

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523
BIBLIOGRAPHIC INPUT SHEET

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Batch 95

1. SUBJECT
CLASSI-
FICATION

A. PRIMARY
Serials

Y-AH60-0000-0000

B. SECONDARY
Food production and nutrition--Weeds

2. TITLE AND SUBTITLE
Weed control systems for representative farms in developing countries; annual report, 1977/1978

3. AUTHOR(S)

(101) Or.State Univ. Int.Plant Protection Ctr.

4. DOCUMENT DATE
1978

5. NUMBER OF PAGES
36p.

6. ARC NUMBER
ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Or.State

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)

(Research summary) (Financial support rendered through AID/ta-C-1295 and AID/ta-C-1303)

9. ABSTRACT

10. CONTROL NUMBER

PN-AAG-092

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Research

13. PROJECT NUMBER
931046300

14. CONTRACT NUMBER
AID/ta-C-1295 Res.

15. TYPE OF DOCUMENT

ANNUAL REPORT
1977-78

Weed Control Systems

Annual Report 1977-78

PA-MAG-77-1



COVER

The symbol appearing on the cover represents herbicides and is one of a 12-symbol series designed by a U.S. firm to graphically identify the contents of packaged agricultural products. The series was created in 1975 by Vertac International to overcome international trade language barriers and to provide standardized identification through visual representation of packaged contents or properties.

ANNUAL REPORT 1977-78

Weed Control Systems and Systems Utilization for Representative Farms in Developing Countries

**U. S. Agency for International Development
and Oregon State University**

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Project Profile

1. Project titles:
 - (Research) - Weed Control Systems for Representative Farms in Developing Countries
 - (Technical Assistance) - Weed Control Systems Utilization for Representative Farms in Developing Countries
2. Contract numbers:
 - (Research) - AID/ta-C-1295
 - (Technical Assistance) - AID/ta-C-1303
3. Principal Investigator:

Dr. Stanley F. Miller, Director
International Plant Protection Center
Oregon State University
Corvallis, OR 97331 / USA
4. Contractual periods:

April 1, 1976 through March 31, 1979
5. Period covered by this report:

April 1, 1977 through March 31, 1978
6. Total AID funding of contracts to date:
 - (Research) - \$389,190.51
 - (Technical Assistance) - \$554,039.83
7. Total expenditures and obligations through previous contract year:
 - (Research) - \$160,026.55
 - (Technical Assistance) - \$201,352.79
8. Total expenditures and obligations for current year:
 - (Research) - \$229,163.96
 - (Technical Assistance) - \$352,687.04

NOTE: In 1976, the Agency for International Development/Oregon State University weed control systems research and assistance program aimed at developing countries was redefined into closely linked research and technical assistance contracts. The two activities function in tandem, have a synergistic effect, and are virtually inseparable in the field. Hence, this report treats the two contracts individually in the finances section only.

Summary

The traditional Latin American orientation of the U.S. Agency for International Development/Oregon State University weed control systems program was broadened with the establishment and growth of an Asian regional effort centered at Los Banos, the Philippines.

A two-man project team arrived at Los Banos and began activities to integrate weed research and technical assistance with both the National Crop Protection Center (Los Banos) and several regional crop protection centers. Twelve research trials were established. In addition to field research, project specialists worked closely with counterparts to present several weed science mini-courses and formulate plans for major short courses in the future.

In Costa Rica project scientists concentrated their efforts on developing and refining pre-plant vegetation control systems that provide effective, practical, and realistically priced weed control for small farmers. Additional system benefits included flexibility (useful on steep terrain without causing erosion; farmers selecting between capital or labor emphasis) and adaptability. The technique promises to be a major breakthrough for weed control by small farmers.

A series of short courses and seminars in Nicaragua, Panama, and Honduras, as well as Costa Rica, keynoted the program's technical assistance efforts.

Socio-economic research advanced in both project regions. Farm surveys of Costa Rican small farms region yielded insights into existing weed control practices and their economic and social importance. The efficiency of the preplant vegetation control option is being analyzed. Research also got underway to determine the economic importance of weed control for complex multiple cropping regimes in the Philippines. A site for the research has been selected and the collection of data started. Members of the program's aquatic weed group presented a short course in Thailand and later consulted with Thai National Research Council officials regarding the shape and scope of a proposed aquatic weed project.

Information dissemination continued as a major effort of the program highlighted by completion and initial world distribution of two Spanish language publications, and announcement of a new 4-page leaflet listing the bare essentials of equipment for conducting weed control research. Project personnel at Corvallis responded to a variety of information requests, not only for publications and reprints, but for technical weed control information. Research on small scale pesticide application equipment, new herbicides, and control of purple nutsedge (Cyperus rotundus L.) progressed.

Sumario

La orientación tradicional de la Agencia Internacional de Desarrollo de la Universidad de Oregon State en sistemas y programas de control de malezas para América Latina, se ha engrandecido con el establecimiento y esfuerzo centrado en la Región Asiática de Los Baños en Filipinas.

El proyecto llevado a Los Baños por un equipo de dos hombres empezó actividades para integrar estudios en malezas y asistencia técnica en unión con el Centro de Protección Nacional de Cultivos (Los Baños) y numerosos centros regionales de Protección de Cultivos. Doce estudios de prueba fueron establecidos.

En adición al estudio de campo, especialistas en el proyecto trabajaron conjuntamente con sus contrapartes para presentar numerosos mini-cursos en malezas y formular planes para mejoras de los mismos en el futuro.

En Costa Rica encargados del proyecto concentraron sus esfuerzos en el desenvolvimiento y refinamiento en sistemas de control de preplantación que provee una efectiva, práctica y realística apreciación del control de malezas por los pequeños agricultores.

Beneficios adicionales en el sistema incluyen flexibilidad (beneficioso en la pendiente del terreno sin causar erosión; agricultores seleccionan entre capital o énfasis en la mano de obra) y adaptabilidad. La técnica puede ser un gran empuje para control de malezas por los pequeños agricultores.

Una serie de cursos de corta duración y seminarios en Nicaragua, Panamá y Honduras como también Costa Rica, hicieron énfasis en los programas de asistencia técnica.

Estudios socio-económicos continuaron en ambas regiones en dichos proyectos. Censos agrícolas llevados a cabo en una región de pequeñas propiedades en Costa Rica permitieron ver las prácticas existentes para el control de malezas y su importancia socio-económica. La eficacia de la opción de pre-plantación está siendo analizada.

Se empezaron estudios para determinar la importancia económica en el control de malezas para los complejos y múltiples régimes de cultivo en Filipinas. El sitio para el estudio ha sido seleccionado y la colección de datos a comenzado.

Miembros del grupo del programa de malezas acuáticas presentó un pequeño curso en Tailandia y luego consultó con oficiales del Consejo Nacional de Estudios de Tailandia, en cuanto a la forma y alcance del proyecto de malezas acuáticas presentado.

Distribución de información continuó como un esfuerzo primordial del énfasis del programa através de completación y distribución inicial al mundo de dos publicaciones en español y através de la publicación de un nuevo panfleto de cuatro páginas el cual lista los equipos esenciales para llevar a cabo las investigaciones acerca del control de malezas.

Los miembros del proyecto en Corvallis, respondieron a la variedad de información requerida, no solo para publicaciones e impresos sino también para información técnica sobre control de malezas.

Estudios sobre equipos utilizados para la aplicación de pesticidas a pequeña escala, nuevos herbicidas y control de coquillo (Cyperus rotundus) se continuaron.

The Project in Focus

Small and medium-sized farm enterprise economic position in many developing countries deteriorated with the advancement of agricultural technology. Costs for requisite inputs (fertilizer, seed, irrigation) pushed dramatic production increases beyond reach of all but the more affluent farmers. Economics and market realities tended to focus agricultural input manufacturer's attention on larger, more commercialized operations. For many countries the undeniable need to increase agricultural production caused development programs to neglect the small grower.

The introduction of new technology inadvertently contributed to the intensification of weed problems. Weeds, as well as crops, respond favorably to improved growing conditions. New cultivars often do not compete with weeds as well as native varieties. Studies also revealed that, in some areas where herbicides were used for several years, weed populations shifted from relatively controllable broadleaf varieties to more pernicious grassy species which, once established, become extremely difficult to control.

The international development community raised questions about weed control needs and technologies in developing countries:

- i. to what extent do weeds limit production, either by direct competition with crop plants for available nutrients, light, and water, or by demands for control inputs, i.e., land, labor, and capital?
- ii. given prevailing constraints--economic, social, and political--what realistic level of agricultural technology could or should be instituted for weed control?
- iii. what is the inter-relationship of weed control technology with other advanced agricultural inputs?
- iv. how do various weed control systems--including the absence of control--affect the farmer, his family, the associated labor pool, and the community, both economically and socially?

As a result of these concerns, the AID-Oregon State University weed control research project, a contract begun in 1966, was encouraged to study the emerging implications of weed control. The formerly production-oriented research effort was restructured in 1972 to include a broader overview of peasant farm problems and to work toward evolving weed control systems for representative farms in developing countries.

At the same time, the project assumed the added dimension of assessing the social and economic impact of weed control technology related to employment and income distribution. The restructured project's initial effort was in Brazil and El Salvador; these programs were completed by phases and terminated in 1976. New project areas were identified in Central America and Southeast Asia, and a series of multi-faceted programs launched in these regions.

Aquatic weeds are serious pests throughout the tropics and sub-tropics of the world, especially in developing countries. Explosive growth of aquatic weed populations in major hydrological systems of several developing countries since 1960 has reduced or restricted water availability. Where water systems serve multiple purposes, e.g. irrigation, transportation, cooking, sewage disposal, and hygiene, in Southeast Asia, for example, loss of ready access to water would cause serious sociological problems.

For agriculture, aquatic plants occupy space needed for water storage; they also cause water loss through transpiration at a rate three to eight times greater than the loss from a free water surface. This fact is especially pertinent for areas with critically short water resources such as the African Sahel.

To address these problems the AID-OSU weed effort asked the University of Florida to conduct an aquatic weed program that would (under a sub-contract) consist of offering technical assistance through short-term consultations with governments of developing countries as well as providing a reference and information center to this same group of nations. The agreement was signed and the program begun in April 1976.

Objectives

The AID weed program constitutes one of many elements in the overall effort to raise food crop production levels. It specifically aims for reduction of food crop losses due to weed competition to the extent that production gains are justified economically and socially.

Attempts to develop and evaluate weed control technologies for representative farms imply a special emphasis on smaller-sized, subsistence farms. Resulting technologies, or systems, are evaluated in terms of various societal goals and performance criteria, including economic efficiency, employment, and income distribution.

Additional objectives include:

- training host country counterparts in appropriate weed control research methodology;
- promoting only practical and safe usage of herbicides and other pesticides through training programs;
- encouraging evaluation of ecological-environmental aspects of weed control systems;
- and fostering continued development and maintenance of a world-wide communication/information network for weed control linking the institutions and individuals concerned.

Recognition of aquatic weed problems and their impact has produced attempts by developing countries to eliminate or control these pests. A need exists to supply technical expertise and personnel training in aquatic weed control to the nations in need. Establishment of a central source to cooperate with host country governmental agencies facilitates both access to expertise and training required to cope effectively with water weed programs.

Objectives of the aquatic weed component include:

- identifying biological and socio-economic problems of aquatic weeds in agricultural and related non-agricultural production;

- providing short-term consultation in integrated weed control methods to developing countries;
- establishing general criteria for the assessment of aquatic weed problems;
- creating an extensive aquatic weed information and reference center;
- developing integrated control systems for important aquatic weeds.

Activities Review

I. RESEARCH RELATED ACTIVITIES

● COSTA RICA ●

Research results point to pre-plant weed control

Results of research conducted in the high rainfall areas of Costa Rica by the AID-Oregon State University weed program corroborated the belief that an effective, practical, and relatively low cost method of reducing weed competition hinged on improved methods of controlling vegetation before planting. The techniques developed and tested meshed with current small farmer practices.

In addition to providing weed suppression throughout the crop cycle, pre-plant vegetation control has the added benefits of controlling--instead of increasing--erosion, being adaptable to even steep, rocky terrain, and requiring virtually only one piece of equipment, a knapsack style spray applicator.

Many small farmers in Costa Rica have used chemicals for various crop protection practices due to the proximity of large plantations that employ advanced technology. OSU weed scientists Dr. Eduardo Locatelli and Myron Shenk found that many small Costa Rican farmers owned, or had access to, a knapsack sprayer.

The spraying performed on plantations may have helped make use of chemicals familiar, but it also seems to have contributed to small farmers assuming "if that herbicide is good for weed control on the banana plantation, it must be good for controlling weeds on my farm." The result has been use of inappropriate materials, or potentially hazardous "farmer cocktail" mixtures.

Trials were conducted on experiment stations and in farmers' fields (corn and bean crops). Examples of the pre-plant vegetation control systems tested include:

- I. -hand chop tall weeds;
-plant crop into mulch;
-hand weed as needed in crop or use directed application of contact herbicide (non-selective) after crop emerges.
- II. -knock down tall annual weeds with contact herbicide;
-plant into mulch;
-hand weed or use directed herbicide after crop emerges.
- III. -knock down perennial grasses with translocated herbicide;
-plant into mulch;
-hand weed or use directed herbicide as needed after crop emerges.
- IV. -plow;
-plant;
-hand weed or use directed herbicide as needed after crop emerges.

The systems listed generate important benefits for the small farmer. They provide an effective choice of weed control using either labor or capital intensive inputs, thus giving the farmer flexibility to fit his means. For researchers the systems appear attractive in their effectiveness for both large-seeded and transplanted crops.

The data in the following table provides an example of the relationship between the systems tested. The weeds in this trial were all annuals. All chemical treatments, with the exception of trial number 3 (MSMA), produced yields statistically similar to the local method of hand-chopped mulch. In this instance the advantage to the farmer would lie in labor savings, timeliness of weed control, erosion control, and potential ability to farm additional land.

Treatment	Procedure	Shelled corn yield - kg/ha	Statistical similarity
1	Glyphosate @ 1.38 kg/ha	3127	a
2	Paraquat @ .95 kg/ha	2487	abc
3	MSMA @ 5.56 kg/ha	1830	c
4	Plow + 2 weedings in crop	2276	bc
5	Control (local method of hand cut mulch)	2613	abc

CV-19%, LSD @ 5%

The AID-OSU effort is also testing mechanical weed control (using tractors). The technique is limited to traversable terrain and by the availability of tractors.

Trainees and students at CATIE (Centro Agronómico Tropical de Investigación y Enseñanza) are collaborating with the AID-OSU program by conducting related research on rates of herbicides, timing of application, weed species shifts, and interaction with insects.

● PHILIPPINES ●

Philippine program research completes first year

A typical mix of trials characterized the first year of field research in the Philippines conducted by the AID-OSU weed program. Substitution trials were launched to determine the relationship between chemical and mechanical weed control methods as well as the role of fertilizer. Herbicide selectivity experiments were begun on important crops of the region including corn, mungbean, and sorghum.

Familiarity with the area brought additional realization of how serious the weed problem is. One OSU weed scientist commented that it was the first time he had ever seen entire fields abandoned to weeds after being planted with a crop. The weed *Rottboellia exaltata* is a rapidly spreading, serious threat in Philippine agricultural zones. It is capable of germinating at any time, and is difficult to control with most herbicides. Hand weeding is unpleasant and difficult due to the plant having small, fiberglass-like needles on the sheath that

penetrate flesh, break off, and cause a painful infection.

AID-OSU weed scientists Dr. Philip Motooka and Herb Fisher encountered relatively little use of herbicides for small farm food crops in the Philippines. They concluded that present methods of seed preparation-- animal draft and crude implements--fail to provide the uniform, fine seedbed needed for most soil-applied herbicides to be effective.

An overview of the research activity includes:

-two substitution trials on mungbeans in Central Luzon; data being processed.

-herbicide selectivity trial on sorghum in Central Luzon; data being processed; initial observations indicate positive results from pre-emergence applications of atrazine and linuron and post-emergence applications of atrazine, linuron and diuron.

-four different corn trials were established in Mindanao; these were labor-capital substitution, selectivity, and weed control systems trials;

-five additional trials were established and abandoned due to drought or problems with seed germination; no data available.

Research contacts established

While the AID-OSU weed scientists work through and under the coordination of the National Crop Protection Center (NCPC) at Los Baños, they have contacted researchers and established cooperative programs with a number of institutions. The latter includes the University of the Philippines Los Baños (UPLB), the Bureau of Plant Industry (BPI), several regional crop protection centers (RCPCs), Central Mindanao University (CMU), the International Institute of Rural Reconstruction (IIRR), Central Luzon State University (CLSU), and the International Rice Research Institute (IRRI). Exploratory discussions were held to plan research programs, research training, and information collection.

The research site being developed by IIRR at Cavite, Silang, is in an area where the average farm size is 2.53 ha with just over 1 ha arable land. Crops are predominantly rainfed and both land preparation and cultivation are performed almost exclusively by draft animal; more than 96 percent of the farms have plows and harrows. Most farmers in the area use fertilizer, but only a few employ pesticides. Weed research is focusing on control of weeds in upland rice, corn, grain sorghum, and mung beans.

● SOCIO-ECONOMIC ●

Costa Rican farm survey conducted

A detailed survey of twenty one small farmers in a target area of Costa Rica was conducted in August 1977 by OSU agricultural economist Thomas McCarty in conjunction with the AID-OSU team and personnel from

CATIE. All the farmers visited provided all the requested information. The questionnaire used was designed with input from several CATIE scientists, pre-tested, and revised twice before being taken to the field.

Preliminary results of the survey analysis indicate:

1. Limited use of continuous cropping on the same parcel of land throughout the year; typically, a crop grown during the rainy season is followed by fallowing of the land during the dry season.
2. Common usage of herbicides for weed control after crop planting.
3. Heterogeneity of weed types--both grasses and broadleaves--and methods of soil preparation between farms.
4. Weed management practiced before and after planting corn (including up to four hand weedings after planting) and again at harvest.
5. Nearly half the labor and half the capital expense associated with growing a corn crop relate to weed control activities.
6. Few farmers use fertilizer.
7. Competition in farm wages exists between weeding, banana production, and coffee harvest.

The preliminary survey results, coupled with general observations, support the contention that weeds are a serious problem, that traditional weeding is labor intensive, and that labor supply shortages exist at certain times of the year. Hence, the development of practical weed control systems that could increase crop production or decrease labor capital expense would generate positive benefits for Costa Rican small farmers. This is especially true if other farming activities or off-farm employment have significant economic appeal to the small farm labor pool.

Multiple cropping weed control importance under study

Research to determine the economic importance of weed control associated with complex multiple cropping practiced in the Philippines was initiated in mid-year 1977 concurrently with agronomic weed control experiments. The combination of no weed technology research results for multiple cropping and the complexity of the cropping cycles led OSU agricultural economist Dennis O'Brien to establish socio-economic objectives of:

-gaining an insight into the physical and economic relationships existing within complex upland multiple cropping systems in the Philippines;

-evaluating the role played by traditional weed control practices within multiple cropping systems by appraising the economic importance relative to other functions of the system.

A proposal was developed based on a literature review, field observations, and discussions with personnel at various Philippine institutions. A socio-economic study of weed control impact will center on upland rice based multiple cropping systems. A site at Cale, Batangas, was chosen. In January 1978 farmers in Cale, and also in Cavite province, were interviewed by Mr. O'Brien to determine specifics of farming practices in the two areas.

The farm interviews, along with references emerging from existing literature, are being used to develop detailed descriptions of farming practices and socio-economic conditions in the two study areas. Preliminary findings point to highest labor demands occurring during hand weeding and harvesting of the rice crop in July and October.

Relatively few Cale farmers--less than 5 percent--use herbicides. The reasons appear to be:

- limited finances of most farmers;
- adverse effect of herbicides on other crops in the multiple crop sequence;
- insufficient labor reduction to permit advantageous off-farm employment.

Avoidance of risk in volume of production is a major concern for Cale farmers. Research will focus on the effect of weed control technology on risk.

● CORVALLIS ●

Knapsack spraying study conducted

The agronomic and socio-economic feasibility of weed control systems involving use of herbicides rests, in no little part, on the physical aspects of application. For most LDCs, the basic application unit is the manually pumped, man-carried "knapsack" sprayer.

Project personnel, during trips to many LDCs, have observed that knapsack sprayers, if present in a region, are quite frequently mis-used: improperly adjusted, carelessly cleaned, and frequently lacking in maintenance.

Initial improvisation with multiple nozzle spray booms for research at Corvallis lead the AID-OSU's project technician, Frank Fraser, to consider the possibility of developing and testing booms for use in LDCs. The basic objective: to design an arrangement that provides maximum uniformity of application for both small farmers and researchers.

Sophisticated, evenly-applying booms may be assembled, but the components to do so are usually expensive, high technology items (such as aluminum aircraft fittings). However, Mr. Fraser began looking at what could be accomplished with available materials. For instance, copper refrigeration tubing is utilized universally and, with relatively simple fittings, can be fabricated into a respectable boom. Even bamboo can be pressed into service for use as a boom.

The information developed will be disseminated via a publication. Work on a rough draft began during the report period.

Nutsedge control studies continued

Purple nutsedge (*Cyperus rotundus* L.) is acknowledged as one of the world's most troublesome weeds. It is nearly impossible to control by either manual methods or herbicides alone. Glyphosate, a relatively new herbicide, has shown promise of being the most effective material on the market.

Project agronomist Rick Chase conducted nutsedge control field research in El Salvador earlier and continued the investigation effort at Corvallis during the 1977-78 period. A series of growth chamber studies he designed were aimed at determining how environmental factors affected the performance of glyphosate. Results indicate that both low humidity and high moisture stress reduce glyphosate's effect on nutsedge.

Corvallis trial generates herbicide information

A herbicide screening trial was established at OSU's experimental farm in May 1977 to evaluate 14 experimental compounds from seven chemical companies. Thirty seven crop and weed species were used as indicators as well as to generate information concerning general phytotoxicity and crop selectivity. Representative commercial herbicides were included in the trial for comparative purposes to help determine the effectiveness of the new experimental materials. Reports of the results were provided to public (institution) researchers as well as the companies involved.

II. AQUATIC WEED PROGRAM ACTIVITIES

AID aquatic weed program completes second year

A contract between Oregon State University and the University of Florida (Gainesville) to carry out an aquatic weed component of the overall AID weed control systems effort completed two years of operation. U. of F.'s Dr. George Allen leads the aquatic program which linked up with International Plant Protection Center at OSU in early 1976.

The aquatic weed thrust focuses on a dual goal of helping developing countries identify researchable aquatic weed problems and serving as a centralized international repository and distribution center for aquatic weed related information.

Thai aquatic short course presented

The National Research Council (NRC) of Thailand requested (through USAID channels) that the AID-IPPC aquatic project supply technical assistance for developing an aquatic weed control program and training course. The proposed program's scope and size were considered excessive without being preceded by a thorough assessment of the water weed problem in Thailand.

IPPC, responding to the request, recommended an alternative program including a three-week short course and a two-week field assessment of aquatic weeds in Thailand. The NRC withdrew its initial request and submitted a second one incorporating these recommendations. Supplemental funds were requested from, and approved by, AID central programs to conduct the training course and assessment trip.

The training course was organized by the Coordinating Sub-committee on Aquatic Weeds (CSAW) of NRC and conducted at the Royal Irrigation Department (RID) during April 4-22, 1977. Twenty-five representatives of Thai governmental agencies and universities attended the course with instruction provided by a joint U.S.-Thai 11-person team.

The course consisted of lectures during the morning and laboratories or demonstrations during the afternoons. Two one-day field trips were conducted to observe aquatic weed problems in various aquatic systems.

The training course emphasized the "systems ecology" approach and the critical nature of understanding aquatic systems as a whole before considering control measures. Participants were told that aquatic weed problems are the result of serious alterations in the aquatic ecosystem, and that control programs designed for a particular water system should contain steps to correct the alterations causing the problem.

Lectures also stressed that the control measures cited were currently being developed or practiced in the U.S. and that these techniques provide a foundation upon which a modified program could be devised for use in Thailand.

Team carries out assessment study

A team of five technicians--Drs. George Allen and Frank Conklin (IPPC), and three Thai representatives--conducted a two-week assessment trip to provide on-site evaluation of the major aquatic weed problems throughout Thailand. The group aimed to: determine the extent of aquatic weed problems; identify procedures for assessing their economic impact; and formulate a plan of action for control programs.

A report covering the Thai project activities was prepared and 47 copies disseminated.

Experts visit Asian grass carp sites

In April 1977, the IPPC Aquatic Weed Program retained Drs. William M. Bailey of the Arkansas Game and Fish Commission and William T. Haller of the University of Florida as consultants to visit Japan, the Philippines, and Taiwan to observe sites where the Chinese grass carp is reported to spawn naturally.

The Chinese grass carp, *Ctenopharyngodon idella*, has become the object of intense investigation in the U.S. because of its ability to consume two to three times its weight in submersed aquatic vegetation. As a biological control agent for noxious aquatic weeds, it has the advantage over chemical herbicides of leaving no potentially harmful residues. According to some studies, the grass carp eats 35 species of aquatic vegetation.

Despite the grass carp's potential usefulness, authorities have been cautious to introduce it into U.S. waters. The possibility that carp might decrease important native game fish populations through competition has caused some states to outlaw its importation. An important factor in the controversy concerns the grass carp's ability to spawn outside its native habitat, i.e., mainland Southeast Asia. Although never known to spawn naturally in the United States (temperatures over 20°C and a strong current flow are required), the fish has been artificially bred in Arkansas.

The consultants found that the only location outside mainland Asia where the grass carp has actually been confirmed to spawn naturally is in Japan's Tone River. After extensive exchange of information with scientists in the countries visited, Drs. Bailey and Haller concluded that grass carp probably will eventually spawn in the U.S. However, they believe it highly unlikely that it will ever become excessively abundant.

Aquatic plant short course held

Ten participants representing Indonesia, Thailand, Fiji, Egypt, Syria, Sudan, Portugal, and Tanzania attended a short course entitled "Identification, Control and Utilization of Aquatic Plants" during August 1 to September 23, 1977, at Gainesville. Dr. Allen was technical leader for the U.S. Department of Agriculture international training program sponsored course. Dr. Stanley Miller, IPPC Director, served as one of the instructors.

Discussion topics covered basic biology of aquatic plants, the aquatic ecosystem, control measures, utilization, and socio-economic impact. Twenty-seven aquatic plant experts from Florida and the U.S. assisted in the presentations. Emphasis was placed on laboratory and field work as well as on classroom training. Participants also contributed to the course by presenting the aquatic weed problems of their respective countries.

The participants took two extended field trips to view Florida's aquatic weed problems and to visit the state's leading researchers. In addition, participants attended the Florida Department of Natural Resources Annual Aquatic Plant Research Review Conference.

The information retrieval system of the Aquatic Weed Program provided participants with approximately 250 publications, according to their various particular interests. Each participant received a collection of 60 slides of aquatic weed problems around the world.

Information retrieval system expands

In order to provide researchers and weed control officials worldwide with a continuing source of information on all aspects of fresh water macrophytes, IPPC-Florida developed, and has continued to expand and refine, an international literature retrieval system. Over 10,000 references (books, journal articles, abstracts and unpublished reports) have been cataloged. System 2000--a software package--has been used to computerize the system, and bibliographies on selected topics are now available.

Each entry has been indexed according to one or more of the following categories:

BIOLOGICAL CONTROL	ECOLOGY	ECONOMICS
animals	lakes	INTEGRATED CONTROL
fish	marshes	MECHANICAL CONTROL
insects	ponds	MORPHOLOGY
manatee	rivers	PHYSIOLOGY
pathogens	swamps	REPRODUCTION
plants	bogs	REVIEW
snails	primary production	TAXONOMY
CHEMICAL CONTROL	plant succession	
CULTURAL CONTROL	eutrophication	

All material is cross-indexed according to author, year, and plant species discussed, as well as the above categories. Computer print-out reference lists can be obtained on a single topic (e.g., biological control), a plant (e.g., *Hydrilla verticillata*) or a combination (e.g., biological control of *Hydrilla*

verticillata). Once a basic bibliography of a selected topic is obtained and sent, quarterly updates can be made available to requesting parties.

To date, bibliographies are compiled and typed manually. During the year of this report, nine bibliographies were compiled and sent to requestors in 12 countries: Australia, Brazil, Canada, El Salvador, Fiji, India, Iran, Mexico, New Caledonia, Papua New Guinea, Portugal, and the United States.

Variety of publications distributed worldwide

During the report year 128 copies of the circular Hydrilla, A New and Rapidly Spreading Aquatic Weed Problem, by William T. Haller, were distributed to individuals and institutions in 25 countries. Thirty-six copies of the National Academy of Sciences publication Making Aquatic Weeds Useful were provided to individuals in 11 countries as were 244 copies of miscellaneous other publications to requestors in 12 countries. Appendix III contains a country-by-country summary of distribution.

III. TECHNICAL ASSISTANCE RELATED ACTIVITIES

● CENTRAL AMERICA ●

OSU team takes part in short courses

A series of short courses involved the two OSU weed scientists assigned to the AID-ROCAP regional weed program centered at the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) at Turrialba, Costa Rica.

On the basis of a highly successful short course at León, Nicaragua, organized by the Universidad Nacional Autónoma de Nicaragua, in March 1977, the OSU weed scientists were invited to present the weed science section of another course at León during February 1978. The latter included trainees from the Dominican Republic, Peru, Costa Rica, and Mexico, as well as Nicaragua.

Thirty one participants took part in a one week weed control short course at Managua in October. The OSU team presented material organized under 20 categories ranging from weed control methods to research techniques.

The most recent short course, a week long event in March 1978, sponsored by the National Institute of Agricultural Research - Panama (IDIAP), drew 21 trainees representing IDIAP, two national agricultural banks, and the Panamanian Ministry of Agricultural Development.

Panamanian weed program reviewed

OSU research agronomist Myron Shenk travelled to Panama in early June and again in late September 1977. During the latter trip he visited several weed research sites, helped establish an 18-treatment weed control experiment at Bayano, and met with a number of Panamanian and AID officials. The trips stemmed from interest in Panama for reviving a national weed control research program.

Mr. Shenk observed that the pesticide application equipment available for research was inadequate and that the organization of experiments needed to be improved. He noted that intensive training was needed for all personnel involved in weed research, particularly in connection with handling and application of herbicides.

Dr. Eduardo Locatelli and Mr. Shenk met with an official of Honduras' cropping system program to assist with weed control aspects, and discussed weed management systems with a Guatemalan program technical director.

Series of seminars presented

Both OSU weed specialists presented a number of seminars during the report period. Seminars in Panama included: weed management; and research methodology and weed control experiments. Several seminars were offered to CATIE staff on a variety of weed-related topics.

Dr. Locatelli and Mr. Shenk have each been designated as major professors for graduate students at CATIE. Thesis projects in weed management for both students were planned and field work begun.

Oregon State University was honored by a request of CATIE director Dr. Santiago Fonseca Martínez that Dr. Locatelli assume a part-time administrative position with CATIE. OSU agreed to a plan whereby Dr. Locatelli became CATIE sub-director of training and technical assistance while retaining a reduced presence on the weed program.

● PHILIPPINES ●

AID-OSU team takes part in information events

AID-OSU weed specialists Dr. Philip Motooka and Herb Fisher took part in a variety of information dissemination activities during the year including presentations, seminars, and training courses. Dr. Motooka presented a lecture June 20, 1977, during a BPI training program at the Maligaya Rice Research and Training Center at Nueva Ecija. On August 11th Mr. Fisher and Dr. Motooka presented a joint four-hour seminar to 30 participants at a UPLB rice training course for extension workers. Pest management and techniques for developing weed control systems for small food producers were covered.

Later in the year the OSU scientists presented a two hour seminar, "Pest management and general weed control," to the Central Mindanao University Crop Science Society. Dr. Motooka was invited to lecture at three BPI training courses. He also conducted a two day mini-workshop on research methods for 15 participants at BPI's Maligaya, Nueva Ecija research station.

Mr. Fisher presented several lectures and demonstrations--including knapsack sprayer calibration--to a Central Mindanao University (CMU) 22-student class. He also addressed 130 CMU staff, students, and Crop Science Society members on the topic of weed control research progress.

Mindanao workshop plans formulated

Plans were discussed and solidified for the first Mindanao weed science workshop with the event scheduled for early April at Central Mindanao University (CMU), Musuan, Bukidnon. CMU, the National Crop Protection Center, and industry joined AID and OSU to organize the gathering, first of its kind in the region.

Lecturers were drawn from several educational institutions, regional crop protection centers, and private firms. A maximum of 25 trainee positions was established, allotted among eight entities.

A complete day-by-day, hour-by-hour course program was drawn up beginning at 7:30 a.m. daily and running into the evening hours. The workshop's basic objectives were set as: providing information and background on methods of executing effective field weed control trials; and, generating a forum for the interchange of ideas among trainees and session leaders.

A three-to-four week major weed science course also has been planned for January-February 1979 under the joint auspices of PCARR, NCPC, and AID-OSU.

OSU scientists participants at APWSS

Both OSU agronomists attended the 6th Asian-Pacific Weed Science Society (APWSS) gathering at Jakarta, Indonesia during July 1977. As APWSS newsletter editor, Dr. Motooka met with the group's executive committee. Mr. Fisher was appointed chairman of a committee on weed control research techniques, chaired two sessions, and presented an overview paper.

Approximately 270 people from throughout Asia and the Pacific, plus FAO and other organizations, heard 91 presentations on weed research and education. A special workshop that was held, Weed Control on Small Scale Farms, focused on weed problems and the challenge of developing and delivering appropriate control technology to small farms.

Under a travel grant from the East-West Center Food Institute, Dr. Motooka attended a Workshop on Crop Surveillance for Pest Management at the Center's facility in Honolulu. Approximately 45 agricultural scientists and administrators representing 15 countries and numerous U.S. states discussed the current status of crop surveillance and promising new innovations in the discipline.

●CORVALLIS●

Information dissemination activity stressed

Publication of two major titles by the project, in conjunction with the International Plant Protection Center, highlighted the report year. The Spanish translation of a 1976 publication appeared as Manual de Campo para Investigación en Control de Malezas, a 64-page effort believed to be the only such compendium of information available in Spanish.

The other title was also both in Spanish and an update. This was the second edition of Bibliografía Parcial de Investigación sobre Malezas y su Control para América del Sur, América Central, el Caribe y México, 1942-1976. The work contains nearly 4,000 entries and four years of listings previously omitted, or approximately one-third new material.

The project/IPPC (Corvallis) continued to distribute other publications as well as announce and begin distribution of the two new titles mentioned. Appendix IV contains a listing of all titles with distribution by country of receipt.

INFOLETTER begins ninth year of publication

The IPPC INFOLETTER, first issued in February 1970, entered its ninth year of publication as a free periodical concerned with weed control and provided to all recipients requesting it. IPPC publishes the newsletter with major financial support from the AID/OSU project. During 1977-78 report year four issues were sent to nearly 4,000 recipients in more than 120 countries. (See Appendix II for details of distribution by country).

A sampling of news items that appeared in the four issues includes:

- New book names world's worst weeds
- OSU-AID team begins Philippine assignment
- Crop protection center launched
- U.S. agency offers range of agricultural programs
- Biocontrol pace quickens
- Project meshes agronomic, socio-economic research
- Weeds top India crop loss list
- Weeding labor need blocks crop increase
- Pest management degree offered
- AID assigns new manager
- Field gear for weed research: what's needed?
- Starch helps herbicides
- Weeds poison livestock

The item on field gear for weed research was based on a new project publication, A List of Suggested Equipment and Facilities to Support a Weed Research Program. The list grouped items under several headings including facilities, field equipment and tools, and protective gear.

Each category was subdivided into "minimum," basic items believed to be absolutely essential to a weed research effort and "optimum," those items that would be a welcome though not mandatory addition.

One month after being mentioned in the February 1978 issue of INFOLETTER, the List had been provided in response to over 100 requests.

The article "Biocontrol pace quickens," the lead item in the September 1977 INFOLETTER, was reprinted unchanged as the lead feature in the January/February 1978 issue of International Pest Control from the U.K.

Each issue of INFOLETTER continues to carry both "In Print" and "Dates and Events" sections listing items believed to be of interest to the international weed science community.

An additional feature in most issues focuses on equipment items that could be useful to LDC agriculture or agricultural research programs. Several knapsack spray applicators (both manual and powered) plus small tractors were included during the report year as well as a round-up of hand-held spinning disc applicators now on the market including the solar

powered unit developed at the International Institute of Tropical Agriculture, Ibadan, Nigeria.

Sixteen equipment items were mentioned during the year as was a summary of listings for the two previous years. These generated 119 requests from 37 countries for manufacturer names and addresses; many requests stated an interest in more than one item.

Two State of Oregon weed leaflets briefly mentioned in the February 1978 INFOLETTER resulted in 62 requests as of March 31, 1978, with requests still being received, according to State officials.

The INFOLETTER mailing list is highly dynamic as might be expected. A review of several countries (with large numbers of recipients) was carried out using notices in appropriate languages. As a result, disinterested parties were removed from the mailing list. Over 100 requests to be added to the mailing list were received and processed during the year.

Scholarly publications receive support

The project not only provided an earlier monetary grant to support research, but also assisted with distribution and publicity for a landmark publication. The work, The World's Worst Weeds, Distribution and Biology, by Drs. LeRoy Holm, Donald Plucknett, Juan Pancho, and James Herberger, stands as a unique international reference published through the University of Hawaii Press for the East-West Center's Food Institute. Descriptions of 76 weed species are presented in full detail with emphasis on the 18 most destructive species in order of their impact on world agriculture. Taxonomic data is supplemented by world distribution maps.

On another front, IPPC (with project support) commissioned preparation of a monograph focusing on weed competition, that is, the existence and extent of crop growth reduction attributable to weeds. Professor Robert L. Zimdahl of Colorado State University undertook the effort to produce a definitive compilation of world data.

By December 1977, Dr. Zimdahl had assembled nearly 400 pertinent references. He expects to obtain and integrate additional items in the final version due to be completed late in 1978 and then published the following year.

Reprint series remains popular

IPPC Papers, a series of free reprints concerning various phases of weed science made available through IPPC with project support, grew in popularity. Two titles were added to the series:

Purple nutsedge: tropical scourge
The beautiful blue devil (water hyacinth)

IPPC distributed 1,139 copies of the various papers during the year, a 62% increase over last year.

Project receives requests for assistance

A variety of requests for assistance and cooperation were received in addition to requests for publications and reprints. There were three requests for project personnel to visit overseas (non-project) sites, 13 requests for formal training in weed science at Oregon State University, one for informal training, and eight inquiries regarding visits to OSU to review the project.

Project personnel were asked to edit an FAO weed control manual, an industry article, and a potential International Weed Science Society (IWSS) publication. There were 27 requests for technical information such as specific weed control practices and equipment capabilities or characteristics.

Project collaborates with USDA/SEA

The project was contacted by a USDA/SEA weed scientist regarding the supply of materials for a new PL-488 project, All-India Coordinated Research Program on Weed Control (IN-ARS-47). The requested publications were supplied and, reportedly, well received. The program officially started April 1, 1978 with Indian principal investigators at six locations.

Nutsedge descriptive pamphlet published

Work initiated and conducted by project weed specialist Rick Chase during his stay in El Salvador formed the basis for an 18-page, full color pamphlet (in Spanish) dedicated to the problems and control of nutsedge (Cyperus rotundus L.).

The publication, published by the Centro Nacional de Tecnología Agropecuaria (CENTA) in El Salvador, was co-authored by CENTA weed specialist Eduardo Vides. The project was promised 300 copies for distribution worldwide.

Visitors welcomed at project

The AID/OSU and U. of F. weed project staffs continued to welcome international visitors for interchange of ideas and information. The director of the Central Plant Protection Training Institute at Hyderabad, India, spent a week at Corvallis culminating in his presentation of an informative seminar.

The training officer from IITA (International Institute of Tropical Agriculture) Ibadan, Nigeria, met with the project to discuss mutual interests and the possibilities of establishing a training-education link, as did a training representative from CIMMYT (International Maize and Wheat Improvement Center), Mexico.

The officer in charge of herbicide testing at a major Japanese research station obtained industry support to visit and observe research procedures at IPPC for two weeks. The contact initially developed at the Asian-Pacific Weed Science Society meeting.

Negotiations were begun to host Indonesian weed scientist M. Sundaru for a 6-week training program at Oregon beginning in May 1978. Plans called for both theoretical and practical elements in his program including responsibility for an entire weed control trial from design through result evaluation.

Project collaborates with weed groups

IPPC was officially named as the secretariat for IWSS (International Weed Science Society) resulting from a mail poll of, and vote by, IWSS members. The project assisted IWSS in collecting information,

translating, publishing, and distributing the IWSS newsletter. Project weed scientist Larry Burrill was elected first IWSS secretary-treasurer.

Project members, as a service to APWSS (the Asian-Pacific Weed Science Society), collected information, designed, and printed a booklet commemorating the Society's ten years of existence.

Project members attend conferences

A chronological listing of the major weed science conferences and meetings attended by project personnel follows:

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>Participant</u>	<u>Activity</u>
July 77	Asian-Pacific Weed Science Society meeting	Jakarta	Burrill Fisher Motooka	Motooka serves as Society editor; Fisher presented paper and chaired two sections; Burrill chaired one.
July 77	East-West Workshop on Crop Surveillance for Pest Management	Honolulu	Burrill Miller Motooka	Participants
July 77	Aquatic Plant Management Society Annual Meeting	Minneapolis	Monsour	Described literature storage and retrieval system
Aug. 77	American Agricultural Economists Association	San Diego	Miller	Participant
Sept. 77	Annual Aquatic Plant Research Review Conference, Florida Dept. of Natural Resources	Orlando	Allen	Presented two papers.
Jan. 78	Sociedad Colombiana de Control de Malezas y Fisiología Vegetal (COMALFI), and Asociación Latino-Americana de Malezas (ALAM)	Cali	Locatelli Shenk	Each presented a paper.
Feb. 78	Weed Science Society of America annual meeting	Dallas	Burrill	Met with international affairs committee.
Mar. 78	Western Society of Weed Science annual meeting	Reno	Burrill Chase Fraser	Burrill named president-elect.

IV. OTHER ACTIVITIES

18-month project review conducted

Both research and technical assistance program components were intensively scrutinized during the 18-month review conducted at Corvallis on August 25 and 26. Keith Byergo, project manager, represented AID. Warren S. Shaw, ARS/USDA National Program Staff weed scientist, completed the two-man review team.

Project staff members presented a series of brief overviews concerning the historical background and progress of the program, the status of both research and technical assistance contracts, including the socio-economic and aquatic components, and a detailed current financial report.

The project review team circulated evaluation issues papers for both contracts. The OSU project group prepared detailed responses and submitted them for consideration by the team.

A broad ranging discussion during the review focused on future activities of the weed systems program beyond the current contracts (which expire March 31, 1979). The project's interest in exploring potential involvement in certain regions of Africa was presented to the review team and received a favorable response.

Document outlines interest in Africa

The AID/OSU weed program, with a long (10 year) involvement in Latin America and a shorter formalized presence in Asia, prepared a working document expressing strong interest in extending weed control systems research and technical assistance to certain regions of Africa.

The 11-page proposed African extension noted the preponderance of small farms and the related socio-economic problem surrounding weed control, labor, costs, and technical uplift. The proposal suggested program objectives similar to those currently guiding research and technical assistance activities:

1. Identify optimal weed control technologies for representative small- and medium-size farms in selected African countries;
2. Evaluate the socio-economic impacts of these technologies for the farm and associated labor pool;
3. Estimate efficiency trade-offs to achieve other societal goals such as greater rural employment and a more even distribution of income.

Crop protection consortium forms

OSU received an invitation to become a charter member of the 10-institution Consortium for International Crop Protection (CICP). During the year Dr. Miller attended meetings of the Ad Hoc Advisory Committee to the University of California/AID pest management program where the formation, scope, and objectives of CICP were discussed extensively.

Work Plans

Activities scheduled and anticipated for the 1978-79 project year (through March 31, 1979) include the following:

Central American Regional Program (Costa Rica)

1. Continue investigation of preplant vegetation control systems and investigate possible fertilizer-weed control systems interaction. Twelve separate experiments (at three locations) will be installed.
2. Test promising control systems under small farm production conditions.
3. Support OSU agricultural economists in the evaluation of the new technologies.
4. Continue to collaborate and interact with, and provide assistance to, colleagues and counterparts within the structures of CATIE and ROCAP.
5. Travel to various Central American or Caribbean nations, as requested, for consultation, advising, and training. Short courses will be given in El Salvador, Honduras, and Panama, as well as Costa Rica.
6. Test preplant vegetation control system as a tool for reforestation.

ASIAN REGIONAL PROGRAM (PHILIPPINES)

1. Continue field experiments--substitution trials, herbicide selectivity, and alternative weed control systems in Central Luzon, Mindanao, Cavite, and Los Baños.
2. Continue on-job training of NCPC counterpart personnel, as well as personnel from CLSU, UPLB, IIRR, and CMJ.
3. Support OSU agricultural economist to evaluate the socio-economic impacts of promising weed control technologies.
4. Encourage the proper use of herbicides in the Philippines and increase the general awareness of environmental hazards of unwise chemical use.
5. Conduct four short courses and one major weed control workshop; locations will be Central Luzon, Mindanao, and Los Baños.
6. Serve on the Board of Directors and the Editorial Review Committee of the Weed Science Society of the Philippines.

SOCIO-ECONOMIC COMPONENT

1. Complete the intensive economic analysis of data obtained from the Costa Rican farmer survey.

2. Complete economic analysis of field experiments to identify those weed technologies which show greatest economic potential in Costa Rica.
3. Appraise the compatibility of promising experimental weed control technologies with existing on-farm practices to determine their economic feasibility. Evaluate socio-economic impacts of promising weed control technologies from the social as well as the private perspective. A quantitative economic model may be used for this purpose.
4. Analyze the weed control component of complex multiple cropping systems in the upland area of the Philippines. Farmer survey data from a variety of sources will be evaluated.
5. Develop a quantitative economic model of multiple cropping in the Philippines with appropriate weed control components from which alternative weed control technologies can be evaluated, both from a private as well as a social viewpoint.
6. Prepare technical and general audience papers discussing project results.

AQUATIC WEED COMPONENT

1. In response to a request received through USAID/ACCra, Dr. Allen will travel to Ghana to help assess aquatic weed problems;
2. The USDA sanctioned international training program short course entitled "Identification, Control and Utilization of Aquatic Plants," will be held for the second year at Gainesville during July and August with Dr. Allen serving as technical leader;
3. The computer-based information storage and retrieval system will be expanded and refined;
4. Work will begin on a manual for aquatic weed control technology suited for developing countries.

SUPPORTING RESEARCH

1. New CDA application equipment will be evaluated in terms of its ability to serve small farm needs.
2. Herbicide coating of beans will be evaluated, in cooperation with the USDA, in two locations in Central America.
3. In Corvallis promising herbicides will be evaluated.
4. Research will continue on the proper use and care of backpack sprayers. Simple improvements will be tested and suggested for use by small farmers.
5. Publish research on environmental factors effecting the action of glyphosate to control of purple nutsedge (Cyperus rotundus).

INFORMATION ACTIVITIES

1. Continue collection of information and preparation of a manuscript for a HANDBOOK OF SMALL PESTICIDE APPLICATION EQUIPMENT with a goal of publishing and commencing distribution in early 1979.
2. Publish and disseminate no less than four issues of the IPPC INFOLETTER.
3. Complete and publish review of world literature on weed competition.
4. Continue distribution of recently issued publications in response to requests.
5. Continue to service requests for technical and general information.

OTHER ACTIVITIES

1. Continue to stand in readiness to respond affirmatively to request for on-site assistance, advising, or consultation in LDCs.
2. Continue to serve as secretariat for IWSS.
3. Participate in regional and international society meetings as officers and through presentation of scientific papers.

Financial Review

The following two tables list the expenditures and obligations related to the program's broad work areas during the period April 1, 1977, through March 31, 1978.

Table A

Weed Control Systems for Representative Farms
in Developing Countries (AID/ta-C-1295)

RESEARCH

Classification	Corvallis: Head- quarters	Central America	Southeast Asia	Corvallis: Publications	Line Totals
Salaries and Wages	\$53,125.15	\$23,829.93	\$19,456.58	\$ 4,800.17	\$101,211.03
Fringe Benefits	8,250.37	4,094.99	3,340.75	752.15	16,438.26
Indirect Costs					
On-campus	27,516.40	-	-	2,211.93	29,728.33
Off-campus	-	7,935.17	12,168.14	-	20,103.31
Total	27,516.40	7,935.17	12,168.14	2,211.93	49,831.64
Allowances	-	4,445.49	13,189.55	-	17,635.04
Travel and Transportation	10,554.11	4,475.58	17,970.22	-	32,999.91
Other Direct Costs	1,279.90	1,382.89	958.34	132.91	3,754.04
Equipment, Vehicles, Materials and Supplies	2,107.83	446.13	4,406.64	332.64	7,293.24
Totals	\$102,833.76	\$46,610.18	\$71,490.22	\$8,229.80	\$229,163.96

Table B

Weed Control Systems Utilization for
Representative Farms in Developing Countries (AID/ta-C-1303)

TECHNICAL ASSISTANCE

Classification	Corvallis: Head- quarters	Central America	Southeast Asia	Corvallis: Publications	Line Totals
Salaries and Wages	\$55,759.57	\$18,298.46	\$19,704.83	\$24,046.73	\$117,809.59
Fringe Benefits	8,699.91	2,819.47	3,660.02	3,770.36	18,949.76
Indirect Costs					
On-campus	28,267.28	-	-	13,455.59	41,722.87
Off-campus	-	7,567.16	10,253.75	-	17,820.91
Total	28,267.28	7,567.16	10,253.75	13,455.59	59,543.78
Differential and Allowances	-	5,767.47	11,064.46	-	16,831.93
Travel and Transportation	8,157.02	9,652.01	11,680.37	-	29,489.40
Other Direct Costs	1,120.06	1,915.45	752.98	3,827.67	7,616.16
Equipment, Vehicles, Materials and Supplies	3,307.99	399.07	2,027.17	5,093.65	10,827.88
Aquatic weed sub-contract	91,618.54	-	-	-	91,618.54
Totals	\$196,930.37	\$46,419.09	\$59,143.58	\$50,194.00	\$352,687.04

Appendixes

I. BIBLIOGRAPHIC LIST

- | | | | |
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II. DISTRIBUTION OF INFOLETTER

Abu Dhabi 1	Ghana 24	Peru 73
Aden 1	Greece 24	Philippines 139
Afghanistan 13	Guatemala 8	Poland 9
Algeria 3	Guinea 1	Portugal 7
Angola 2	Guyana 3	Romania 2
Antigua 2	Haiti 3	St. Kitts 1
Arab Rep. of Egypt 11	Honduras 18	Saudi Arabia 6
Argentina 131	Hong Kong 4	Scotland 4
Australia 63	Hungary 4	Senegal 18
Austria 5	India 183	Seychelles 2
Bahamas 1	Indonesia 86	Sierra Leone 4
Bangladesh 4	Iran 12	Singapore 13
Barbados 2	Iraq 3	Solomon Islands 2
Belgium 12	Ireland 7	Somali 1
Belize 8	Israel 18	South Africa 2
Benin 1	Italy 27	South Vietnam 11
Bermuda 1	Ivory Coast 5	Spain 14
Bolivia 29	Jamaica 11	Sri Lanka 15
Botswana 3	Japan 53	Sudan 13
Brazil 186	Jordan 8	Surinam 4
Brunei 3	Kenya 28	Swaziland 2
Bulgaria 2	Korea 15	Sweden 16
Burma 3	Laos 7	Switzerland 26
Cameroon 5	Lebanon 7	Syria 6
Canada 108	Lesotho 2	Tahiti 3
Canary Islands 1	Liberia 8	Taiwan 8
Cape Verde Islands 1	Libya 2	Tanzania 13
Cayman Islands 1	Malagasy Rep. 1	Thailand 45
Central African Rep. 1	Malawi 6	Togo 1
Chad 5	Malaysia 59	Trinidad 17
Chile 37	Mali 2	Trucial States 1
China 1	Malta 3	Tunisia 4
Colombia 92	Mauritania 2	Turkey 15
Comores Islands 2	Mauritius 2	Uganda 5
Costa Rica 68	Mexico 56	Upper Volta 5
Cuba 1	Morocco 3	Uruguay 22
Cyprus 2	Mozambique 2	United States 1,350
Czechoslovakia 10	Nepal 2	Canal Zone 4
Denmark 10	Netherlands 17	Guam 2
Djibouti 1	New Caledonia 4	U.S.S.R. 4
Dominican Rep. 11	New Guinea 17	Venezuela 53
EDR 1	New Hebrides 2	West Germany 41
Ecuador 46	New Zealand 30	Western Samoa 7
El Salvador 10	Nicaragua 16	Yemen 1
England 120	Niger 1	Yugoslavia 6
Ethiopia 25	Nigeria 38	Zambia 7
Fiji 3	Norway 10	Zaire 3
Finland 9	Pacific Islands 3	
France 27	Pakistan 21	
Gabon 9	Panama 15	TOTAL 3998
Gambia 5	Paraguay 10	

III. WORLD DISTRIBUTION OF AQUATIC PROGRAM MATERIALS

Key

Hydrilla - "Hydrilla, A New and Rapidly Spreading Aquatic Weed Problem," W.T. Haller

Making - MAKING AQUATIC WEEDS USEFUL, sponsored by the National Academy of Sciences

Biblios - Bibliographies

Misc - Miscellaneous publications (articles, books, etc.)

Country	Hydrilla	Making	Biblios	Misc
Arab Republic of Egypt	1	1		25
Argentina	1			
Australia	13		1	
Brazil	3		1	
Canada	1	1		
Columbia	2			
Costa Rica	1			
El Salvador	1		1	
Fiji	1	1	2	53
Indonesia	4	1		25
India	11		1	
Iran		1		
Japan	1			
Malaysia	3			
Mexico	2			
New Caledonia			2	26
New Zealand	2			1
Papua New Guinea				
Portugal	3	2	4	8
Sudan	1	1		53
Sri Lanka	1			25
Switzerland	1			
Syria	1	1		
Tanzania	1	1		25
Thailand	26	26		25
United States	46		9	1
West Germany	1			
	<u>128</u>	<u>36</u>	<u>21</u>	<u>292</u>

IV. WORLD DISTRIBUTION OF OTHER PUBLICATIONS

Key to Titles

- 1/ Aquatic Weeds: MALEZAS ACUATICAS/AQUATIC WEEDS.
- 2/ Bibliografia: BIBLIOGRAFIA PARCIAL DE INVESTIGACION SOBRE MALEZAS Y SU CONTROL PARA AMERICA DEL SUR, AMERICA CENTRAL, EL CARIBE Y MEXICO, 1942-1976.
- 3/ Field Manual: FIELD MANUAL FOR WEED CONTROL, RESEARCH.
- 4/ PWOCA: MALEZAS PREVALENTES DE AMERICA CENTRAL/PREVALENT WEEDS OF CENTRAL AMERICA.
- 5/ Manual de Campo: MANUAL DE CAMPO PARA INVESTIGACION EN CONTROL DE MALEZAS
- 6/ Trucos: ALGUNOS "TRUCOS" UTILES IN ESTADISTICA/SOME USEFUL TRICKS IN STATISTICS.
- 7/ Weed Seeds: SEMILLAS DE MALEZAS TROPICALES I Y II/ TROPICAL WEED SEEDS I AND II.
- 8/ WW List: A WORLDWIDE CATEGORIZED PARCIAL LISTING FOR MANUFACTURERS OF PESTICIDE APPLICATION EQUIPMENT/UNA LISTA PARCIAL MUNDIAL Y CLASIFICADA DE FABRICANTES DE EQUIPOS PARA LA APLICACION DE PESTICIDAS.

Country	Aquatic Weeds 1/	Bibliografia 2/	Field Manual 3/	PWOCA 4/	Manual de Campo 5/	Trucos 6/	Weed Seeds 7/	WW Lit. 8/
Algeria	--	--	1	--	--	--	--	1
Arab Rep. of Egypt	--	--	--	--	--	--	--	1
Argentina	3	1	10	1	30	2	--	17
Australia	--	--	32	1	--	1	--	14
Bangladesh	--	--	--	--	--	--	--	1
Belgium	1	--	6	1	--	1	--	3
Belize	--	--	2	--	--	--	--	2
Bolivia	1	--	13	3	2	8	8	8
Botswana	1	--	--	--	--	--	--	--
Brazil	1	2	30	6	11	7	9	17
Burma	1	--	1	1	--	1	1	1
Canada	--	--	25	--	1	--	--	26
Canal Zone	1	--	--	1	--	--	--	--
Cayman Islands	1	--	1	--	--	--	--	--
Chad	--	--	1	--	--	--	--	1
Chile	--	--	--	--	1	--	--	--
Colombia	3	3	6	2	23	4	13	416
Comores Islands	--	--	--	--	--	1	--	--
Costa Rica	6	10	38	64	2	5	209	55
Cyprus	--	--	--	--	--	--	--	1
Czechoslovakia	--	--	1	--	--	--	--	1
Denmark	--	--	1	--	--	--	--	1
Dominican Rep.	2	--	1	1	2	--	--	1
Ecuador	--	1	2	1	1	--	--	2
El Salvador	6	1	4	4	3	3	2	7
England	--	1	26	2	1	--	1	18
Ethiopia	3	--	7	1	--	--	2	6
Fiji	--	--	2	--	--	--	--	--
Finland	--	--	1	--	--	--	--	--
France	--	1	8	3	1	--	--	7
Gambia	--	--	2	--	--	--	1	1
Ghana	2	--	4	2	--	--	2	2
Greece	1	--	6	1	--	--	1	--
Guatemala	--	--	8	18	8	--	1	4
Guyana	--	--	2	--	--	--	--	--
Honduras	3	--	6	9	3	2	3	2
Hong Kong	--	--	--	--	--	--	--	1
Hungary	--	--	--	--	--	--	--	1
India	6	--	44	2	--	--	6	80
Indonesia	1	--	29	2	--	1	2	26
Iran	--	--	4	--	--	--	--	2
Iraq	2	--	2	3	--	--	2	2
Ireland	--	--	4	--	--	--	--	--
Israel	--	--	4	1	--	1	--	--
Italy	1	--	7	1	1	--	1	3
								20

Country	Aquatic Weeds 1/	Bibliografia 2/	Field Manual 3/	PWOCA 4/	Manual de Campo 5/	Trucos 6/	Weed Seeds 7/	WW List 8/
Jamaica	--	--	1	--	--	--	--	1
Japan	--	--	--	--	--	--	--	3
Jordon	--	--	1	--	--	--	--	--
Kenya	--	--	4	--	--	--	--	3
Korea	--	--	1	--	--	--	--	--
Lebanon	1	--	4	1	--	--	1	2
Liberia	1	--	3	--	--	--	1	2
Libya	--	--	1	--	--	--	--	1
Mariana Is.	--	--	1	--	--	--	--	--
Malaysia	3	--	15	1	--	--	1	11
Mexico	7	4	67	5	162	9	6	74
Morocco	--	--	100	--	--	--	--	--
Mozambique	--	--	1	--	--	--	--	--
Netherlands	1	--	17	--	--	--	3	4
New Guinea	--	--	1	--	--	--	--	1
New Hebrides	--	--	--	--	--	--	--	1
New Zealand	--	--	9	--	--	--	--	8
Nicaragua	1	--	3	17	13	2	2	5
Niger	--	--	1	--	--	--	--	1
Nigeria	2	--	6	--	--	--	1	58
Pakistan	1	--	7	1	--	1	1	2
Panama	1	1	1	6	2	2	2	3
Paraguay	2	1	--	2	2	2	2	2
Peru	--	1	2	2	7	--	--	31
Philippines	14	7	623	34	10	7	617	186
Poland	--	--	--	--	--	--	--	1
Portugal	1	--	--	--	--	--	--	--
Romania	--	--	1	--	--	--	--	--
St. Kitts	--	--	1	--	--	--	--	1
Saudi Arabia	--	--	--	--	--	--	--	1
Senegal	--	--	6	--	--	--	--	2
Sierra Leone	--	--	1	--	--	--	--	--
Singapore	--	--	2	--	--	--	--	1
Solomon Is.	--	--	2	--	--	--	--	--
South Africa	--	--	1	1	--	--	--	--
Spain	--	--	1	1	2	1	1	11
Sri Lanka	--	--	6	--	--	--	--	6
Sudan	--	--	2	--	--	--	--	6
Swaziland	--	--	2	--	--	--	--	--
Sweden	--	--	1	--	--	--	--	2
Switzerland	1	--	18	--	--	--	1	18
Tahiti	--	--	1	--	--	--	--	--
Taiwan	1	--	3	--	--	1	--	4
Tanzania	1	--	6	1	--	--	1	2
Thailand	1	--	6	1	--	--	1	3
Trinidad	--	--	3	--	--	--	--	3
Turkey	--	--	2	--	--	--	--	1
Uganda	--	--	1	--	--	--	--	--
Upper Volta	1	1	1	--	--	--	1	1
Uruguay	--	1	--	--	2	1	--	1
United States	28	60	36	49	904	17	35	171
Venezuela	2	--	5	3	8	2	3	8
West Germany	9	--	9	1	--	1	2	6
Western Samoa	--	--	--	--	--	--	--	1
Zambia	--	--	2	--	--	--	--	1
TOTALS	125	96	1,329	261	1,202	83	946	1,402

V. PROJECT PERSONNEL

Project staff members for the period covered by this report, or the period indicated are listed below.

Key: R=research; TA=technical assistance; FTE=full-time equivalent

STANLEY F. MILLER, Oregon, director, 50% FTE	R/TA
GEORGE E. ALLEN, Florida, aquatic programs director, 33% FTE	TA
CHRISTIE ANDERSON, Oregon, clerical specialist, April 1, 1977 to February 3, 1978	R/TA
LARRY C. BURRILL, Oregon, weed research specialist/support agronomist	R/TA
RICHARD L. CHASE, Oregon, weed research specialist, 50% FTE	TA
FRANK S. CONKLIN, Oregon, agricultural economist, 50% FTE	R
ALLAN DEUTSCH, Oregon, information/administration	R/TA
HERBERT H. FISHER, Philippines, weed research specialist	R
FRANK FRASER, Oregon, technician	R/TA
CAROLYN JOHNSON, Oregon, secretary, 50% FTE	R
GEORGENA S. KNAPP, Oregon, fiscal/translation	R/TA
EDUARDO LOCATELLI, Costa Rica, weed research specialist, April 1, 1977 December 31, 1977, full-time; January 1, 1978 to March 31, 1978, 25% FTE	TA
THOMAS V. McCARTY, Oregon/Costa Rica, agricultural economist, 50% FTE, June 18, 1977 to March 31, 1978	R
MIMI MONSOUR, Florida, information specialist	TA
PHILIP S. MOTOOKA, Philippines, weed research specialist	TA
DENNIS O'BRIEN, Oregon/Philippines, agricultural economist, 50% FTE	R
SYLVIA SAN MARTIN, Florida, information specialist, June 1, 1977 to March 31, 1978	TA
MYRON SHENK, Costa Rica, weed research specialist	R
MEREDITH SMITH, Oregon, clerical specialist, February 7, 1978 to March 31, 1978	R/TA
CAROLYN A. WALLS, Oregon, secretary	R/TA