle populations, which were very low in July and August, have also increased in September. Periodic outbreaks have been found at the other study sites although the overall population has been relatively constant.

CITRUS

Population surveys were continued on the wooly whitefly (*Aleurothrixus floccosus* (Maskell)) and the parasitoid *Eretmocerus* sp. in 1987. Wooly whitefly populations were very low over most of 1986-1987 (Fig. 3). In April, following a period of low parasitization, an brief outbreak of the wooly whiteflies took place. Whiteflies populations quickly declined thereafter. Parasitization rates continue to fluctuate between 40-60 percent although a low of 20 percent was found prior to the increase in the numbers of the whiteflies in April.

INSECTS ESTABLISHED IN MICRONESIA WHICH WERE FIRST IDENTIFIED IN 1987

GUAM Insect *Genus species* Order: family	Host	Status	Comments
Epitrix hirtipennis (Mels.) Coleoptera: Chrysomelidae	Eggplant	New record	On Guam since at least 1981 Chews pitlike holes in leaves
Chaetocnema confinis Crotch Coleoptera: Chrysomelidae	Sweet potato	New record	First observed in 1986 in northern Guam Chews furrow-like tracks in leaves
Curinus coeruleus Mulsant Coleoptera: Coccinellidae	scales psyllids	Biocontrol establishment	Released 3/86 for control of *Heteropsylla cubana*: Recovered at UOG 3/87
Eotetranychus cendanai Rimando Acari:Tetranychidae	citrus	New record	On Guam since at least 1983 Causes defoliation of citrus trees
Flaccia dione Fennah Homoptera:Derbidae	banana, coconut	New record	On Guam at least since 1985 Not a pest
Euplectrus sp. nr. *parvulus* Hymenoptera: Eulophidae	mango shoot caterpillar	Biocontrol establishment	Repeatedly released in 1986-1987 Recovered July, 1987
Blepharella lateralis Diptera: Tachinidae	mango shoot caterpillar	Biocontrol establishment	Repeatedly released in 1986-1987 Recovered July, 1987
Rogas sp. or *Aleoides* sp. Hymenoptera: Braconidae	mango shoot caterpillar	Biocontrol establishment	Repeatedly released in 1986-1987 Recovered July, 1987, may be extinct as no recoveries since August 1987
Procontarina sp.	mango	New report	Possibly a native insect. This is probably an undescribed species. It has been on Guam for a long time. Creates blotches in young leaves.
Furcaspis biformis (Cockerell) Homoptera: Diaspididae	orchids	New record	First identified in 1987, new since 1955
Genaparlatoria pseudaspidiotus (Lindinger) Homoptera: Diaspididae	orchids	New record	First identified in 1987, new since 1955
Tenuipaplus pacificus Baker Acari: Tenuipalpidae	orchids	?New record	First identified in 1987, but may have been on Guam for many years
Pohnpei			
Dialeurodes citrifolii (Morgan) Homoptera:Aleyrodidae	citrus	New record	Found only in Kolonia area in 1986. Abundant on a few trees. No parasitazion

Table 1. Number of predators and Asian corn borers in corn monoculture and corn intercropped with sweet potatoes.

Species	Corn growth stage	Unit	Intercrop	Monoculture	't'
Neoscana sp.	Whorl	Number per	2.5	1.0	1.13 $P<0.375$
	Tassel	plant	19.8	9.0	2.29 $P<0.05$
	Blister		83.0	46.2	1.51 $P<0.1$
Solenopsis	Whorl	Number plants	9	6	1.01 $P<0.375$
geminata	Tassel	infested	14	7	1.53 $P<0.1$
	Blister	per 75 plants	35	22	1.78 $P<0.1$
Anthocoridae	Whorl	Number per	17.2	19.5	1.13 $P<0.375$
	Tassel	plant	5.4	3.7	0.79 $P<0.375$
	Blister		11.0	9.8	0.24 $P<0.375$
Ostrinia furnacalis	Tassel	Number per plant	13.2	15.5	0.45 $P<0.375$

Table 2. Survival and developmental time of Asian corn borers on various hosts.

Host	Num. Trials tested	Total larvae	Number surviving	% surviving	Developmental time (days)
Sweet corn ears	3	120	46	38.3	26
Bell pepper fruit	4	160	2	1.2	54
Sorghum halpense	4	158	19	12.0	32
Phragmites karka	4	160	0	0.0	—
Panicum maximum	4	160	0	0.0	—
Saccharum spontaeum	4	160	1	0.6	39
Eleusine indica	2	80	0	0.0	—
Brachiaria mutica	3	120	2	1.7	54
Pennisetum polystachyon	4	160	0	0.0	—

Table 3. Leaf and tassel ratings for resistance to the Asian corn borer of some tropical corn inbreds.

	Leaf rating			Tassel rating		
Inbred	'83	'84	'87	'83	'84	'87
ANT C-S5		4.2[1]	3.6[2]		2.8	3.7
AR258		7.0	7.8		2.2	5.7
A619 (Hi)	3.8	3.8	3.9	3.7	3.0	3.7
A632 (Hi)	4.4	5.3[1]	4.8	2.8	3.3[1]	4.1
Arg F872		4.3[1]			4.1	

Table 3.(Continued)

Inbred	Leaf rating '83	Leaf rating '84	Leaf rating '87	Tassel rating '83	Tassel rating '84	Tassel rating '87
B37 (Hi)	5.4	4.3	7.2	3.9	3.3	4.5
B73 (Hi)		4.3	7.6		2.7	5.7
B77 (Hi)			5.9			5.1
B87 (Hi)		5.4[1]			2.3[1]	
CI64 (Hi)	6.5	5.6	7.2	3.7	3.1	4.6
CI66 (Hi)	5.4	4.1[1]	7.1	3.2	3.4	5.2
CIM. A-6 (Hi)		6.8	5.4		4.5	5.0
CIM.A-21 (Hi)		3.9	8.1		2.6	5.1
CIM.T-11ES (Hi)		2.8	3.2		1.7	3.7
CM103 (Hi)	6.5	5.4	7.1	3.4	2.1	4.9
CM116		6.0	7.6		2.5	5.5
CM117		5.2	8.3		2.8	5.0
CM118						5.0
CM201 (Hi)	3.6	6.3[1]	5.8	4.0	2.7[1]	5.0
CM207		5.2	6.2		2.5	5.3
EMBRAPA 38		5.8[1]			3.5[1]	
F44 (Hi)	5.9	4.6	6.7	2.8	3.4	5.1
Fla2AT98			7.7			5.6
Fla2AT113		4.6[1]	6.0		2.5	4.6
Fla2AT114		5.8	6.5		3.3	5.2
Fla2AT115		4.3	5.3		2.3[1]	4.4
Fla2AT116			5.2			4.8
Fla2BT106		4.4	6.9		2.7	4.9
Fla2BT54		4.3	4.6		3.1	4.7
Fla2BT73		3.6	5.3		3.5	4.9
Ga209 (Hi)	6.4	6.6	7.0	3.1	2.8	5.8
GT112Rf		5.8	6.4		4.1[1]	5.4
H55 (Hi)		5.1	6.5		3.3	5.6
H60 (Hi)	3.4	5.5[1]	4.4	2.8	1.5[1]	4.4
H632A		6.4			3.4	
H632F	7.1	3.5	7.9	3.9	3.7	5.7
H632G	7.4	5.2	7.8	3.6	2.6	5.9
H84 (Hi)	3.5	3.5	8.1	2.8	3.5[1]	
H95 (Hi)	3.7	5.2	6.5	1.9	2.3	5.4
Hi25	4.5		7.8	3.4	1.4[1]	4.9
Hi26	6.1	4.6	5.8	3.2	2.2	4.2
Hi27	3.8	6.2[1]	6.7	2.8	1.9[1]	4.8
Hi28	5.6	4.7	8.1	3.5	2.7	5.7
Hi29	5.0	4.8	8.0	3.1	2.9	5.8
Hi30	4.3	3.9[1]	6.0	2.7	1.8	4.6
Hi31	3.8	5.8[1]	4.9	2.8	2.2	4.8
Hi32	3.2	2.2[1]	5.9	1.5	1.5[1]	5.0
Hi33	4.0	3.3[1]	3.8	3.3	2.3[1]	3.8
Hi34		3.9[1]	5.9		2.8	4.9
Hi35		5.7	7.0		3.4	5.4
Hi39		4.2	5.8		3.0	5.0
Hi40		3.4	6.8		2.3	4.6
Hi41		6.5[1]	7.8		3.1[1]	4.9

Table 3. (Continued)

Inbred	Leaf rating '83	Leaf rating '84	Leaf rating '87	Tassel rating '83	Tassel rating '84	Tassel rating '87
HIX4231		**2.2**[1]			**1.8**[1]	5.6
HIX4263		4.3	7.2		2.5[1]	5.4
HIX4267		4.5	5.0		2.9	4.3
HIX4269			6.2			5.0
HIX4283		5.9	7.8		2.8	5.8
ICA L210	4.4	4.7	8.5	2.9	2.8	5.5
ICA L219		6.1	7.4		2.7	5.1
ICA L221		5.4	7.1		3.8	5.3
ICA L223	4.1	4.5	**3.6**	2.7	2.5	3.9
ICA L224	**3.0**	4.6	6.5	2.9	2.7	5.4
ICA L25		**2.5**[1]	**3.8**		**1.8**[1]	
ICA L27		5.2[1]			2.7	4.0
ICA L29	**2.9**	3.5[1]	5.1	**1.6**	**1.5**[1]	3.8
ICA L36	4.2	4.9	6.1	**2.1**	2.2	5.0
IITA1368		6.4			3.0	
INV138	3.9	4.2	6.6	2.6	3.4	4.8
INV302		5.5	8.3		3.9	5.3
INV36		4.7	7.0		3.6	4.3
INV534		4.9	7.2		2.6	5.0
INV575	4.2	5.2	7.8	3.3	3.2	5.6
KU1403			7.6			5.8
KU1409		5.4	7.9		4.4	5.5
KU1414		5.6	6.4		3.9	5.6
KU1418			4.8			4.5
Ky226 (Hi)	4.3		6.9	2.3		5.2
MIT 2-S6		5.0[1]	5.3		2.4[1]	5.5
MIT 11-S3		**2.3**[1]			3.7[1]	
Mo5	**3.2**	**1.5**[1]	6.7	2.9	**1.6**[1]	5.0
Mo20W		4.8	6.7		3.1	5.7
Mp496		**3.0**	4.7		**1.9**	**2.7**
Mp68:616 (Hi)	4.7	**2.2**[1]	6.2	3.3	**1.5**	5.2
N28 (Hi)	5.8	3.6[1]	6.3	3.2	2.1	5.1
N139		5.8[1]	6.0		3.1	5.5
N6G (Hi)		4.4	7.4		2.2	5.8
Narino 330-S6		**3.3**[1]	5.6		2.4	5.1
NC246		5.7	6.4		2.3	5.1
NC248		3.8[1]	7.7		2.7	5.7
Oh43 (Hi)	4.9	4.3	6.4	3.4	3.3	5.3
Pa762		5.1			2.7	
Pa91		4.7[1]			5.5	
PAC90038		**2.0**[1]	7.8		2.3	6.0
Phil DMR6-S5		4.5[1]	7.6		2.4	5.0
R168	**3.2**	5.8		2.7	3.6	
SAA272			6.3			4.8
SAP356			6.0			5.1
SC12		5.1			3.3	3.9
SC213		7.4[1]	5.5		3.5[1]	3.9
SC301D (Hi)	3.8		6.6	2.9		5.7

Table 3. (Continued)

Inbred	Leaf rating '83	Leaf rating '84	Leaf rating '87	Tassel rating '83	Tassel rating '84	Tassel rating '87
SC43		6.2[1]	6.1		3.3	5.4
SC55		6.4[1]			3.0	
SR52F	4.8	5.2[1]		3.9	3.2	
T220		4.2			2.3	
T232 (Hi)	5.2		7.2	3.8	4.5	5.8
T250		6.3[1]			2.5[1]	
T256		3.8	5.9		2.5	4.9
T258		4.1[1]	**4.5**		2.5	4.7
Tuxpeno-S5		5.5	6.5		2.8	5.2
Tx29A (Hi)		5.8	6.1		3.0	5.0
Tx5855	6.5	5.7	7.5	4.0	4.2	6.0
Tx601 (Hi)		6.1	8.6	**1.6**	3.4	5.7
TZi3			8.3			5.7
TZi4			5.6			4.3
TZi14			7.7			5.6
TZi17			6.3			5.2
TZi18			7.9			5.5
Va35 (Hi)	4.3	5.5	**4.5**	3.1	2.8	4.0
W64A (Hi)		5.5	6.9		3.7	5.2
average	4.6	4.8	6.5	3.0	2.9	5.0
70% of average	3.2	3.3	4.5	2.1	2.0	3.5

[1] Total number of plants rated less than 10

[2] Numbers in bold face have rating of 70% or less of the mean rating for the trial

Table 4. Effect of soil and foliar insectidides on *D. indica* numbers and cucumber yield.

Treatment and lbs AI/acre	Number *D. indica* per leaf	Number cucumbers	Yield (kg)
Diazinon 14G 4lbs+ Sevin 50WP	0.3	99	33.2
Diazinon 14G 4lbs+ Dipel	0.4	84	29.7
Diazinon 14G 4lbs	0.5	90	30.3
Sevin 50WP	0.3	107	32.2
Dipel	0.4	101	31.0
Control	0.6	107	32.7

Analysis of Variance			
Soil treatment			
F (and probability)	0.01(0.9201)	1.66(0.235)	0.06(0.818)
Foliar treatment			
F (and probability)	1.49 (0.249)	0.52(0.604)	0.17(0.842)
Soil*Foliar Treatment			
F (and probability)	.04(0.961)	0.11(0.894)	0.91(0.911)

Table 5. Effect of soil and foliar insectidides on cucmber insect number in second trial.

Treatment and lbs	Number per leaf		Number per row	
AI/acre	*D. indica*	*T. palmi*	*A.gosypii*	*A.similis*
Diazinon 14G 4lbs+ Sevin 50WP	0.45	117	5	4.2
Diazinon 14G 4lbs+ Dipel	0.05	104	15	6.8
Diazinon 14G 4lbs+ Vydate	1.00	81	16	9.8
Diazinon 14G 4lbs	1.95	92	56	7.2
Sevin 50WP	0.47	138	9	7.0
Dipel	0.10	109	19	5.2
Vydate	0.97	150	3	8.0
Control	1.40	119	32	5.2
Analysis of Variance				
Soil treatment				
F (and probability)	1.02 (0.386)	3.19 (0.171)	1.29 (0.338)	0.39 (0.577)
Foliar treatment				
F (and probability)	23.76 (0.0001)	0.35 (0.791)	4.68 (0.013)	1.65 (0.214)
Soil*Foliar Treatment				
F (and probability)	1.01 (0.4133)	0.61 (0.616)	0.78 (0.519)	0.96 (0.433)

Table 6. Yield and insect numbers on eggplant

Variety and	Number	Seasonal mean number per leaf				
treatment	Eggplants	*S. biguttula*	*A. gossypii*	*T. palmi*	*Tetranychus*	*P. latus*
Green local						
Sevin+Sulfur	271	0.02	1.1	5.0	7.5	19.3
Sulfur	296	0.13	1.8	6.0	0.3	14.8
None	192	0.54	22.9	1.3	0.7	31.0
Ichiban						
Sevin+Sulfur	239	0.14	0.5	0.6	12.3	46.5
Sulfur	227	0.19	1.3	2.0	2.7	2.7
None	161	1.93	4.4	0.8	1.2	32.6

Analysis of variance						
Variety						
F	2.53	21.66	1.24	16.13	1.71	0.96
Significance level	n.s.	0.005	n.s	0.01	n.s	n.s.
Foliar treatment						
F	9.30	25.81	2.22	5.14	10.97	4.37
Significance level	0.001	0.0001	n.s.	0.02	n.s	0.02
Variety X Foliar treatment						
F	0.49	8.69	1.15	1.76	0.05	2.40
Significance level	n.s.	0.002	n.s	n.s.	n.s.	n.s.

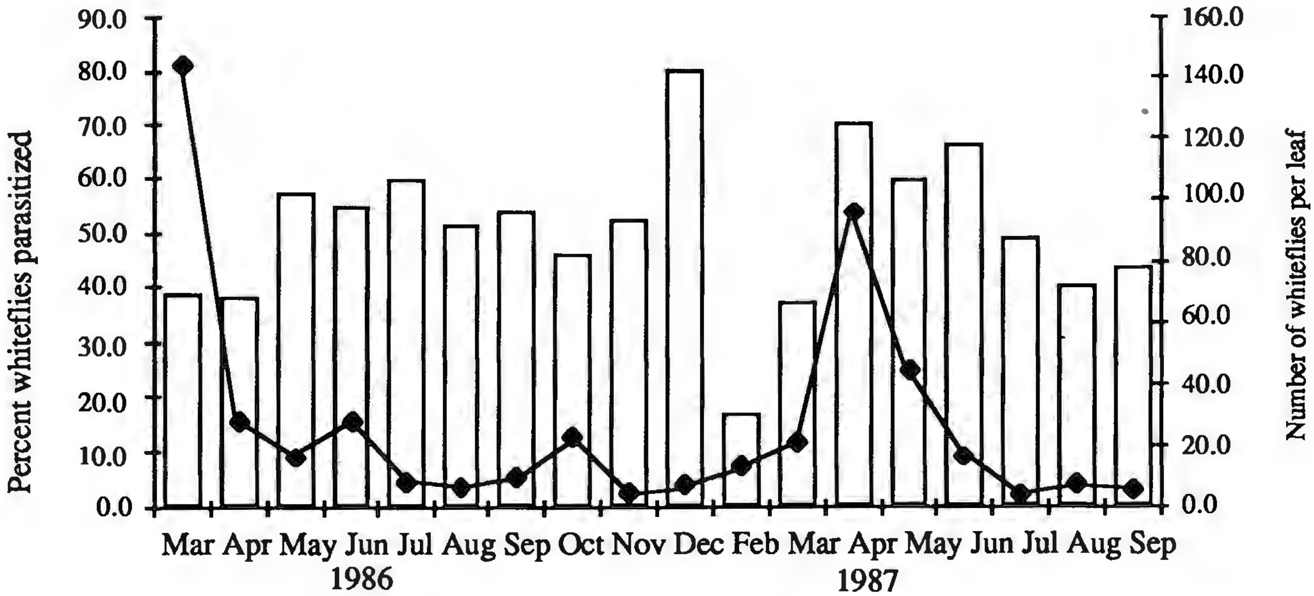


Fig. 1. Population trends of the wooly whitefly in relation to parasitization levels by Eretmocerus sp. in 1986 and 1987.

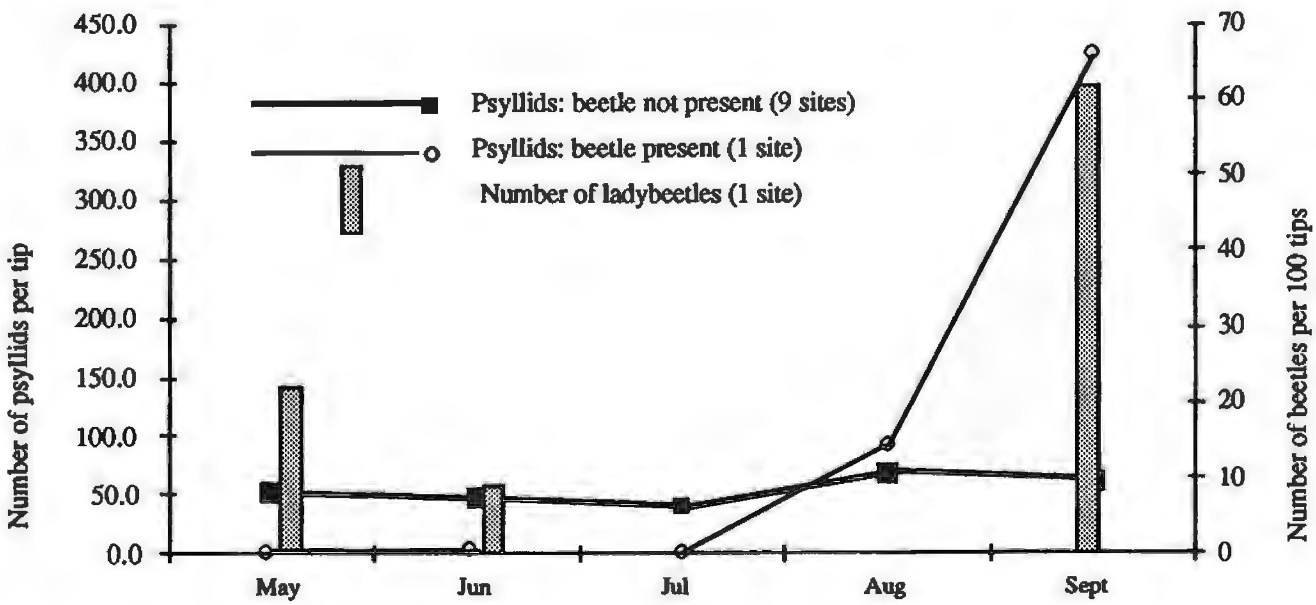
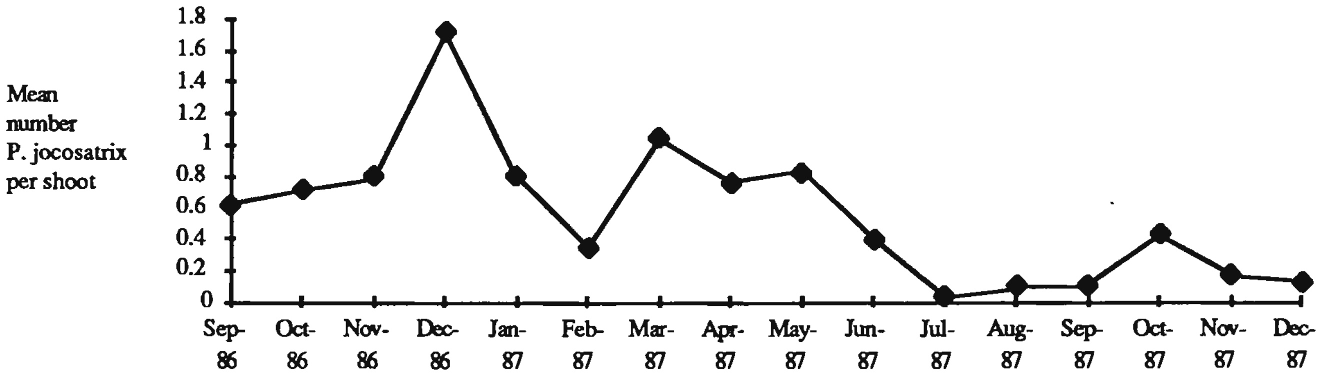
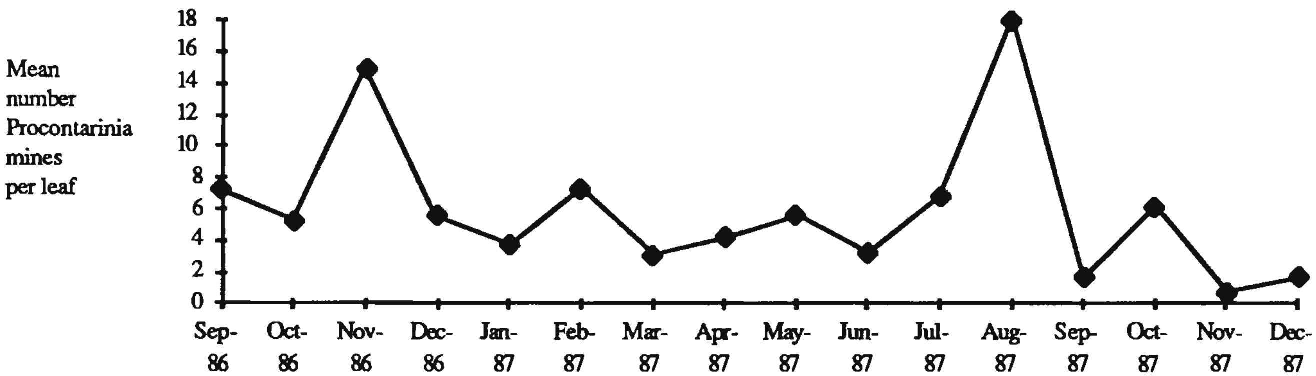
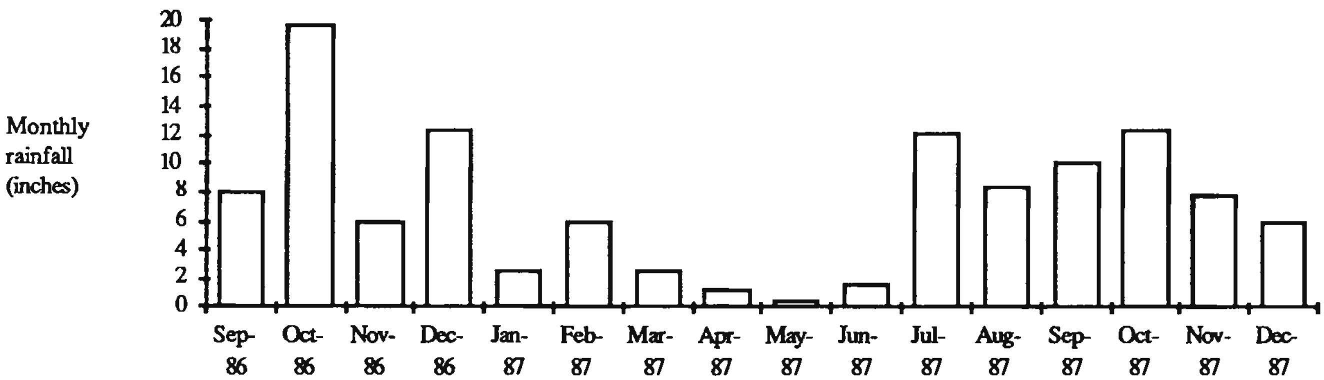


Fig. 2. Number of psyllids at sites with C. coeruleus compared to sites without C. coeruleus. Number of C. Coeruleus are reported in establishment area.





precipitation



HORTICULTURE - Fruit crops

R. Rajendran

Survey and Accession

A survey of the fruit and nut bearing plants on Guam was done and a pictorial write-up is being compiled for publication. As a byproduct of this survey, poisonous and irritating plants growing on Guam were identified. A report on these plants has been compiled to provide information, as consolidated information on these plants were not available.

A survey of the banana production on Guam was also done, in collaboration with the agricultural economist and extension personnel, on the cost and return of producing bananas. It was observed that the farmers on Guam do not use modern technology such as optimum density of plants, adequate ventilation, proper land preparation, maintenance and inter cultural operations, selection of healthy disease free clones, de-suckering, pruning, and disposal of waste materials, regular application of fertilizers and irrigation, plant protection and planned marketing in commercial banana production. Formation of hard pan around the plant due to movement of trucks and inadequate intercultural operations and maintenance, failure to control weeds, pests and disease were common feature of the farmers field. This results in low and unpredictable yields and poor quality of the harvested crop, which produces little financial gain.

Most of the banana farms on Guam were planted earlier than 8 to 10 years ago and in many of them, the banana rhizomes were seen growing above the ground, as little to no earthing-up operations are practiced on Guam. This leaves little space for the roots to grow, resulting in weak plants and low yield. In commercial banana growing areas of the world, planned crop rotation is followed to maintain a nutrient balanced, disease-free soil. Banana plantations are replanted every 4 years, in new areas. The old fields are ploughed deep and either allow to lie fallow or nitrogen fixing crops such as legumes, and green manuring crops that add more organic matter to the soil are grown on them for a few years before replanting with bananas. If this practice were followed on Guam, total marketable yield, as well as quality of the produce would improve, resulting in better returns to the farmers.

A cost breakdown showed that eating bananas, as opposed to cooking bananas, command a better selling price; hence contributing to positive net return in most cases. It appears that 3 or 4 acres is the ideal size for a family operated farm on Guam.

Papaya

Papaya is a wind-pollinated crop with light pollen that can can travel long distances with the wind. On Guam, where wild papayas flourish in forests and on uncultivated land, maintenance of pure lines is very difficult. Therefore farmers must obtain seeds from reputed sources to be able to grow a uniform crop. The usual procedure followed by the farmer is to sow a handful of seeds in each pit, retain healthy seedlings and weed out the excess, that continue to emerge even after 3 months. This procedure of sowing a handful of seeds is not economical when the seeds are purchased.

The sarcotesta and seedcoat of papaya contain organic inhibiters that prevent the seeds from germinating until they are naturally broken down or washed away. An experiment was conducted to find the best seed planting media and method of treating the seed to get better germination. The following variables were used: a) three growth media -- 1) Jiffy-7, 2) Sand, 3) Vermiculite; b) three seed treatments, 1) Sowing seeds with sarcotesta intact 2) Sowing seeds with the sarcotesta removed and washed, and 3) Sowing seeds with sarcotesta removed and seeds kept for 15 hours in running water; c) five seed drying treatments -- seeds dried for 0, 10, 20, 30, and 40 days. Seed germination was recorded after every 10 days up to 70 days.

Statistical analysis of the data was done using the SPSS = X 2.1, IBM DOS/VSE. In the variance estimate, the 'F' probability was less than 0.05 %. The separate variance estimate 'T' probability are given in Table 1, 2, 3 and 4. The results are graphically presented in Fig 1, 2, and 3. The 'F' probability for the three growth media, the three treatments, five groups of drying treatments were all below 0.05 %. For the comparison of the three growth media, the 'T' probability of below 0.05 % for 'Jiffy-7 versus sand' and also 'sand versus vermiculite' indicates that they are significantly different. The 'T' probability of 0.146 % for the comparison of 'Jiffy-7 and vermiculite' establishes that they show similar trend, in germination, and there is no significant difference between them. The effect of the three seed treatments was significantly different in all three media giving a 'T' probability of less than 0.05%.

In papaya, longer the seed are dried the better the germination rate. The 40-day drying treatment was significantly superior to drying for lesser number of days. While comparing the germination of the papaya seed, as observed at 10 day interval up to 70 days, the separate variance estimate of 'T' probability was less than 0.05 %, indicating that they were significantly different. Germination rate of seeds planted in sand was significantly grater ('T'= 0.000)than the those planted in Jiffy-7, as well as vermiculite. There was no significant difference in the germination rate between Jiffy-7 and vermiculite ('T'= 0.146).

In the comparison of the growth media, the seed treatment of removing the sarcotesta and allowing the water to run through the seeds for about 15 hours was significantly superior in increasing germination in all the three growth media.

In papaya, to obtain high seed germination the following procedure may be followed: - 1) remove the sarcotesta, 2) wash the seeds in running water for about 15 hours, 3) dry the seeds in shade for 40 days and 4) sow them on sand. As sand has no nutrients, it is necessary to transfer the germinated seedlings to a potting mixture within a few days of emergence.

Seasonal Variation of TSS in Papaya: TSS (Total Soluble Solids) is a measure of sucrose in %, which indicates the sweetness of the juice from the flesh of papaya. The TSS was recorded in the 1123 tree ripe papaya fruits grown at the experiment station from November to June, 1987. A graph of the pooled, average TSS of tree ripe fruits in five cultivars, harvested every week is given in figure 4. On Guam, TSS in papaya fruit increases in a leaner fashion between October to June.

Guava

Guava, grows wild and is also a cultivated plant on Guam. Most of the plants are seed grown and tend to be of inferior quality, with small fruits low in sugars and high in seed content. Crosses were attempted between some local cultivars and the hybrid population were grown at the experimental station. It was observed that some hybrids plants produced fruits with higher total soluble solids (a measure of sucrose in the fruit) than either of the parents.

Grafting in Guava: Tip grafting was attempted on six-month old seedlings. The graft success was recorded at 87 %. The grafted plants started flowering and setting fruit within one year of planting. In the initial trial the survival rate of the grafted plants when transferred to the field was 100 %.

Mango

The effect of typhoons on mango was observed. Many trees suffered limb and leaf loss. All the local mangoes and many of the introduced grafted plants started flowering soon after the typhoon. Even those trees which were flowering and fruiting before the storm and lost them in the storm started flowering again after the typhoon. However it was observed that some of cultivars including the Haden did not follow the same pattern. The experiment on flower induction had to be postponed because of this disturbance.

HORTICULTURE - Ornamentals

J. McConnell

The emphasis this year continued to be on orchids as cut flowers. The research included evaluation of cultivars, growing media, light intensities, fertilizers and plant densities. In addition, propagation studies were done on the rapid multiplication of selected cultivars by shoot tip culture and evaluation of compotting methods. A new project was added which is studying the effects of various environmental factors on the flowering of vanda and dendrobium orchids. Other plant materials were also under evaluation. These included anthuriums, heliconias, gingers, ferns, and several ground covers.

Evaluation and Culture of Ornamental Plants in Guam

Anthuriums: The anthurium collection was destroyed by an outbreak of a bacteria blight (*Xanthamonas dieffenbachieae*). No cultivars demonstrated any resistance to the blight. As a result of this, the collection was destroyed. A new collection will have to be developed from tissue cultured cultivars. This is a recommended practice that will help assure that the collections will be free of the bacterium.

Mondo Grass: Mondo Grass "Nana", *Ophiopogon japonicus* (thunb.), is an evergreen herbaceous ground cover that produces a grass-like mat which grows to a maximum height of 6 inches. This low maintenance ground cover could be used by landscapers in Guam as a substitute for grass in areas without pedestrian traffic. The objective of this study was to determine under what light intensities Mondo Grass can be grown. Two flats each containing 20 plants were grown in four light conditions: full sun, 30% shade, 70% shade, and 90% shade. The plants were evaluated for survival and general appearance after growing for one year. It was found that Mondo Grass can be grown under all light conditions. The plants growing in full sun were found to not be drought tolerant during the dry season. The leaf tips died if irrigation was not supplied. Under less intense lighting Mondo Grass appears to be very drought resistant. It was concluded that Mondo Grass can be grown under most conditions found in Guam, however, irrigation is recommended for plantings in full sun.

Tissue Culture: An aseptic tissue culture lab was developed at the University of Guam campus. This lab will allow for the rapid multiplication of selected cultivars. Two studies were conducted on aspects of the propagation of orchids using tissue culture.

The growing medium for orchid seedlings is a Modified Vacin and Went medium. This contains chopped William's Hybrid bananas. These bananas are not grown in Guam so the objective of this study was to determine whether locally grown cooking bananas could be substituted for William's Hybrid. The results indicated that different bananas could be used. There appeared to be some difference but the cooking bananas produced acceptable plants. Another ingredient in the medium is coconut water. The coconut water is collected from coconuts and stored in the freezer. It was found that a convenient way of storing the coconut water is in zip lock bags. A pre-measured volume can be poured into each bag. The bags are easily stored in the freezer. They freeze quickly and take little space. In addition they are frozen so thin that there is no need to thaw them when used. The pieces easily break up in the blender during media preparation.

A commonly used covering for sterile flasks is aluminum foil. It was found that foil was not satisfactory in the University of Guam tissue culture lab. The foil appeared to oxidize and develop small holes which caused the cultures to contaminate after months in culture. A new type of culture cup was located and is currently under evaluation.

Vanda XMiss Joaquim shoot tips have been cultured and are currently being multiplied in liquid medium. The first plants will be planted in 1988.

Orchid Seedlings: Maintaining seedlings transplanted from flask into community pot are one of the most difficult phases of growing orchids. The plants are very susceptible to desiccation and disease when first removed from flask. This is a big change in the growing conditions for the seedlings. When they are in the flask they are in a protected sterile environment with all the nutrients supplied by the growing medium. The objective of this study was to determine what is the best way to plant seedlings from flasks. Seedlings in flasks are the most economical way to purchase orchids. When the seedlings are removed from flask they are planted in groups or communities. Many different growing media and containers can be used. A comparison was made between growing communities in 4 inch pots and seedling flats. Also several media were compared; tree fern fiber, sphagnum moss, root fiber from ferns growing in Guam, peat moss mix containing peat moss, vermiculite, and perlite plus a wetting agent. The best combination was found to be planting in seedling flats using the peat moss mix. There were several benefits to this combination.

1) The watering was more easily controlled. The individual plants needs could be monitored. In community pots the seedlings are sufficently dense making it more difficult to observe the medium. The peat moss mix changes color as it dries. This indicates when water is needed. The wetting agent allows the mix to be kept dry while still allowing water to penetrate the mix when water is applied.

2) Disease control is easier. The plants are in individual cells. This allows the removal of diseased plants without disturbing the surrounding plants. Once the diseased plants are removed, spraying can be done thoroughly.

3) The spacing among the plants allows more thorough spraying. And since the seedlings are in separate cells they can easily be transplanted as needed without disturbing the surrounding plants.

4) Seedling mortality was less using this method, especially with the smaller seedlings coming out of the flask.

Vanda Media Experiment: *Vanda X* Miss Joaquim was grown in either coconut husk or crushed limestone aggregate with no fertilizer or the application of liquid or slow release fertilizer. Vegetative characteristics and tissue analysis were compared. Plants grown in the limestone had fewer leaves, nodes, shorter stem length, lower fresh weight, and lower dry weight. Tissue analysis revealed that vandas grown in limestone had reduced levels of calcium and magnesium. Vandas grown in limestone without fertilizer also had lower levels of phosphorus. The tissue nutrient levels of calcium were high for all treatments but were highest in vandas grown in husk. The water holding capacity of husk is greater than crushed limestone. Guam water has a naturally high level of calcium. The irrigation water appears to have supplied the high levels of calcium.

Vanda Cultivars: Several vanda hybrids are under evaluation. Two cultivars, *V.* X Miss Joaquim, a local cultivar, and *V.* X Miss Joaquim "Atherton" have been used in several experiments. It was found that the two cultivars varied in time of flowering. The cultivar "Atherton" generally flowered one month later than the local cultivar. This trend was observed through the yearly cycle. It should be noted that it is beneficial to identify cultivars with different flowering times so that a commercial grower can supply flowers throughout the year.

Several *Aranda* X Wendy Scott hybrids are undergoing advanced testing. The flower is an attractive purple and flower production is high. Advance testing includes further evaluation of flower production, and vase life after harvest. Selected plants are being propagated by shoot tip culture to allow release of selected cultivars.

Irrigation: Orchids generally are irrigated by some form of sprinkler irrigation. Several types of sprinklers have been under evaluation: 1) Impact, 2) Shrub and 3) Spinner.

Impact sprinklers were found to not function below 20psi. This is unacceptable because during the dry season, the water pressure drops below 20psi. The result is that the grower is unable to irrigate.

The shrub sprinklers were found to operate at lower pressures but their coverage was variable and they were prone to wind drift.

The spinner types were found to have good coverage in low wind and low water pressures and were not affected by wind drift as much as shrub sprinklers. The sprinklers are relatively low cost and have replaceable nozzles. Also the area of coverage per sprinkler is greater for the spinner than the shrub sprinkler so less are needed for a given area.

Environmental Factors affecting Flowering in Some *Vanda* and *Dendrobium* Hybrids in the Tropics

Mature plants of *Vanda* X Miss Joaquim were established at two locations. In addition seedlings of *Dendrobium* X Jaquelyn Thomas "Uniwai Supreme" were potted in two inch pots and are being monitored for first flower. Phenological data is being recorded for the mature vandas and dendrobiums. Flowering is recorded daily. Other characters are recorded weekly. The plants are irrigated daily and fertilized weekly.

The weather stations were set up at two locations. The weather data is logged at a 15 minute interval. Solar radiation, rainfall and air temperature are the three variable being recorded at both locations. In addition, wind speed and direction and speed are recorded at one site. Methods for interfacing with personal computers were developed. The data is uploaded to a personal computer where it is accumulated, summarized and archived. The phenological data is currently typed into the computer.

Much of this period of work has been devoted to developing a database manager to maintain and summarize the data. The database manager is being further developed to monitor the experiments more completely. The database manager can communicate directly with the loggers. It also has error checking capabilities. The program will alert to data that has not been entered. The development of this database manager has been important to the progress of this project. The database is being developed in 4th Dimension for MacIntosh computers.

Preliminary data indicates the solar radiation has the greatest influence on flowering, as expected. Different orchid cultivars have flowered at different times of the year. The dendrobiums growing in 30% shade showed peak flowering one month before the dendrobiums growing in full sun. The greatest flowering occurred in January.

HORTICULTURE - Vegetable Crops (Potato)

M. Marutani

Research Objectives for the period from November 1, 1986 to January 31, 1988

1) *Evaluate field performance of several varieties during dry season.*
2) *Conduct an irrigation experiment to determine effect of supplemental irrigation on canopy growth and tuber development.*
3) *Conduct a fertilizer experiment to study effect of a green manure and additional application of fertilizers during plant development.*
4) *Conduct on-farm trials during dry season on Guam and other micronesian islands.*
5) *Maintain clean plant materials with in-vitro culture. Start a rapid multiplication program to propagate locally available planting materials.*

Cultivar Evaluation

Two varietal trials were conducted during dry season of 1986-1987. The first trial was conducted from November 13, 1986 to February 3, 1987. Eighteen cultivars included in the trial were Atlantic, Belchip, BR112-113, Cosima, Denali, Kennebec, LT-1, Norchip, Patrones, Red Pontiac, Sequoia, Shepody, Tarago, Up-To-Date, 337.319.7, CIP720087, CIP720088, CIP720110 produced the highest yield of 488.6 (g/plant), followed by Atlantic (467.2 g/plant) and Denali (458.5 g/plant). CIP720110 yielded the lowest of 102.2 g/plant. Sequoia, Red Pontiac and Kennebec yielded 374.1, 628.6 and 315.1 g/plant, respectively. Lower yield of three cultivars was due to high incidence of root knot nematodes and soil-borne bacterial diseases. It was recognized that the cultivar, Red Pontiac, was highly susceptible to root knot nematodes and puncturing tubers by nematodes increase occurrence of bacterial diseases.

The second trial was conducted from December 11, 1986 to March 3, 1987. Cultivars in the second trial included MS 35.22, Kennebec, Red Pontiac, Sequoia, Cosima, Norchip, LT-2, LT-1, LT-5, DTO-28, Desiree, C1.434, C1.884, and Katahdin. Sequoia, Red Pontiac and Kennebec yielded more than other cultivars. Comparison of the size of seed tubers was also incorporated in the experiment and large seed tubers of Sequoia produced the highest yield of 481.9 g/plant. Medium and small sized mother tubers of Sequoia yielded about the same (347.9 g/plant from the medium sized tubers and 352.5 g/plant from the small sized tubers). Planting the cut pieces of seed tuber is the common practice in potato production in temperate region to increase planting material. In this trial, tubers of Sequoia were cut into four pieces and were compared with planting small, medium and large sized seed tubers. Cut pieces of Sequoia produced 301.6 g/plant which was lower than the yields obtained from whole seed tubers. Extra care of cut seed pieces was necessary in order to prevent occurrence of soil-borne diseases right after planting. Large seed tubers of Red Pontiac produced 458.3 g/plant which was the second highest yield in this trial. Medium and small sized seed tubers of Red Pontiac produced 258.2 g/plant and 271.4 g/plant, respectively. Again, the large sized tubers yielded more than medium and small seed tubers. There was no obvious correlation between the size of seed tubers and yield of Kennebec. Yields of Kennebec by planting large, medium and small seed tubers were 332.4 g/plant, 252.3 g/plant, and 334.7 g/plant, respectively. Other cultivars produced low yield, LT-1 being the lowest yielder of 61.5 g/plant.

It was noticed that field performance of each cultivar was greatly affected by not only genetic background but also various cultural practices. Stability of field performance of each cultivar should be determined when data of varietal trials from repeated experiments for years are accumulated.

Currently, fifteen cultivars are being tested during the 1987-1988 dry season. The result of the current experiment will be added to the previous evaluation and recommended varieties will be determined.

Irrigation Experiment

Seed tubers of Red Pontiac were grown under different levels of supplemental irrigation in soil classified as clayey, montnorillonitic, isohyperthemic Udic Haplustalfs. The soil was consisted of 73% of clay, 25% of silt and 2% of sand with pH of 6.0. A randomized block design with 3 replications was used. The four irrigation treatments included: 1) maintenance of soil moisture level of 0.1 bar; 2) maintenance of soil moisture level of 0.4 bar; 3) maintenance of soil moisture level of 0.7 bar; and 4) no supplemental irrigation. Parameters of plant development examined included the fresh and dried weight of leaves and stems, the height of main stem, the total tuber yield, the marketable tuber yield, and average weight of marketable tubers. At 64 and 77 days after planting (DAP) the influence of irrigation levels on quality of tubers was determined by classifying tubers into three classes, i.e. diseased, green and deformed, and marketable tubers. Climatological data including rainfall, solar radiation, and air temperature were monitored at the site of experiment during the study. The minimum data set was accumulated and sent to IBSNAT program at University of Hawaii.

The total rainfall of the entire growing season was 332.5 mm. Solar radiation ranged from 4.0 to 25.0 MJ/m^2/day with the average of 18.2 MJ/m^2/day. The lowest air temperature recorded was 18.2C and the height was 31.2C. Only three days had the minimum air temperature below 20C.

Tuber initiation was observed at 29 DAP for all treatments. Canopy development was vigorous with supplemental irrigation, however over-irrigated plants produced tubers with soil-borne diseases such as root knot nematodes and bacterial diseases. The regression analysis between the amount of water received by plants and marketable yield indicated that optimal water requirement for *S. tuberosum* var. Red Pontiac was 5.5 mm/day. The highest yield of 854 g/plant was obtained with the treatment of 0.7 bar at 64 DAP.

A decrease in the number of marketable tubers near the final harvest was evident. At 64 DAP, there were no significant difference in the incidence of the diseased, green and deformed tubers among 4 treatments, however the field which was maintained at a soil moisture of 0.1 bar showed that plants produced significantly less marketable tubers due to high incidence of nematode infestation (*Meloidogyne* spp.) and bacterial diseases (*Erwinia* spp.).

The result of the irrigation experiment was presented at the 84th American Society of Horticultural Science Annual Meeting which was held from November 6-12, 1987.

Fertilizer Experiment with use of a Green Manure

Effect of a green manure, Tropic Sun sunn hemp (*Crotalaria juncea* L.), on yield of Kennebec was tested with the combination of fertilizer aplications. A split plot design was used with use of *C. juncea* L. as the main plot and use of fertilizer as a subplot with three replications. The experiment staated on October 1, 1986 when *C. juncea* L. was planted prior to potato planting. Tubers were planted on December 5, 1986 and harvested at 81 DAP for treatments of 1) green manure + fertilizer and 2) fertilizer only. Plots with 3) green manure only and 4) control were harvested at 74 DAP due to earlier defoliation of canopy.

The highest yield was obtained with the combination of incorporating the green manure *C. juncea* L. prior to planting and application of a complete fertilizer before planting + N fertilizer at 25 and 55 DAP. Without fertilizer applications, yield was significantly low. Effect of the green manure was very little but there was slight improvement of plant growth with use of green manure. An experiment to determine effect of supplemental N application is currently being conducted. The result of two experiments will be compiled to estimate the amount of N fertilizer to obtain high yield.

On-Farm Trial

During the 1986-1987 dry season, three farmers from Guam and one farmeer on Saipan participated in the on-farm trial of potato production. Three cultivars, Kennebec, Sequoia, and Red Pontiac and necessary fertilizers were distributed to those farmers. Since potaatoes were new crops for farmers on Micronesian Islands, a genral guideline of growing potatoes was given to them. Vsisitation to farmer's fields were made periodically to find out problems that they encountered. One of the major disease problems in Saipan was *Rhizoctonia solani*. Other fungal diseases suuch as Early Blight (*Alternaaria solani*) and Stem Rot (*Sclerotium rolfsii*) were commonly observed on Guam. At the early stage of plant development, cutworms were the major insect pest and at the later stage leaf miners attacked plants. Yield in farmer's fields were about half of the yield that we obtained from the experimental field. A rigid chemical spraying program appears necessary in order to obtain reasonable yield.

Currently the Northern Marianas College on Saipan, and the Department of Agriculture at Yap and Kosrae are participating in on-farm trials.

Maintenance of Clean Plant Materials

Six cultivars originally obtained from Cornell University have been maintained for further propagation in in-vitro culture. The emphases on field experiments during this period of the project delayed a rapid multiplication program. The last phase of the proejct will concentrate on the development of methods for producing clean palnt material locally during off-season of planting.

HORTICULTURE - Vegetable Crops (Winged Bean, Tomatoes)

C.T. Lee

Horticultural research on vegetable crops in 1987 continued to work two approved projects. One project is to study the effect of exogenous growth regulators on growth, yield and quality of solanaceous and cucurbit crops. The vegetable crops studied under this project were tomato and cucumber. Another project is to study promoting flowering and dwarfing of winged bean with plant growth regulators.

I. Promote Flowering and Dwarfing of Winged Bean with Plant Growth Regulators

The objectives of this projects are: (a) to assess the possibility of year-round production through flower induction and increasing of number of flowers and pod sets by the application of growth regulators; (b) to evaluate the use of plant growth regulators on dwarfing to reduce labor and material costs of staking in the production of winged bean; and (c) to study the effect of plant growth regulators on the quality of winged bean pod and seeds.

Materials and Methods

Four field experiments were conducted at the Guam Agricultural Experiment Station to study the possibility of year-round production on winged bean through flower induction, increasing the number of flowers and pod sets; to determine the optimum rate of growth regulators on the growth and yields; and to evaluate dwarfing response by the application of growth regulators.

Winged bean cultivar "Chimbu" was planted for the four field experiments and a randomized complete block design with three replications were used. Five treatments of four growth regulators for each experiment were: 0, 15, 30, 45, and 60 ppm of 2, 3, 5-triiodobenzoic acid; 0, 25, 50, 75 and 100 ppm of (B-naphthoxy) acetic acid; 0, 25, 50, 75 and 100 ppm of (2-chloroethyl) trimethyl ammonium chloride; and 0, 1,000, 2,000, 3,000, and 4,000 ppm of Spray-N-Grow. These growth regulators were applied to the foliage at 3, 4, and 5-trifoliate stages.

Each experimental plot was three rows of 4.57 meters long. The spacing adopted was 1.22 meters between rows and 0.46 meters within rows. Before planting, all the winged bean seeds were immersed in a concentrated sulfuric acid (sp.gr.1.184) at 25°C for 5 minutes followed by a 10-minute rinse under running tap water. The seeds were directed sown in the field. The whole field received a blanket application of 387 kg/ha of 10-20-20 fertilizer prior to planting. Side-dressing with the same fertilizer at the same rate was done 4 weeks after planting. A preventive spraying program was followed once weekly by using Kelthane and Melathion 50 to reduce possible insect damage. A rotary tiller and garden hoe were used to control weeds. Sprinklers were used as needed for irrigation. The plants were supported with a trellis constructed by leucaena (*Leucaena leucocephala* (Lam.) de Wit) stakes and plastic nets.

All the data were collected from the central row of each plot. The data collected were plant height, pod weight, number of pods per plant, marketable fresh pod yield and unmarketable pod yield.

Results and Discussions

The results of the effect of different rate of the four growth regulators on plant height are presented in Tables 1, 3, 5, and 7. The plant height was significantly reduced up to about 8 weeks after planting by the application of 2, 3, 5-triiodobenzoic acid at 30, 45, or 60 ppm; or (B-naphthoxy) acetic acid at 75 or 100 ppm; or (2-chloroethyl) trimethyl ammonium chloride at 75 or 100 ppm. While plant height significantly reduced only up to 2 weeks after planting by the application of Spray-N-Grow at 3,000 or 4,000 ppm.

The effects of different rates of the four growth regulators on some horticultural characteristics and production of winged bean were shown in Tables 2, 4, 6, and 8. A significant increase in number of fresh pods and yield of fresh pods was 2, 3, 5-triiodobenzoic acid applied at 30 or 45 ppm; or (B-naphthoxy) acetic acid at 50 or 75 ppm; or (2-chloroethyl) trimethyl ammonium chloride at 50 or 75 ppm; or Spray-N-Grow at 3,000 ppm. The number of fresh pods per plant is one of the major factors affecting the yield on winged bean. Fresh pod weight with an average of 23 g was not significantly affected by the four growth regulators at the different rates. There was also no significant difference in the unmarketable fresh pod by the four growth regulators at the different rates.

Table 1. The Effect of Different Rates of 2, 3, 5-triiodobenzoic Acid on Plant Height of Winged Bean

	Plant Height (cm)						
Treatment	4 weeks after Planting	5 weeks after Planting	6 weeks after Planting	7 weeks after Planting	8 weeks after Planting	9 weeks after Planting	10 weeks after Planting
Control	29.3a*	40.4a	52.9a	66.5a	75.9a	88.1a	102.3a
15 ppm	25.3b	32.8b	45.4b	58.5b	72.1a	87.3a	101.2a
30 ppm	30.1c	27.2c	39.3c	54.1b	70.7a	86.5a	100.3a
45 ppm	20.4c	29.4c	39.8c	55.3b	71.0a	87.1a	99.5a
60 ppm	20.6c	39.1c	39.1c	54.7b	70.9a	86.7a	101.8a

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 2. The Effect of Different Rates of 2, 3, 5-triiodobenzoic Acid on Some Horticultural Characteristics and Production

Treatment	Fresh Pod Weight (g)	Number of Pods/ Plants	Unmarketable Fresh Pod Yield (MT/ha)	Marketable Fresh Pod Yield (MT/ha)
Control	22.7a	58.7a	1.01a	21.87a
15 ppm	23.2a	58.9a	1.02a	21.93a
30 ppm	22.9a	67.1b	1.10a	24.72b
45 ppm	23.3a	66.9b	1.09a	24.29b
60 ppm	24.1a	58.0a	1.02a	21.35a

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 3. The Effect of Different Rates of (B-naphthoxy) Acetic Acid on Plant Height of Winged Bean

	Plant Height (cm)						
Treatment	4 weeks after Planting	5 weeks after Planting	6 weeks after Planting	7 weeks after Planting	8 weeks after Planting	9 weeks after Planting	10 weeks after Planting
Control	28.5*	38.7a	51.6a	67.0a	74.8a	87.4a	104.7a
25 ppm	27.8a	37.9a	50.1a	65.2a	71.2a	86.2a	101.2a
50 ppm	24.1b	32.0b	43.2b	57.1b	64.3b	82.1a	95.5a
75 ppm	20.0c	26.8c	35.7c	50.2c	57.3c	80.2a	94.1a
100 ppm	19.7c	27.1c	36.2c	50.5c	57.5c	80.3a	95.0a

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 4. The Effect of Different Rates of (B-naphthoxy) Acetic Acid on Some Horticultural Characteristics and Production of Winged Bean

Treatment	Fresh Pod Weight (g)	Number of Pods/ Plants	Unmarketable Fresh Pod Yield (MT/ha)	Marketable Fresh Pod Yield (MT/ha)
Control	23.0a*	60.1a	1.05a	22.71a
25 ppm	24.1a	60.3a	1.06a	22.82a
50 ppm	23.5a	75.2c	1.12a	26.22c
75 ppm	23.7a	76.1c	1.11a	26.33c
100 ppm	23.9a	66.2ab	1.09a	25.20ab

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 5. The Effect of Different Rates of (2-chloroethyl) Trimethyl Ammonium Cloride on Plant Height of Winged Bean

	Plant Height (cm)						
Treatment	4 weeks after Planting	5 weeks after Planting	6 weeks after Planting	7 weeks after Planting	8 weeks after Planting	9 weeks after Planting	10 weeks after Planting
Control	29.0a*	37.6a	52.0a	66.3a	74.0a	88.5a	106.1a
25 ppm	29.5a	37.8a	51.1a	67.1a	75.2a	87.6a	104.2a
50 ppm	29.3a	38.1a	51.6a	65.3a	75.0a	87.9a	107.0a
75 ppm	25.1b	33.7b	43.1a	56.2b	66.5b	79.2a	95.1a
100 ppm	24.2b	34.0b	43.5b	57.1b	66.3b	80.0a	96.2a

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 6. The Effect of Different Rates of (2-chloroethyl) Trimethyl Ammonium Chloride on Some Horticultural Characteristics and Production of Winged Bean

Treatment	Fresh Pod Weight (g)	Number of Pods/ Plants	Unmarketable Fresh Pod Yield (MT/ha)	Marketable Fresh Pod Yield (MT/ha)
Control	23.3a*	61.0a	1.07a	22.68a
25 ppm	24.1a	60.9a	1.06a	22.71a
50 ppm	23.9a	75.5c	1.12a	25.13c
75 ppm	23.7a	73.0c	1.14a	25.85c
100 ppm	24.0a	65.1ab	1.09a	24.90ab

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 7. The Effect of Different Rates of Spray-N-Grow on Plant Height of Winged Bean

	Plant Height (cm)						
Treatment	4 weeks after Planting	5 weeks after Planting	6 weeks after Planting	7 weeks after Planting	8 weeks after Planting	9 weeks after Planting	10 weeks after Planting
Control	30.1a*	36.4a	53.0a	64.5a	73.5a	87.8a	103.9a
1,000 ppm	31.3a	35.7a	51.7a	66.0a	74.1a	87.1a	101.3a
2,000 ppm	31.3a	36.8a	52.6a	65.2a	76.2a	89.2a	105.2a
3,000 ppm	35.1b	39.8b	54.2a	66.7a	77.4a	89.8a	106.3a
4,000 ppm	35.7b	40.0b	57.0a	67.1a	76.7a	88.9a	106.7a

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Table 8. The Effect of Different Rates of Spray-N-Grow on Some Horticultural Characteristics and Production of Winged Bean

Treatment	Fresh Pod Weight (g)	Number of Pods/ Plants	Unmarketable Fresh Pod Yield (MT/ha)	Marketable Fresh Pod Yield (MT/ha)
Control	23.9a*	63.5a	1.13a	23.71a
1,000 ppm	24.0a	65.0a	1.15a	24.00a
2,000 ppm	24.2a	63.2c	1.09a	23.50a
3,000 ppm	23.3a	75.7c	1.20a	26.87b
4,000 ppm	24.1a	76.1b	1.21a	26.90b

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

Conclusions

The experiments were to study the effect of different rates of plant growth regulators on the flowering and production of winged bean. Application of four different growth regulators at five rates on winged bean were conducted.

In these experiments, the application of 2, 3, 5-triiodobenzoic acetic acid at 30, 45 or 60 ppm; or (B-naphthoxy) acetic acid at 75 or 100 ppm; or (2-chloroethyl) trimethyl ammonium chloride at 75 or 100 ppm effectively reduced plant heights up to about 8 weeks. A significant increase in number of fresh pods and yield of fresh pods was 2, 3, 5-triiodobenzoic acetic acid applied at 30 or 45 ppm; or (B-naphthoxy) acetic acid at 50 or 75 ppm; or (2-chloroethyl) trimethyl ammonium chloride at 50 or 75 ppm.

II. Effect of Exogenous Growth Regulators on Growth, Yield and Quality of Solanaceous and Cucurbit Crops

IIa. Effect of Tomaset on the Growth and Production of Tomato

This experiment was to study the effect of tomaset (N-meta-tolyphthalmic acid) on the growth and production of tomato during the wet season. It is very difficult to grow tomato at this season due to high temperature, high moisture and other environmental factors.

Materials and Methods

Thirteen AVRDC accessions of tomato were used in this experiment. Seeds were sown in Jiffy-7 pellets and one-month old seedlings were transplanted to the experimental field. The experimental design was a split-plot design with three treatments replicated three times. The thirteen accessions of tomato were the main treatments. Four rates (0, 100, 200 and 300 ppm) of Tomaset were the subtreatment. Each block was divided into 13 main plots. Thirteen main treatments were randomly distributed in each of the main plots. A main plot was divided into four sub-plots, each measuring 4.32 m x 9.00 m. Plants in the sub-plots were grown in three rows spaced 1.44 m apart and 0.45 m within rows.

A 10-20-20 fertilizer at the rate of 448 kg/ha was broadcast and incorporated into the soil before transplanting. The Tomaset solution was applied at a 10-day interval to the flower blooms only but not to the foliage as it might cause burning of the plant. A preventive spraying program was followed twice weekly to reduce possible insect, mite, and disease damage. Diazinon Ag 500 EC, Malathion 50, Lannate 1.8L, Kelthane, Diathane M-22 or M-45 and Tribasic Coppers were used. Sprinklers were used for irrigation whenever watering was needed. A rotary tiller and garden hoe were used to control weeds.

All the data were collected from the central row of each sub-plot. The data collected were days to maturity, fruit-set, fruit-crack, fruit size, number of fruits per plant, and marketable fruit yield.

Results and Discussions

Days to Maturity: The effect of different rates of Tomaset on days to maturity is show in Table 9. It took from 70 to 76 days to reach maturity. Days to maturity was not affected by the treatment of Tomaset. It was found that significant difference was among the accessions. Accessioon CL 143-0-10-3, CL 123-24-0-0 and CL 8d-0-7-1-0-0-0 took 70 days while CL 32d-0-1-1p-0-0 took 76 days.

Table 9. Effect of Different Rates of Tomaset on Days to Maturity on Tomato

Main Treatment	Subtreatment (Rate of Tomaset)				Main Treatment
(Cultivar or Pedigree)	0 ppm	100 ppm	200 ppm	300 ppm	Mean
L124	73	73	72	73	73
L1	74	74	73	73	74
CL P-0-0-1-0-0	71	72	70	71	71
CL 127-4-1-0	74	72	74	73	73
CL 143-0-4b-1-0-0-0	71	70	71	70	71
CL 11d-0-1-2-0-0-0	70	71	70	71	71
CL 32d-0-1-1p-0-0	76	75	76	76	76
CL 246-0-3b-p-0-0	75	74	76	75	75
CL 114-5-5-0-0	74	76	74	73	74
CL 11p-1-2-0	75	74	75	75	75
CL 8d-0-7-1-0-0-0	70	70	71	70	70
CL 124-24-0-0	70	70	70	70	70
CL 143-0-10-3	70	70	71	70	70
Mean	73	72	73	72	

LSD 0.05 between main treatment	3
LSD 0.05 between sub-treatment	NS
LSD 0.05 between sub-treatment for the same main treatment	NS
LSD 0.05 between sub-treatment for the different main treatment	3

Fruit-Set: The effect of different rates of Tomaset on fruit-set is presented in Table 10. Application of Tomaset at 200 or 300 ppm significant increase in fruit-set for 5 out of 13 accessions were: CL 143-0-4b-1-0-0-0, CL 11d-0-1-2-0-0-0, CL 114-5-5-0-0, CL 123-24-0-0 and CL 143-0-10-3. It showed that response of the fruit-set was varied among the accessions. High temperature in the wet season retarded anther and pistil development. It was suggested that the cause of retarded flower growth might be associated with the decrease in anther and pistil DNA and RNA.

Table 10. Effect of Different Rates of Tomaset on Fruit-Set* of Tomato

Main Treatment (Cultivar or Pedigree)	Subtreatment (Rate of Tomaset) 0 ppm	100 ppm	200 ppm	300 ppm	Main Treatment Mean
L124	2.8	2.0	2.1	2.3	2.1
L1	1.9	1.9	2.0	2.0	2.0
CL P-0-0-1-0-0	2.2	2.1	2.0	2.0	2.0
CL 127-4-1-0	2.0	2.0	2.0	2.1	2.0
CL 143-0-4b-1-0-0-0	2.4	2.4	2.6	2.8	2.6
CL 11d-0-1-2-0-0-0	2.3	2.5	2.9	3.0	2.7
CL 32d-0-1-1p-0-0	1.8	1.8	1.8	1.9	1.8
CL 246-0-3b-p-0-0	1.8	1.9	1.8	2.0	1.9
CL 114-5-5-0-0	1.6	1.6	2.0	2.1	1.8
CL 11p-1-2-0	2.1	2.0	2.1	2.2	2.1
CL 8d-0-7-1-0-0-0	1.9	1.8	2.0	2.0	1.9
CL 124-24-0-0	2.2	2.0	2.7	2.7	2.4
CL 143-0-10-3	2.7	2.8	3.2	3.2	3.0
Mean	2.1	2.1	2.3	2.3	

LSD 0.05 between main treatment	0.4
LSD 0.05 between sub-treatment	NS
LSD 0.05 between sub-treatment for the same main treatment	NS
LSD 0.05 between sub-treatment for the different main treatment	0.4

*Fruit-Set:
1 = No fruit to light setting
2 = Light to medium setting
3 = Medium setting
4 = Medium to heavy setting
5 = Heavy setting

Fruit-Cracking Rate: Table 11 indicated the effect of different rates of Tomaset on fruit-crack. Application of Tomaset did not affect fruit-crack for all tested accessions. However, fruit-crack was significantly different among the accessions. Lowest fruit-cracking rate was found in CL 143-0-10-3 and highest in L1. Fruit-crack is one of the major factors affecting fruit yield.

Table 11. Effect of Different Rates of Tomaset on Fruit-Crack* of Tomato

Main Treatment (Cultivar or Pedigree)	Subtreatment (Rate of Tomaset) 0 ppm	100 ppm	200 ppm	300 ppm	Main Treatment Mean
L124	3.5	3.5	3.5	3.4	3.5
L1	3.9	3.9	3.9	3.8	3.9
CL P-0-0-1-0-0	3.2	3.2	3.1	3.2	3.2
CL 127-4-1-0	3.4	3.3	3.4	3.3	3.4
CL 143-0-4b-1-0-0-0	3.5	3.4	3.6	3.4	3.5
CL 11d-0-1-2-0-0-0	3.0	3.0	2.9	3.1	3.0
CL 32d-0-1-1p-0-0	3.1	3.0	3.0	3.2	3.1
CL 246-0-3b-p-0-0	3.6	3.5	3.6	3.5	3.6
CL 114-5-5-0-0	3.5	3.6	3.5	3.5	3.5
CL 11p-1-2-0	3.5	3.5	3.4	3.5	3.5
CL 8d-0-7-1-0-0-0	3.6	3.6	3.5	3.6	3.6
CL 124-24-0-0	3.4	3.4	3.2	3.3	3.3
CL 143-0-10-3	2.0	2.1	2.0	1.9	2.0
Mean	3.3	3.3	3.3	3.3	

LSD 0.05 between main treatment	0.5
LSD 0.05 between sub-treatment	NS
LSD 0.05 between sub-treatment for the same main treatment	NS
LSD 0.05 between sub-treatment for the different main treatment	0.5

*Fruit-Crack:
1 = None to light cracking
2 = Light to medium cracking
3 = Medium cracking
4 = Medium to heavy cracking
5 = Heavy cracking

<u>Fruit Size and Number of Fruit</u>: The effect of different rates of Tomaset on fruit size is showin in Table 12. The fruit size of the tested accessions were very small to small size, ranging from 29 to 62 g. Fruit size was not affected by the application of the growth regulators. However, the fruit size was significantly different among the assessions. CL 143-0-10-3 with 62 g in fruit size was significantly larger than the rest of the twelve accessions, and L124, CL p-0-0-1-0-0, CL 143-0-4b-1-0-0-0, and CL 11d-0-1-2-0-0-0 were the next largest. L1 with 29 g was the smallest.

Table 12. Effect of Different Rates of Tomaset on Fruit Size (g) on Tomato

Main Treatment (Cultivar or Pedigree)	Subtreatment (Rate of Tomaset) 0 ppm	100 ppm	200 ppm	300 ppm	Main Treatment Mean
L124	49	47	45	50	48
L1	29	30	27	28	29
CL P-0-0-1-0-0	51	50	51	48	50
CL 127-4-1-0	40	39	41	40	40
CL 143-0-4b-1-0-0-0	50	50	49	50	50
CL 11d-0-1-2-0-0-0	46	45	44	45	45
CL 32d-0-1-1p-0-0	32	30	33	31	32
CL 246-0-3b-p-0-0	39	37	36	40	38
CL 114-5-5-0-0	33	31	34	33	33
CL 11p-1-2-0	28	28	31	28	29
CL 8d-0-7-1-0-0-0	41	40	41	43	41
CL 124-24-0-0	40	43	40	44	42
CL 143-0-10-3	62	60	61	64	62
Mean	42	41	41	42	

LSD 0.05 between main treatment	5
LSD 0.05 between sub-treatment	NS
LSD 0.05 between sub-treatment for the same main treatment	NS
LSD 0.05 between sub-treatment for the different main treatment	6

Table 13. Effect of Different Rates of Tomaset on Number of Fruits Per Plant on Tomato

Main Treatment (Cultivar or Pedigree)	Subtreatment (Rate of Tomaset) 0 ppm	100 ppm	200 ppm	300 ppm	Main Treatment Mean
L124	1.0	1.0	1.7	2.5	1.6
L1	1.8	1.5	2.2	2.1	1.9
CL P-0-0-1-0-0	5.1	5.0	5.0	5.4	5.1
CL 127-4-1-0	2.5	2.5	2.4	2.7	2.5
CL 143-0-4b-1-0-0-0	8.0	8.6	10.2	10.5	9.3
CL 11d-0-1-2-0-0-0	8.2	8.3	11.0	10.5	9.5
CL 32d-0-1-1p-0-0	2.4	2.4	2.4	2.3	2.4
CL 246-0-3b-p-0-0	1.9	2.1	2.2	1.9	2.0
CL 114-5-5-0-0	1.1	1.4	1.9	2.7	1.8
CL 11p-1-2-0	2.2	2.3	2.3	2.6	2.4
CL 8d-0-7-1-0-0-0	1.9	2.0	2.3	2.1	2.1
CL 124-24-0-0	2.5	2.6	3.3	3.3	2.9
CL 143-0-10-3	9.2	10.4	11.7	11.8	10.7

Mean	3.7	3.9	4.5	4.6	

LSD 0.05 between main treatment	0.8
LSD 0.05 between sub-treatment	1.0
LSD 0.05 between sub-treatment for the same main treatment	0.7
LSD 0.05 between sub-treatment for the different main treatment	0.9

The number of fruit on tomato is affected by fruit-set. Poor fruit-set will result in lower number of fruit per plant. Five out of thirteen accessions increased in the number of fruit per plant by the application of Tomaset at 200 or 300 ppm were L124, CL 143-0-4b-1-0-0-0, CL 11d-0-1-2-0-0-0, CL 114-5-5-0-0 and CL 143-0-10-3. The number of fruit in CL 143-0-10-3, CL 143-0-4b-1-0-0-0 and CL 11d-0-1-2-0-0-0 was the highest with an average of 9.8 fruits per plant and CL p-0-0-1-0-0 was the next highest with 5.1 fruits. The rest of six accessions were very low in number of fruit ranging fom 1.6 to 2.9 fruits per plant.

Marketable Fruit Yield: The effect of different rates of Tomaset on marketable fruit yield of tomato was presented in Table 14. CL 143-0-10-3 with a production of 7.42 MT/ha significantly outyielded the other twelve entries. CL 143-0-4b-1-0-0-0 and CL 11d-0-1-2-0-0-0 with a production of 5.72 and 6.38 MT/ha respectively were the next highest in fruit yield. The rest of ten entries produced very low in fruit yield ranging from 0.61 to 2.89 MT/ha.

Table 14. Effect of Different Rates of Tomaset on Marketable Yield of Tomato (MT/ha)

Main Treatment (Cultivar or Pedigree)	Subtreatment (Rate of Tomaset) 0 ppm	100 ppm	200 ppm	300 ppm	Main Treatment Mean
L124	0.57	0.58	0.87	1.40	0.86
L1	0.60	0.51	0.67	0.66	0.61
CL P-0-0-1-0-0	2.90	2.80	2.85	2.91	2.87
CL 127-4-1-0	1.10	1.11	1.12	1.20	1.13
CL 143-0-4b-1-0-0-0	4.92	5.38	6.12	6.45	5.72
CL 11d-0-1-2-0-C-0	5.08	5.72	6.92	7.80	6.38
CL 32d-0-1-1p-0-0	0.87	0.82	0.88	0.79	0.84
CL 246-0-3b-p-0-0	0.81	0.89	0.90	0.87	0.87
CL 114-5-5-0-0	0.39	0.50	0.72	0.99	0.65
CL 11p-1-2-0	0.70	0.72	0.81	0.83	0.77
CL 8d-0-7-1-0-0-0	0.85	0.89	1.05	1.01	0.95
CL 124-24-0-0	1.10	1.23	1.48	1.62	1.36
CL 143-0-10-3	6.70	7.01	7.82	8.13	7.42
Mean	2.05	2.17	2.48	2.67	

LSD 0.05 between main treatment	0.35
LSD 0.05 between sub-treatment	0.41
LSD 0.05 between sub-treatment for the same main treatment	0.24
LSD 0.05 between sub-treatment for the different main treatment	0.38

Conclusions: Application of Tomaset at a rate of 200 or 300 ppm increased the number of fruit per plant and fruit yield on 5 out of 13 tested entries. There were significant difference in production; accession CL 143-0-2-1 yielded 7.42 MT/ha against 0.61 MT/ha from L1. No significant difference in fruit size and fruit-crack between treated and untreated plants.

IIb. Effect of Ethrel on the Growth and Production of Cucumber

The sex-expression in cucumber is governed by genetical as well as environmental factors and might be effectively modified by the application of growth regulators. This experiment was designed to determine the effect of application of Ethrel [(2-chlorethyl) phosphonic acid] on the growth and production of cucumber.

Materials and Methods

The cucumber cultivar "Market King" was used in this expeirment. Seeds were directly sown in the field during the dry season. Treatment consisted fo five rates (0, 25, 50, 75 and 100 ppm) of Ethrel. The experiment design was randomized complete block with three replication. Each experimental plot consisted of three rows of 5.03 meters long. A spacing of 1.22 meters between rows and 0.46 meters was adopted. The Ethrel solution was applied to the foliage at 3-4 leaf stages.

A 10-20-20 fertilizer at the rate of 448 kg/ha was broadcast and incorporated into the soil before sowing the seed. Side-dressing with the same fertilizer at the same rate was done three to four weeks after sowing the seed. A preventive spraying program was followed twice weekly to reduce possible insect and disease damage by applying Malathion 50, Lannate 1.8L, Dithane M-45 and Tribasic Coppers. A rotary tiller and garden hoe were used to control weeds. Sprinklers were used for irrigation. Cucumber vines and fruits were strained onto a plastic net to reduce the problem of fruit rot. The data recorded were the mode number for appearance of first male and female flowers, the total number of male and female flowers of main vine, sex-ratio and fruit yield.

Results and Discussion

The data presented in Table 15 revealed that Ethrel treatments delayed the formation of first male flower as compared to the control in terms of node number. Ethrel treatments also induced the first female flower at the lower nodes. Ethrel at 75 or 100 ppm proved superior to all other treatments in reducing the node number for the appearance of first female flower.

Table 15. Effect of Ethrel on Node Number of First Male and Female Flower Appearance in Cucumber.

Treatment	Node Number of First Male Flower	Node Number of First Female Flower
Control	3.0a*	8.5a
25 ppm	5.7b	7.2b
50 ppm	10.1c	5.9c
75 ppm	12.4d	5.0c
100 ppm	12.1d	5.2c

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

The data in Table 16 indicated all Ehtrel treatments suppressed the number of male flowers, reduced the total number of flowers and reduced sex-ratio. Ethrel applied at 75 or 100 ppm proved to be the best in inducing the female flower production.

Table 16. Effect of Ethrel on Number of Male, Female, Total Flowers; Total Flowers, Sex-Ratio and Yield in Cucumber.

Treatment	Male Flowers	Female Flowers	Total Flowers	Sex-Ratio (M/F)	Yield (MT/ha)
Control	20.4a*	5.4a	25.8a	3.8	26.7a
25 ppm	16.8b	6.8b	25.6a	2.5	25.3a
50 ppm	14.9c	7.0b	21.9b	2.1	27.1b
75 ppm	8.2d	8.5c	16.7c	1.0	32.0c
100 ppm	6.7d	10.9c	17.6c	0.6	31.6c

*Means followed by the same letter within same measurement in a column do not differ significantly at the 5% probability level using Ducan's Multiple Test.

It is also evident from Table 16 that Ethrel applied at 75 or 100 ppm in cucumber producing about 31.8 MT/ha significantly outyielded the rest of treatments.

Conclusions

The appearance of male and female flowers and fruit production in cucumber was affected by the application of growth regulator. Ethrel applied at 75 or 100 ppm induced the first female flower at lower modes, produced the lowest sex-ratio and produced the highest yield.

PLANT PATHOLOGY

G.C. Wall

Soilborne Pathogens Project

Regional project W-147 was revised in 1987, and the new title of it is now 'Biological control of soilborne pathogens'. It has been approved from Oct 1, 1987 to Sep 30, 1992. In order to take part in this regional project, I attended their last meeting, held in Tucson, AZ, on Dec 9-10.

The objectives set for Guam regarding this project are to screen for antagonistic organisms that may occur locally, and test Trichoderma sp. strains identified by other workers as effective biocontrol agents for soilborne plant pathogens.

Potential of cassava as a crop for Guam and Micronesia

Palafox previously reported that no differences were found in cassava yields with different chemical fertilizer treatments, tested at Inarajan. He also reported cultivar 23 as the highest yielding in one trial, and 37 in a second trial. He reported yields that ranged from 5.18 to 11.2 Tons/Ha.

Studies completed during 1987 compared yields of 5 cultivars (5, 18, 27, 36, & 38), and two planting densities. The planting densities were: 1m between plants and between rows, and 0.5m between plants with 1m between rows. The experiment was carried out in Inarajan Experiment Station. Planting date was 17 Nov 86, under drip irrigation and plastic mulch. Fertilizer used was 10-20-20, at the rate of 15g/plant. All plants had to be pruned on Jan 27, 1987, because of bacterial blight. They were then allowed to develop for 24 more weeks. Roots were harvested on July 13, 1987. The higher plant density (20,000 plants/Ha) yielded the most. Cultivar 27 produced the highest yields in both planting densities. Yields were 13.36 Tons/Ha at the lower planting density (10,000 plants/Ha), and 20.12 Tons/Ha at the higher density. Bacterial blight damage was minimal at the end of the season. The disease incidence was too low to detect differences between cultivars.

Yields for 5 Cultivars at Inarajan

Cv	Source	Yield (Ton/Ha) Density A	Density B	Fisher
36	Saipan	13.36	20.12	a
18	IPRI	9.16	11.86	a b
5	Guam	8.32	9.56	b
27	IPRI	7.73	7.54	b
38	Saipan	5.03	3.54	b

Several harvests were completed before the experiment was concluded. Data are still awaiting analyses.

A third experiment was done in the greenhouse at Inarajan Experiment Station. This was a study of the effect of water stress and organic matter on the incidence of southern blight. Planting date was July 8, 1987. Four treatments, with four replications, were potted as follows: pasteurized soil plus organic matter (chicken manure), and pasteurized soil with no ammendments. Half of each of these were given water daily after planting, while the others were allowed to show temporary wilt symptoms before they were watered. Plants were inoculated with Sclerotium rolfsii when transplanted. The treatment with organic matter added to the soil and subjected to water stress sustained the highest disease incidence. The treatment with the least number of diseased plants, and the highest yield, was that with organic matter added to the soil and not subjected to water stress. Water stress should be avoided to prevent an increase in soilborne disease incidence.

Mean Values for Plant Count and Yield Components of Bell Peppers Grown on Soil with and without O.M.Ammendment, and With and Without Soil Moisture Stress

Trt	# Plants	# Fruits	Wt (g)	Lng (cm)	Wdth (cm)
Soil+O.M.	5.5	0.5	23.5	3.0	1.25
Soil+O.M.+Water	11.25	10.0	650.0*	10.75	4.0
Soil	9.75	0.75	16.5	1.75	0.75
Soil+Water	11.5	1.25	58.5	4.75	2.0

A fourth experiment was planted on July 7, 1987, in Mangilao. Cultural practices were evaluated for control of bacterial diseases on bell peppers. There were 4 treatments, 2 sub-treatments, replicated 4 times. These were: flat beds with black plastic mulch, flat beds with no mulch, raised beds (50 cm) with mulch, and raised beds with no mulch. Sub-treatments were overhead polyethylene cover, and no cover.

Cultivar Keystone Giant was used. Bacterial wilt incidence was considerably lower in raised beds with plastic mulch than in the other treatments; yield was 265% higher than the lowest-yielding treatment (flat beds, no mulch). Covered plots had lower bacterial leaf spot severity than uncovered plots, and yields were higher.

Effect of Various Cultural Practices on Bacterial Wilt and Bacterial Leaf Spot Incidence and Severity, and their Effect on Plant Count and Yield

Trt	Plant Count	Yield (g)
Raised, Mulched	32.125*	772.50*
Raised, No Mulch	23.375	305.125
Flat, Mulched	19.25	238.125
Flat, No Mulch	15.25	211.375
Sub-Trt: Covered	21.0	478.938*
Not Covered	24.0	284.625

Selected cultivars need to be tested for yield at other locations, where soil types different from that at Inarajan are found. This was not possible during the past year because of the bacterial blight problem. Cuttings had to be grown in the greenhouse and screened for blight before planting at Ija. This limited the amount of planting material available. Before this limited amount of planting material could be propagated (at Ija) free of blight, the cassava plot was severely damaged by wild pigs. An electric fence has been erected now to protect the present cassava plot, consisting of 12 cultivars. When enough planting material becomes available, yield tests may be carried out at Ija and other locations if funds are available. The cassava collection planted at Ija consists of the following:

Cultivar	Name	Source	No. Plants
4	Park	Guam	3
5	Elatico	Guam	4
6	Inarajan	Guam	4
9	Ungcangco	Guam	3
10	1 CM 481-1	IPRI	1
13	6 M COL 1942	IPRI	3
14	9 CM 321-188	IPRI	1
18	25 CM 308-197	IPRI	6
26	36 CM 391-2	IPRI	4
27	Amarillo-1	Hawaii	5
36	Kekara	Saipan	3
38	Saipan-6	Saipan	4

A technical bulletin on the cassava blight disease is now in press. A paper entitled 'Cassava blight eradication program at Inarajan Experiment Station, Guam' was presented at the annual meeting of the American Phytopathological Society in August, 1987. A technical manual is being prepared as a guide for cassava production on Guam.

Effect of cultural practices on disease incidence and severity on bell pepper

Four experiments were completed in 1987 for this project. One was a study on chemical control of bacterial leaf spot. It was planted at Barrigada in Nov 1987, using cv Blue Star. There were 6 treatments, replicated 4 times. Treatments were as follows: weekly application of Tri-Basic copper, weekly application of copper plus maneb, weekly application of copper plus maneb pre-mixed 2 hr before sprayed, 2 applications weekly of Tri-Basic copper, 2 applications weekly of copper plus maneb, 2 applications weekly of pre-mixed copper plus maneb. The experiment was harvested twice weekly. Twenty-four harvests were completed before the study was concluded. The data are still in the process of statistical analyses.

A second experiment, also carried out at Barrigada, was planted on March 5, 1987, with cv Blue Star again. This was a study of cultural practices to control soilborne diseases. It consisted of 5 treatments, replicated 4 times: shredded Casuarina needles incorporated into the soil, shredded Leucaena leaves, chicken manure (10 Tons/Ha), black plastic mulch, and a control with no ammendments or mulch. The first harvest was on May 6, 1987. No statistically significant differences were found between treatments because of the amount of variance and the sample size. The experiment was then re-planted, using twice as many plants as before.

Determination of plant diseases on Guam

Reports of new diseases: 25
86 samples processed.
New disease reports:
Watermelon Fruit Blotch - Pseudomonas pseudoalcaligenes subsp. citulli
Papaya rot - Fusarium sp.
Cassava blight - Xanthomonas campestris pv manihotis
Cabbage Black rot - X. campestris
Cabbage Leaf scald - X. campestris strain
Ascochyta leaf spot on Bittermelon - Ascochyta sp.
Bermuda grass root rot - Rhizoctonia sp.
Rye grass root rot - Rhizoctonia sp
Rye grass leaf spot - Helminthosporium turcicum
Fruit rot on pepper - Ulocladium sp.
Maize Dwarf Mosaic on maize - MDMV
Cercospora leaf spot on maize - Cercospora zeae-maydis
Stem rot on bell pepper - Macrophoma sp.
Powdery mildew on False Verbena - Oidium sp.
Galls on branches of Lansium domesticum - Aphelenchoides sp.
Leaf spot on Mango - Alternaria sp.
Fig rust - Cerotelium fici
Leaf spot on Taro - Phyllosticta sp.
Leaf spot on Taro - Curvularia sp.
Citrus canker - X. campestris pv citri
Root-knot on bell pepper - Meloidogyne sp.
Potato black scurf - Rhizoctonia sp.
Diplodia rot on Annona - Botryodiplodia theobromae
Ashy stem blight on Phaseolus - Macrophomina phaseolina
Common blight on Phaseolus - Pseudomonas phaseolicola

Two surveys were carries out. One was on tinang-aha disease of coconuts, to assay trees with PAGE analysis and compare these to cadang-cadang disease in the Philippine Islands; two scientists from the Philippine Coconut Authority were present to direct the study. Results showed that the two causal agents are similar, but different.

The other survey was for incidence of cassava blight on Guam. The disease was found in several locations, in planted and wild cassava plants.

SOIL SCIENCE - Soil Fertility

J.A. Cruz

Yield Response of Head Cabbage to Varied Nitrogen Rates

Cabbage is one of the crops placed on the priority list by the Dean's Planning Committee in 1987. On April 1987, an inter-disciplinary study was conducted on K-K Cross head cabbage by the soil and entomology section of CALS. The purpose of this study is to determine the yield response of K-K Cross head cabbage to different rates of nitrogen and to evaluate the effect of different rates of nitrogen on the incidence of insect pest on head cabbage. However, this report will emphasize only on the yield response of head cabbage to varied nitrogen rates.

Materials and Methods

Two identically designed experiments were conducted, one planted in April 1987 and the other planted in September 1987, in Mangilao. The soil family at the site is clayey, oxidic, isohyperthermic, Lithic Haplustalfs. Soil samples was taken and chemically analyzed for P, K, Ca, Mg and % OM. The soil test level were as follows: pH 7.50, 18.06 ppm P, 142.50 ppm K, 3375 ppm Ca, 115 ppm Mg, and 5.65% organic matter.

The five nitrogen treatments were replicated four times and arranged in a complete randomized block design. The individual treatment plots were 4.80 M x 5.10 M with five rows and twelve plants spaced 46 cm apart within the row.

The fertilizer (0, 34, 68, 136 and 272 kg ha^{-1} of N) were broadcast and worked into the soil with a rotor tiller at planting. The nitrogen source was urea. Also, a blanket application of 68 kg ha^{-1} P_2O_5 and 68 Kg ha^{-1} as KCL were broadcast and rotor tilled under at planting.

Seventy-five days after transplant, twelve heads per nitrogen treatment per replication were harvested and weighed on a Kg scale for both experiment.

Results

The yield of cabbage heads was greater in Experiment 2 than in Experiment 1. Experiment 1 yield ranged from 20.80 MT ha^{-1} (the highest yield) for treatment 272 kg ha^{-1} of N down to 16.40 MT ha^{-1} (the lowest yield) for treatment 0 kg ha^{-1} of N (Table 1). However, Experiment 1 shows no significant difference among the five nitrogen treatments. Table 2 shows the treatments and yield responses of cabbage heads. Cabbage head yields ranged from 24.49 MT ha^{-1} for 136 Kg ha^{-1} of N treatment to 16.28 MT ha^{-1} for 34 kg ha^{-1} of N treatment. One hundred thirty-six (136) kg ha^{-1} of N treatment showed the highest yield followed by 272 kg ha^{-1} of N treatment, 68 kg ha^{-1} of N treatment, 0 kg ha^{-1} of N treatment, and 34 kg ha^{-1} of N treatment at the lowest yield. The results show a favorable influence on the yield at the 136 kg ha^{-1} of N treatment rate. The response to nitrogen application was substantially larger at 24.49 MT ha^{-1} for 136 kg ha^{-1} of N treatment than 16.28 MT ha^{-1} for

34 kg ha^{-1} of N treatment. Analyses of variance indicated highly significant difference among the N treatments tested on the yield of head cabbage.

Table 1. Experiment 1 - Head Cabbage Yield as Influenced by Varied N Rates

Treatment kg ha^{-1} N	Yield MT ha^{-1} RI	RII	RIII	RV	Treatment Mean
0	16.74	15.11	20.92	12.83	16.40
34	13.80	22.23	19.89	20.82	19.19
68	17.39	15.44	16.58	25.49	18.73
136	15.27	15.87	22.83	24.35	19.58
272	22.01	17.50	19.89	23.81	20.80
Mean					18.94
CV (%)					19
LSD (5%)					NS

Table 2. Experiment 2 - Head Cabbage Yield as Influenced by Varied N Rates

Treatment kg ha^{-1} N	Yield MT ha^{-1} RI	RII	RIII	RV	Treatment Mean
0	14.46	20.16	16.96	15.44	16.76
34	14.24	14.62	16.31	19.95	16.28
68	19.84	20.98	20.16	21.58	20.64
136	24.35	25.44	20.44	27.72	24.49
272	25.33	20.22	17.07	23.59	21.55
Mean					19.94
CV (%)					13
LSD (5%)					10.60
LSD (1%)					17.58