ECOLOGY OF A TYPICAL TARO FARM AT SABANA, ROTA, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

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Abstract

The ecological study of a typical taro farm at Sabana, Rota, Commonwealth of the Northern Mariana Islands (CNMI) was conducted from October, 1990 to June, 1991 to compare the pests associated with taro under low-input, high-input, and farmer's practice of weeding taro. This experiment was superimposed with a yield/profitability study of taro under weeding at 60 and 120 days after planting (DAP) (low input); 30, 60, 90, and 120 DAP (high input); and rototilling at 60 and 120 DAP (farmer's practice).

Under the three weed management schemes, common diseases associated with taro were not observed during the experimental period. Only planthopper (*Tarophagus proserpina*) was consistently observed for eight months. Low-input plots had more counts of nymphs and adult planthoppers than other treated plots. Weed counting done at 60, 120, and 180 days showed 15 weed species as commonly growing with taro. However, *Eleusine indica* L., *Ageratum conyzoides* L., and *Bidens pilosa* L. were predominant and aggressively competing with taro for space, light, water, and nutrients.

Introduction

Taro (*Colocasia esculenta* (L.) Schott) was a staple crop in the Northern Mariana Islands (CNMI) but is now considered a specialty crop served at special occasions like *novenas, fiestas*, weddings, and birthdays. The market value ranges from $0.90 to $2.50 depending upon the variety and the time of the year.

In the CNMI, taro is commercially grown on Rota where this project on ecology was conducted. The study was conducted from October, 1990 to June, 1991 to determine accompanying weeds, insects, and diseases of taro and to what extent they affect taro production. This was superimposed on a separate study determining effects of different weed management practices on yield and profitability of taro.

Materials and Methods

This study was conducted in a farmer-cooperator's field at Sabana, Rota. A red taro variety was provided by this farmer. Other materials, such as fertilizer (14-14-14) and chemicals (Sevin and Malathion), were provided to this cooperator by the project.

The experimental plot on yield was superimposed on six quadrates of the ecology study. There were six replications, each with a quadrate measuring 5 m x 5 m. Low weed management utilized manual weeding at 60 and 120 days after planting (DAP). High weed management had four manual weedings at 30-day intervals during the first four months after planting taro. The farmer's practice utilized a rototiller at 60 and 120 DAP.

Plants were properly maintained based on the recommended cultural practices and the farmer's practice. Irrigation was not provided in any plots. The farmer's plots were not fertilized, but the two other treatments were fertilized with 14-14-14 three times. The fertilizer was applied at planting (1/2 tablespoon/plant) and at 60 and 120 DAP (1 tablespoon/plant).

Observations of pests and diseases were done biweekly in the six quadrate. Weed counts were performed at 60, 120, and 180 DAP. For planthoppers, the number of nymphs and adults found at the third leaf petiole was recorded in 11 biweekly observations. For disease ratings, the first expanded leaf or third leaf of taro were scrutinized for signs and symptoms. For weed counts, the following data were obtained:

1. Average height - Measured from the base of the plant at ground level to the tip of the youngest leaf for five plants in three replications per treatment.
2. Average weed number - Total number of individuals of each species in three replications per treatment.
3. Average weed density - Number of individual species per quadrate divided by the area of the quadrate (25 sq. m.). Three replications were counted to obtain the average weed density.

4. Average frequency - Number of quadrate where a certain weed species was found divided by total number of quadrates. If the species was found in six quadrates, then the frequency would be 6 of 6 = 1.0.

5. Average percent cover of weed species - Proportion of the ground occupied by a vertical projection from the ground to the aerial parts of the plants. The modified Braun-Blanquet scale was used and was defined as follows:

5 = covering more than 75 percent of the area (quadrate)
4 = covering 50 to 75 percent of the area
3 = covering 25 to 50 percent of the area
2 = any number of individuals covering 10 to 25 percent of the area
1 = numerous, covering 5 to 10 percent of the area
+ = sparse, covering less than five percent of the sample area
r = rare and covering less than one percent of the sample area, usually only one sample.

These cover values were given standard percentages as shown below:

5 = 87.5 percent
4 = 62.5 percent
3 = 37.5 percent
2 = 17.5 percent
1 = 7.5 percent
+ = 2.5 percent
r = 0.1 percent

6. Average importance value of a species - Sum of relative density, relative frequency, and relative cover of a species divided by the three replications, as follows:

a. Relative density = number of individuals in a given species divided by total number of individuals of all species.
b. Relative frequency = frequency of a given species divided by sum of the frequencies of all species.
c. Relative cover = coverage for a given species divided by total coverage for all species.

Results and Discussion

Weeds, insects, and diseases associated with taro under the three weed management practices were observed during the eight-month growing period of taro.

Weeds

Fifteen weed species were found commonly associated with taro plants in a farmer's field at Sabana, Rota from October, 1990 to June, 1991 (Table 1). Thirteen were classified as broadleaves. One was a grass (*Eleusine indica* L.), and the other one was a sedge (*Cyperus rotundus* L.).

Average Height

The average heights of the 15 weed species studied varied within and among weed management practices (Table 1).

Monthly weeding for the first four months after taro planting (high weed management) suppressed the growth of seven weed species better than two hand weedings of taro and farmer's practice of rototilling at 60-day intervals. The following weeds consistently grew taller than the other weed species: *Eleusine indica* L., *Cyperus rotundus* L., *Ageratum conyzoides* L., *Chromolaena odorata* L., *Starchytarpheta indica* L., *Phyllantus amarus* Schum & Thorn, and *Mimosa pudica* L.

Table 1. Average height (cm) of 15 weed species associated with taro[1].

Weed species	Weed management practices[2]		
	Low	High	Farmer's
Eleusine indica L. Gaertn	29	12	27
Cyperus rotundus L.	15	7	11
Digitaria sanguinalis L.	24	18	13
Bidens pilosa L.	15	9	9
Ageratum conyzoides L.	25	9	17
Chromolaena odorata L.	16	11	13
Stachytarpheta indica L.	15	12	18
Chenopodium sp.	17	14	10
Physalis peruviana L.	20	15	15
Ipomoea triloba L.	17	15	9
Mimosa pudica L.	11	8	9
Portulaca oleracea L.	4	7	2
Trifolium sp.	3	6	3
Phyllantus amarus Schum & Thorn	5	6	1
Youngia japonicum L.	15	15	10

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Average Weed Number

Observations made from the three quadrate showed that the three most abundant species were *Eleusine indica* L., *Ageratum conyzoides* L., and *Mimosa pudica* L. (Table 2.)

Table 2. Average number of weeds associated with taro[1].

Weed species	Weed management practices[2] Low	High	Farmer's
Eleusine indica L. Gaertn	3,685	4,494	516
Cyperus rotundus L.	19	54	33
Digitaria sanguinalis L.	48	37	72
Bidens pilosa L.	1,858	356	209
Ageratum conyzoides L.	2,096	330	375
Chromolaena odorata L.	1,409	153	288
Stachytarpheta indica L.	484	123	84
Chenopodium sp.	121	85	51
Physalis peruviana L.	271	308	117
Ipomoea triloba L.	361	294	139
Mimosa pudica L.	1,148	564	419
Portulaca oleracea L.	20	24	4
Trifolium sp.	724	368	306
Phyllantus amarus Schum & Thorn	10	6	1
Youngia japonicum L.	161	144	60

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Average Weed Density

Under the three weed management, *Eleusine indica* L., *Ageratum conyzoides* L., and *Mimosa pudica* L. predominated the weed species commonly growing with the taro plants (Table 3).

Average Frequency

Impomoea triloba L. were consistently found in the three weed management schemes in the six quadrate studied (Table 4). Seven weed species were persistent under low-weed control schemes. *Phyllantus amarus* Schum and Thorn was scarce in these taro patches.

Average Percent Cover

Eleusine indica L., *Ageratum conyzoides* L., and *Bidens pilosa* L. seemed to be the competitors of taro for space (Table 5). Others occupied minimal spaces in the taro patches.

Average Importance Value

Regardless of weed management schemes, the taro patches of the farmer-cooperator were predominated by *Eleusine indica* L., *Ageratum conyzoides* L. and *Bidens pilosa* L. (Table 6). If uncontrolled, these weed species could reduce yields of taro through competition for space, moisture, light, and nutrients and harbor other pests like insects or diseases.

Table 3. Average density of 15 weed species associated with taro[1].

Weed species	Weed management practices[2] Low	High	Farmer's
Eleusine indica L. Gaertn	147.3	18.0	20.6
Cyperus rotundus L.	2.4	1.5	0.8
Digitaria sanguinalis L.	1.9	1.5	2.9
Bidens pilosa L.	32.7	10.0	11.4
Ageratum conyzoides L.	83.8	13.1	15.0
Chromolaena odorata L.	17.7	6.1	24.9
Stachytarpheta indica L.	11.4	4.6	3.4
Chenopodium sp.	4.8	2.3	2.1
Physalis peruviana L.	15.8	4.1	4.7
Ipomoea triloba L.	12.5	11.8	5.6
Mimosa pudica L.	46.0	22.6	16.8
Portulaca oleracea L.	0.8	1.0	0.2
Trifolium sp.	29.0	13.2	12.2
Phyllantus amarus Schum & Thorn	0.4	0.2	4.4
Youngia japonicum L.	6.4	5.8	2.4

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Table 4. Average frequency of weed species associated with taro[1].

Weed species	Weed management practices[2] Low	High	Farmer's
Eleusine indica L. Gaertn	1.0	0.9	0.9
Cyperus rotundus L.	0.9	0.8	0.6
Digitaria sanguinalis L.	0.9	0.9	0.6
Bidens pilosa L.	0.8	0.9	0.9
Ageratum conyzoides L.	1.0	0.9	0.9
Chromolaena odorata L.	1.0	0.9	0.9
Stachytarpheta indica	1.0	0.8	0.8
Chenopodium sp.	1.0	0.9	0.8
Physalis peruviana L.	0.9	0.8	0.9
Ipomoea triloba L.	1.0	1.0	1.0
Portulaca oleracea L.	0.4	0.4	0.2
Trifolium sp.	1.0	1.0	0.9
Phyllantus amarus Schum & Thorn	0.6	0.3	0.1
Youngia japonicum L.	0.9	1.0	0.6

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Table 5. Average percent cover of weed species associated with taro.[1]

Weed species	Weed management practices[2] Low	High	Farmer's
Eleusine indica L. Gaertn	28.2	14.5	11.3
Cyperus rotundus L.	0.5	5.6	5.3
Digitaria sanguinalis L.	0.5	1.2	4.8
Bidens pilosa L.	3.1	15.1	11.4
Ageratum conyzoides L.	6.2	12.5	10.2
Chromolaena odorata L.	0.3	0.1	0.1
Stachytarpheta indica 1.0	0.9	0.1	0.1
Chenopodium sp.	0.1	0.1	0.1
Physalis peruviana L.	0.1	0.1	0.1
Ipomoea triloba L.	0.1	0.1	0.1
Portulaca oleracea L.	0.1	0.1	0.1
Trifolium sp.	0.1	0.1	0.1
Phyllantus amarus Schum & Thorn	0.1	0.1	0.1
Youngia japonicum L.	0.1	0.1	0.1

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Table 6. Average importance value of weed species associated with taro.[1]

Weed species	Weed management practices[2] Low	High	Farmer's
Eleusine indica L. Gaertn	0.92	0.52	0.51
Cyperus rotundus L.	0.03	0.20	0.18
Digitaria sanguinalis L.	0.08	0.17	0.22
Bidens pilosa L.	0.16	0.39	0.38
Ageratum conyzoides L.	0.61	0.48	0.52
Chromolaena odorata L.	0.21	0.10	0.19
Stachytarpheta indica 1.0	0.17	0.13	0.11
Chenopodium sp.	0.08	0.09	0.10
Physalis peruviana L.	0.05	0.13	0.14
Ipomoea triloba L.	0.10	0.20	0.15
Portulaca oleracea L.	0.03	0.06	0.04
Trifolium sp.	1.14	0.21	0.23
Phyllantus amarus Schum & Thorn	0.13	0.20	0.18
Youngia japonicum L.	0.08	0.12	0.06

[1] Average taken from three observation dates (December 12, 1990, February 6, and April 4, 1991).
[2] Low - two hand weedings (60 and 120 DAP; high - four hand weedings (30, 60, 90, and 120 DAP), and farmer's - two rototillings (60 and 120 DAP).

Diseases

During the entire period of the experiment, the taro plants were almost free of diseases.

Insects

Planthopper (*Tarophagus proserpina*) was the predominant species throughout the growing period.

Adults

The adult planthoppers are small, black, very mobile insects. They were usually found on the petioles of the plant. The population trend of this insect was unstable. The fluctuation in the number of planthoppers was attributed to the spraying of insecticides (Sevin and Malathion). Spraying was done when high populations of the planthopper were observed. The reported natural enemy of this insect (*Cyrtorhinus fulvus,* an orange mirid bug) was not observed. In the dry months (April and May), the population was drastically reduced, probably because the more mature plants become unpalatable to the adults. Generally, the average populations of the planthopper for the three weed management practices were similar.

Nymphs

Nymph populations were inversely proportional to the population growth of the adults (Tables 7 and 8). If there were high counts for nymphs, adults were few. The nymph population was lower under the farmer's practice of rototilling the soil than by hand weeding. Those plots which were very weedy (low weed management) harbored more nymphs than the less-weeded plots.

Table 7. Average number of adult planthoppers in taro plants.

Days after planting	Weed management practices Low	High	Farmer's
14	0.2	0.2	0.4
28	1.2	1.6	1.2
42	0.8	0.8	0.4
56	1.9	2.4	3.4
70	0.2	0.2	0.2
84	0.4	0.5	0.4
98	1.3	1.2	1.2
112	0.9	0.5	0.6
126	1.4	1.2	1.1
140	0.8	0.8	1.0
154	0.0	0.1	0.1
Average	0.8	0.9	0.9

Table 8. Average number of planthopper nymphs on taro plants.

Days after planting	Weed management practices		
	Low	High	Farmer's
14	1.3	5.0	0.1
28	0.7	0.7	0.3
41	3.2	1.9	0.8
45	5.7	2.7	1.3
70	0.2	0.1	0.1
84	0.6	0.4	0.6
98	2.0	2.5	3.1
112	3.6	0.5	2.5
126	2.8	2.2	1.7
140	1.8	2.0	1.5
154	0.2	0.3	0.1
Average	2.0	1.7	1.1

Conclusion

Plots weeded at 60 and 120 DAP harbored more nymphs than those weeded at 30, 60, 90, and 120 DAP and rototilled at 60 and 120 DAP. However, the populations of adult planthoppers were comparable in all treatments, but counts were relatively low (1-2/taro).

Among 15 weeds identified, *Eleusine indica* L., *Ageratum conyzoides* L., and *Bidens pilosa* L. were predominant and aggressively competing for space, light, water, and soil nutrients.

These plots were not infected with major diseases commonly observed in taro.

Acknowledgment

The authors wish to extend thanks and appreciation to the following Land Grant staff for their untiring assistance and support: Antonio A. Santos (Dean/Director), Wilhelm Maui (Associate Director for Research), Perry Inos (Former County Agent Supervisor/NMC Liaison Officer at Rota), Aquilino Semana (farm laborer), Belinda A. Pagcu (clerk typist), and the hired farmers of the farmer-cooperator (H. Richard). This experiment was made possible through funding from the Agricultural Development for the American Pacific project and the USDA Sustainable Agriculture Research and Education Program.

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The Editor

L. Ferentinos is the Project Coordinator of the Taro Production Systems Project at the University of Hawai'i at Manoa.

Jane C. Muench, an independent editor with J.C.M. Office Services, provided technical support.

Publication was supported in part by a grant from the USDA/CSRA Sustainable Agriculture Research and Education Program (formerly called L.I.S.A.). Additional support was provided by American Samoa Community College, College of Micronesia, Northern Marianas College, University of Guam, Yap Institute of Natural Science, and the University of Hawai'i under the Agricultural Development in the American Pacific (ADAP) Project.

The Library of Congress has catalogued this serial publication as follows:

Research extension series / Hawaii Institute of Tropical Agriculture and Human Resources.—001—[Honolulu, Hawaii]: The Institute, [1980–
v. : ill. ; 22 cm.
Irregular.
Title from cover.
Separately catalogued and classified in LC before and including no. 044.
ISSN 0271-9916 = Research extension series - Hawaii Institute of Tropical Agriculture and Human Resources.
1. Agriculture—Hawaii—Collected works. 2. Agriculture—Research—Hawaii—Collected works. I. Hawaii Institute of Tropical Agriculture and Human Resources. II. Title: Research extension series - Hawaii Institute of Tropical Agriculture and Human Resources.
S52.5R47 630'.5—dc19 85-645281
AACR 2 MARC-S
Library of Congress [8506]