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9. ABSTRACT

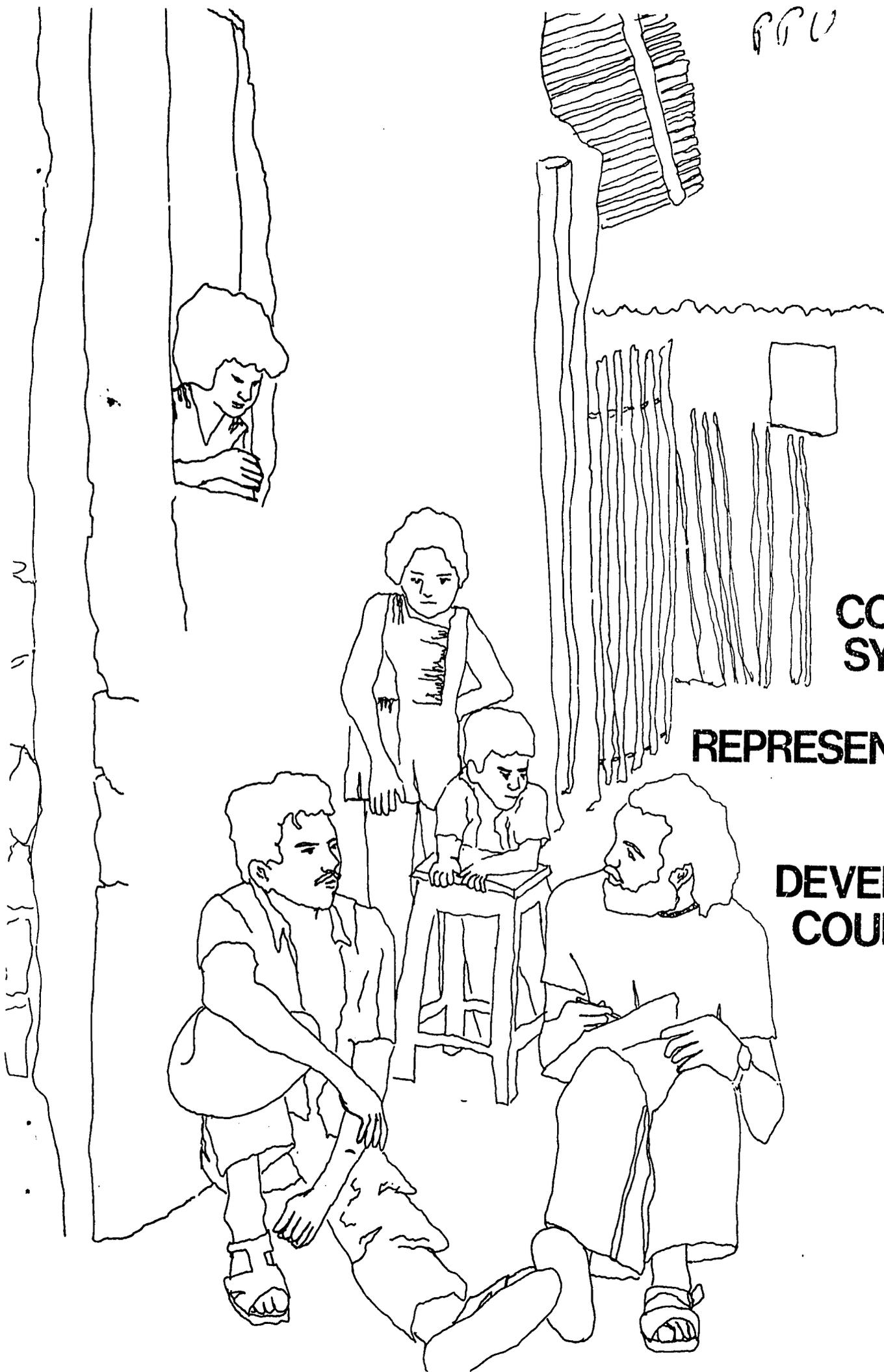
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Oregon
State
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**WEED
CONTROL
SYSTEMS**
for
**REPRESENTATIVE
FARMS**
in
**DEVELOPING
COUNTRIES**

**ANNUAL
RESEARCH
REPORT
1975**



SUMMARIES

A PROJECT SUMMARY

1. Project title: WEED CONTROL SYSTEMS FOR REPRESENTATIVE FARMS IN DEVELOPING COUNTRIES.
2. Contract number: AID/CM/ta-C-73-23
3. Principal investigator: Dr. Stanley F. Miller, International Plant Protection Center, Oregon State University, Corvallis, OR / USA
4. Contract period: March 31, 1973 through December 31, 1975.
5. Period covered by this report: April 1, 1974 through March 31, 1975.
6. Total AID funding of contract to date: \$951,115.
7. Total expenditures and obligations through previous contract year: \$297,014.
8. Total expenditures and obligations for current year: \$331,372.
9. Estimated expenditures for next contract period: \$372,777.

B NARRATIVE SUMMARY OF ACCOMPLISHMENTS AND UTILIZATION

The results of research after one full crop year reflected the project's plural objectives of investigating weed control systems and evaluating their consequent affect on income distribution, employment, and economic efficiency.

The project's team in Brazil, two agronomists and one agricultural economist, established over 1,800 field plots. Preliminary data indicate that, under traditional soil preparation, corn and bean yields were reduced 60-70 percent in the absence of weed control. Timing of manual weeding is critical; one correctly timed hoeing is as effective as the prevalent two manual weedings. Use of herbicides appears both agriculturally and economically questionable.

A survey of 110 farms stratified by size was conducted in the region. These data are presently being analyzed and will provide estimates of many of the needed parameters for the socio-economic models under development.

The use of herbicides in El Salvador, in contrast to Brazil, holds more promise. A herbicide-manual weeding combination appears to be the most economical treatment for corn. Herbicide usage in rice was consistently the most efficient method, while the situation for beans was not clear. One manual weeding in beans seemed to substitute for the recommended rate of herbicide.

Corvallis-based staff continued to provide administrative, logistic, and information support to project field personnel and the world weed research community as well. Project publications, including five issues of a newsletter, were disseminated widely. A weed research "answering service," available to all international agencies and researchers in developing countries, was active. Personnel also participated in seminars and short courses, either developed by the project, or by other institutions. The AID-OSU project will present a weed control workshop at Cali, Colombia, June-July 1975, in cooperation with CIAT.

WEED CONTROL SYSTEMS FOR REPRESENTATIVE FARMS IN DEVELOPING COUNTRIES
AID/CM/TA-C-73-23

ANNUAL RESEARCH REPORT 1974-1975

A. GENERAL BACKGROUND

In many parts of the world the economic position of small- and medium-sized farm enterprises in developing countries has deteriorated with the advancement of agricultural technology. Costs for the requisite inputs (fertilizer, seed, irrigation) have pushed dramatic production increases out of reach, except for more affluent farmers. Economics and market realities have tended to focus the attention of agricultural input manufacturers on the larger more commercialized operations. For many countries the undeniable need to increase production has caused national agricultural development programs to neglect the small grower.

Where new technology has been utilized the weed problem has often been intensified because weeds, as well as crops, responded favorably to improved growing conditions. New cultivars have often been found to be less competitive with weeds than native varieties. Additional studies have shown that in some areas where herbicides have been used for several years weed populations have been observed to shift from relatively controllable broadleaf varieties to more pernicious grassy species that, once established, become extremely difficult to control.

The international community of organizations sponsoring agricultural development research became increasingly concerned over the deteriorating situation. Questions were raised regarding weed control needs and technologies in developing countries such as:

1. to what extent are weeds limiting production, either by their direct competition with crop plants for available nutrients, light, and water, or by their demands for agricultural inputs for control, i.e., land, labor, and capital?
2. given the prevailing constraints--economic, social, and political--- what realistic level of agricultural technology could or should be instituted for weed control?
3. what is the inter-relationship of weed control technology with other advanced agricultural inputs?
4. and, 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 this dialog, the AID-Oregon State University weed control research project, a contractual relationship begun in 1966, was asked to consider the newly 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.

**B. PROJECT OBJECTIVES
AS STATED IN THE
CONTRACT**

Broadly the project constitutes one of many elements in the overall effort to raise food crop production levels. In more specific focus the target is 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.

Other stated objectives include:

- train host country counterparts in appropriate weed control research methodology;
- promote practical and safe usage of herbicides and other pesticides through training programs;
- encourage evaluation of ecological-environmental aspects of weed control systems;
- and foster continued development and maintenance of a worldwide communication/information network for weed control linking the institutions and individuals concerned.

**C. CONTINUED
RELEVANCE OF
OBJECTIVES**

Weed competition remains a critical, and often limiting, factor for increased crop production. The area of land farmed may be restricted by the amount of weed control labor available and the time required for weeding. The constraints can force land out of production. However, certain weed control systems may reduce the need for agricultural labor. Hence, the project's basic goal remains relevant, as weed control technologies must be developed for representative farms and evaluated in terms of impact on social welfare. The research devised to complement these goals is functioning and will require only minor adjustments for the next cropping year.

Project leadership and staff are encouraged by the preliminary data indicating that the research design--a dual thrust of weed control system development and socio-economic assessment--may be useful to AID in planning future assistance programs. Also, the resulting data should provide governments of developing countries (of the geographical areas studied) with a more substantial basis to support rational decisions in formulating agricultural policies.

D. ACCOMPLISHMENTS
TO DATE

Approximately 1,800 plots were laid out, planted, treated, and evaluated--in Northeastern Brazil and El Salvador--for weed research in corn, beans, rice, potatoes, and a joint corn-bean cropping regime. Experimentation was designed to determine what effect (if any) weeds had on the test crops, and to observe the relative efficiency of various weed control systems, along with their relationship to other cultural practices.

The agronomic research, in combination with supplementary economic investigations conducted during 1974, permitted a number of conclusions for weed control systems, both in the Pernambuco *Agreste*, and in El Salvador. These conclusions apply only to the specified regions under the economic conditions prevailing in 1974, or to other areas with essentially similar ecologic and economic conditions.

Because weed control is so closely linked with many variable factors, it is fundamental that primary investigations based on localized conditions yield recommendations that are specific to a particular crop, region, and economic setting. This is a crucial point because of the great variation in the efficacy and cost of different practices under varying climate and soil conditions, as well as capital/labor price relations.

PRELIMINARY OBSERVATIONS - BRAZIL

Based on data obtained, the following preliminary agronomic observations can be made.

1. The traditional weed control practice for corn and beans in the Pernambuco *Agreste* is two hoeings during the crop cycle. However, results during 1974 (a year of above average rainfall) indicated that one well-timed weeding gave equally good yields. This result was observed with both modern (tractor and disc) and traditional (hoe) seedbed preparation. While there is reasonable confidence that one weeding will be sufficient with modern soil preparation, additional confirmation is required both for the case of traditional soil preparation, and under different rainfall regimes. Two weedings improve field aesthetics and may facilitate harvesting under some conditions, but an additional weeding appears to offer little economic advantage when harvesting is exclusively by hand.
2. The importance of weed control during the relatively short critical period of competition, between the second and fifth week of crop life, was demonstrated in both corn and beans. A single weeding at 15-20 days after planting usually resulted in satisfactory yields; in contrast, even two weedings gave reduced yields if the first weeding was delayed 30 days or more after planting.
3. Under traditional soil preparation for the *Agreste* region, corn and bean yields were usually reduced 60-70 percent when no weed control was practiced. Production losses were reduced to about one-half these levels when one or more "weed flushes" were removed by discing over a two to five week period during initial seedbed preparation. Discings eliminated germinating weeds and substantially reduced post-planting weed populations.

4. Partial control systems--mechanical cultivation between rows only, or herbicides within rows only--permitted yields averaging only 46 and 64 percent of bean and corn yields obtained with complete control systems, such as cultivations between and within rows.
5. Under conditions of zero weed control corn generally suffered more than beans. However, when weeds were controlled only between rows (leaving weeds within rows) the reduction in yield was less for corn than for beans.
6. Cultivation by animal-pulled implement or walk-behind power tiller was more suitable for corn than beans. The wider row spacing needed for the implement or tiller reduced bean yields, but not corn yields.
7. Weed control methods utilizing mechanical cultivation or herbicides appeared less satisfactory for intercropped corn-and-beans than in the same crops grown alone. This is due to the problem of plant and row spacing in mixed crops and to the relatively few high cost herbicides possessing acceptable selectivity for both corn and beans under *Agreste* conditions.
8. Chemical weed control was more promising in corn than in beans. Light soils and erratic rainfall, interspersed with occasional intense down-pours, characterize the *Agreste* and combine to increase the possibility of phytotoxicity from herbicides that are normally selective in beans. Alachlor, linuron, and several other products caused substantial damage to beans. Other products were more promising and are being tested again. Lower herbicide rates are advisable in beans under these conditions. High selectivity and acceptable weed control were obtained with most of the herbicides tested in corn.
9. Satisfactory weed control in corn-and-beans was obtained with the following methods, which did not result in statistically significant yield differences: a) hoeing; b) mechanical cultivation between rows complemented by hoeing within rows; c) use of selective herbicides at appropriate rates. Herbicides followed by mechanical or manual control did not produce significantly superior yields than either chemical or hoeing-mechanical methods alone.

Graphs in Appendix VII support these conclusions and are useful in view-treatment effects.

Research and evaluation leads to the following preliminary economic conclusions:

1. Under ecological and economic conditions observed in the Caruaru, Brazil area, the most economical (highest returns over costs) weed control systems for monoculture beans and intercropped corn-and-beans was a single, well-timed hoeing.
2. In areas of heavy weed infestations (higher than those observed on the IPA Station during 1974) where two well-timed weedings are required to give effective control, the most economical system for beans in monoculture or intercropped with corn is to follow the initial soil preparation with cultivation by an animal-drawn implement to remove a "weed flush" before planting, and then employ a single well-timed hoeing during the regular crop cycle. However, if this system was not practical (for example, because it led to an excessive delay in planting during dry years), the most economic system would be the traditional practice of two hoeings during the crop cycle.

Substitution of an animal-drawn cultivator for tractor-pulled disc in the removal of "weed flushes" requires further study.

3. Under existing conditions in the Pernambuco *Agreste*, herbicides are a comparatively expensive method of weed control in beans or corn-and-beans intercropped. The abundance of low cost, unskilled labor in the area, the relatively high prices of herbicides selective for beans, and the fact that one or two weedings are sufficient for effective weed control all are contributing factors.
4. Cultivation by animal-drawn implement, supplemented by within-row hoeing, was an uneconomical weed control system for beans, either alone or planted with corn, due to the marked reduction in yields caused by the wider row spacing necessary for use of the conventional animal-drawn cultivator. In monoculture corn, rarely encountered in the area, the cultivation-hoeing combination was the most profitable system under situations where one weeding per season was sufficient.
5. Under conditions of heavy weed infestation, normally requiring two weedings, the most profitable system for corn would be the removal of a "weed flush" with an animal-drawn cultivator before planting and a single cultivation with supplementary within-row hoeings during the crop cycle. In the event this system was not practical, the second most profitable system for monoculture corn would be the application of a recommended pre-emergence herbicide; e.g. simazine (1.5 kg a.i./ha), atrazine (1.5 kg a.i./ha), or linuron 0.75 kg a.i./ha).

In addition to the economic considerations cited above, there are other constraints to the use of herbicides by the majority of small- and medium-sized farmers in this region of Northeast Brazil. Some of the most important are:

- a very low level of education among the rural population;
- insufficient personal capital or easily accessible credit for the purchase of application equipment and chemicals;
- high risk due to rainfall variability, high incidence of disease and insect damage, and an unstable market which combine to discourage substantial financial outlays for modern inputs.

From a broader societal perspective other criteria may be involved, in addition to farm-level partial budgeting profitability, such as overall farm (or national) resource use efficiency, rural employment-unemployment effects, and income distribution implications within the rural community, any of which could influence the choice of weed control technology. In labor-abundant areas such as the Pernambuco *Agreste* where underemployment is common, the premature adoption of labor-displacing technology--herbicides or tractor mechanization--could aggravate already serious social problems.

In order to facilitate partial analysis of these issues, the project designed and administered a survey in the Caruaru area. The survey sampled the farm population and the associated agricultural labor pool; the results will provide coefficients for production, labor availability, consumption, and human health for the socio-economic models. The models will then be used to trace the consequences of alternative farm and regional decisions on

a variety of decision parameters such as efficiency, income distribution, and employment.

Farms were stratified by size, a sample segment identified, and 110 questionnaires completed. Since almost all agricultural labor comes from small farms, it was not necessary to take a separate survey for the labor pool. The data have been partially analyzed and should be completely summarized within the next few months.

An interesting observation can be made from Table 1 of Appendix VII. From Brazilian statistical data it is observed that both the value of production produced and sold per hectare decreases as the size of the farm increases. The smallest farms probably use the poorest soils. Care must be exercised by the government in encouraging the combining of small farms in an attempt to increase productivity.

PRELIMINARY OBSERVATIONS - EL SALVADOR

In contrast to Northeastern Brazil, the use of herbicides in El Salvador appeared to be more promising.

- a) The most economical treatment for monoculture corn was the combined use of butylate and atrazine, a single hand cultivation, and the recommended fertilizer rate.
- b) The situation for monoculture beans was less clear. One manual cultivation appeared to substitute for the use of the recommended level of herbicide (EPTC 1.5 kg + linuron 0.5 kg). Both were equally efficient and economical.
- c) The use of fertilizer in beans, and its relation to weed control, was not consistent nor clear and needs further investigation.
- d) The use of herbicides in rice was consistently shown to be the most economical weed control system; manual weeding did not effectively replace herbicides. Also, a positive interaction existed between the use of herbicides and plant population and fertilizer.

Survey work has not started in El Salvador due to the delayed arrival of the project agronomist and the necessity of his devoting full time to the agronomic phase of planned research.

The foregoing project observations are preliminary and based on only one year of research under a fixed set of environmental conditions. Past experience in other areas has shown that the relationship between weeds and crops is highly dependent on environmental conditions.

OTHER PROJECT ACTIVITIES

● Review of Thai Proposal

At the request of AID/Washington, two project staff members visited Thailand to review, discuss, and evaluate a proposal to establish a National

Weed Science Research Institute (NWSRI) within the Thai Department of Agriculture. At present in Thailand weed control is estimated to consume from 15-50 percent of the total productive man-hours devoted to crop production, which lends support to the creation of NWSRI.

The AID-OSU team prepared an extensive written review defining parameters of operation and detailing the possible AID input as well as the anticipated personnel, supplies, and equipment needed initially. A tentative time-phased work schedule was also prepared and forwarded, along with copies of other documents, to all parties involved.

● Philippine Linkages

The same trip also included a stop at the International Rice Research Institute at Los Baños, the Philippines, to discuss weed control programs and assess mutual areas of concern with IRRI staff. A seminar based on the AID-OSU program and IPPC was presented at IRRI to a group from the University of the Philippines College of Agriculture.

In addition to observing a number of IRRI's weed control research plots, project members also visited a traditional upland rice farm of approximately four hectares in Batangas province. The farmer did not own the property, used no motorized equipment, and was not practicing any form of weed control.

The AID-OSU team also met with Dr. F. F. Sánchez, director of the Rodent Research Center at Los Baños, to discuss the proposal for establishment of a Southeast Asian and Pacific Regional Program for Control of Pests Affecting Agriculture and Human Health. Further discussion will be needed to clarify the role that could be filled by the AID-OSU weed effort.

● BIOTROP Short Course

One project weed control specialist spent May 4-June 10, 1974, in Indonesia as an invited member of the faculty group presenting the second in a series of weed control short courses sponsored by BIOTROP (SEAMEO Regional Center for Tropical Biology). The course, which took place at BIOTROP's Bogor headquarters, included 15 students from Khmer Republic, Laos, Malaysia, Singapore, Philippines, Thailand, and Indonesia. Both formal classroom instruction and practical field work were included in the intensive five week course.

● New Project Leader in Central America

Early in the reporting period, weed research specialist R.L. "Rick" Chase assumed the regional project leadership for the AID-OSU effort in Central America. Chase supervised the establishment of a new series of weed research field trials. The project, to maintain full liaison with CENTA (Centro Nacional de Tecnología Agropecuaria), the cooperating agency, moved its office from Santa Tecla to the San Andrés Research Station.

There were a number of staff visits to El Salvador including a trip by Chase and OSU graduate student Eduardo Locatelli to Nicaragua, Costa Rica, Guatemala, and Honduras to coordinate with counterparts and explain the pro-

ject's research program for the year. The AID-OSU team also contacted a number of AID mission personnel in the various countries.

● AID-OSU/CIAT Weed Control Training Course

A month-long weed science training course will take place June 15 through July 12, 1975, at CIAT (Centro Internacional Agricultura Tropical) headquarters near Cali, Colombia, under the joint organization of the AID-OSU weed project and CIAT.

Twenty selected weed scientists from a number of Latin American countries have been invited on a full support arrangement, and 10 others on a self-support basis. A faculty group drawn from the AID-OSU program, CIAT, and from Latin America will present a comprehensive overview of weed science with a dual goal of increasing competency and also forging stronger links between a number of key weed scientists and their institutions in the region.

● Aquatic Weed Consultant

At the request of AID/Washington, Dr. George Allen, an aquatic weed biologist at the University of Florida, served as a consultant to the weed research project and attended the Regional Economic Development (RED) workshop on aquatic weed control held at Bangkok, Thailand, on November 26 and 27, 1974.

Dr. Allen presented a brief overview concerning control of aquatic weeds, introduced the screening of a film depicting biological control of alligator weed in the U.S., and engaged in a series of discussions with various governmental and educational institution representatives. He also visited BIOTROP, Indonesia, to learn the current status of aquatic weed control research activity. A one-day stopover in Corvallis on his return to Florida was devoted to a meeting with project personnel to apprise them of the trip and Dr. Allen's impressions of potentially fruitful relationships for aquatic weed research in Southeast Asia.

E. DISSEMINATION AND UTILIZATION OF RESEARCH RESULTS

The project has continued a program of information dissemination that embraces not only research results, but also a broad sphere of material related to weed control and of interest to researchers, educators, and others in developing countries. Vehicles for dissemination include publications, direct contact through presentations at various meetings and conferences, reprints and a periodical newsletter. Also, the project, via IPPC, carries out a continuing effort of responding to inquiries.

LATIN AMERICAN SEMINARS AND FIELD DAYS

AID project monitor Mr. C. J. Fredrickson and project director Dr. S.F. Miller conducted an in-field review of project research activities during February 1975, with seminars presented by each regional project group as highlights.

At Recife, Brazil, twenty-seven representatives of several Brazilian governmental organizations, the U.S. Consul, plus USAID, USIS, World Bank, and FAO attended a morning seminar hosted by the AID-OSU team. Another seminar subsequently was held at the U.S. Embassy at San Salvador to brief USAID and USDA-PASA members on the weed research program.

A field day was held in Caruaru, July 4, 1974, during which the field work of the project was explained to agricultural administrators, educators, and policy makers. Over fifty people attended. A written survey of attendees indicated that most were very favorably impressed with the work and most expressed a desire to be informed of the results.

CONFERENCE PARTICIPATION

Project staff participated in, or attended, a number of professional meetings and conferences during the reporting period including those of the Brazilian Herbicide and Weed Science Society, the Colombian Society of Weed Control and Plant Physiology, the Weed Science Society of America, and the Hyacinth Control Society. Appendix I carries additional information.

INFOLETTER FREQUENCY INCREASED

Five issues of INFOLETTER, the free periodical issued through IPPC, were published during the report period compared with four issues in most of the previous five years of publication. The format was revised (new larger size, different paper stock) to gain additional print space and improve readability. Editorial thrust remained oriented toward emphasizing a variety of weed science facets deemed useful to a developing countries readership. INFOLETTER is currently sent to 3,640 recipients in over 120 countries (Appendix II).

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

- Shifts seen in herbicide usage
- Weed science course by mail
- Weeds threaten African crops
- Latin American weed group adopts new structure
- Aquatic weed wave prompts increasing worldwide concern
- Two insects show promise for control of watermilfoil
- Asian workshop supports aquatic weed research
- Herbicides and the small farmer
- Can crops control weeds?
- India hosts regional aquatic weed seminar

East African weed group formed

Keep weed control flexible

Asian-Pacific meeting nears

Each issue also carries lists of relevant publications (and the sources from which they may be requested) as well as announcements of forthcoming conferences, seminars, and short courses. An additional feature in nearly every issue spotlights equipment that might be of interest, such as a labor-intensive water weed cutter that costs less than \$40, redesigned and improved herbicide-applying gloves, a collapsible tank for hauling liquids, two non-motorized sprayers, a mini-cultivator, and a very simple, inexpensive granule spreader. No brand names appear in the article, but a statement printed with each feature offers to provide manufacturer names and addresses in response to requests.

One of the lead articles in INFOLETTER, *Herbicides and the Small Farmer*, stemmed from the research carried out by a weed scientist working in the Caribbean. The background of how this item appeared in INFOLETTER suggests the sort of linkages and communication network surrounding the AID-OSU project.

The scientist originally presented a paper at the annual meeting of the Weed Science Society of America (WSSA) in February 1974. The staff weed scientist from CIAT attended this meeting, heard the paper, and, in a letter to AID-OSU project staff, commented on the high interest of the subject matter. Project staff followed up by writing the author-scientist to inquire about obtaining a copy of the presentation. He responded that copies would become available when (and if) printed in the WSSA journal. For some reason, the item was not printed, so when the project sought approval to obtain, edit, and reprint the paper, it was granted. The result has been the most popular reprint ever offered by the project: as of March 31, 1975, 114 requests for 127 copies had been serviced.

FREE REPRINTS MADE AVAILABLE

A series of free reprints was initiated during the period, including the one mentioned above. The series has a twofold intent: to provide interesting and informative material to researchers in developing countries who might otherwise be unaware of, or unable to obtain, such items; and to create an outlet for dissemination of material that may not be published through other channels. A list of the titles in the series (known as IPPC Papers) is attached as Appendix III.

INQUIRIES HANDLED BY CORVALLIS STAFF

Inquiries concerning weed control and ranging from fairly brief, specific questions to broad entreaties for assistance of any kind, continued to be received and answered by project staff at Corvallis. No incoming inquiry was ignored; some sort of response, dependent on the nature of the inquiry, was provided in every case. Often the request could be satisfied by providing published materials, or the names of local weed research authorities, or other contacts. In special cases, requests were forwarded to a third party, in which

case the requestor was so notified. The Information Services section of IPPC processed over 300 requests from 59 countries.

OTHER INFORMATION ACTIVITIES

IPPC and the project assembled an international list of recent texts and current periodicals related to weed research and control and issued it as *Selected Publications and Periodicals to Assist in Supplementing, Expanding, or Establishing a Weed Science Library*. Five categories of subjects or publications were included. The goal was to provide a list that constituted a well-rounded basic library which would then need to be fleshed out with localized materials. Almost all titles in the lists include a publisher's name and address to facilitate ordering copies. The list is free on request from IPPC and a copy is attached as Appendix IV. As of March 31, 1975, IPPC had mailed copies in response to 96 requests.

More than 2,250 copies of 11 publications were distributed during calendar 1974. A country-by-country and title-by-title analysis appears in Appendix V (World Distribution of Publications).

At the request of BIOTROP, Indonesia, the project acted as agent for securing and shipping an extensive list of publications for the Center's main library. These were publications which BIOTROP was unable to order through regular channels, despite having the funds to do so.

A direct mail address verification card designed by AID-OSU staff won a first place award in national competition sponsored by the American Association of Agricultural Editors. There were 23 entries. The card was sent to selected names on the IPPC mailing list to ascertain whether recipients wished to remain on the mailing list, to verify and correct addresses, and to solicit names of new recipients.

Host country organization counterparts, who presented a somewhat unstable picture during the period covered by this report, were trained and included in the planning and conduct of research wherever feasible. Also, host organization leadership was regularly informed of plans and progress of the program.

One project staff member participated in the first AID Workshop on Research Information Networking in Agriculture held in Washington, October 24 and 25, 1974. The sessions provided an exposure to the information dissemination activities of other projects as well as an opportunity to interact with AID and project personnel concerned with information networking.

**F. STATEMENT OF EXPENDITURE
AND OBLIGATIONS AND
CONTRACTOR RESOURCES**

The following table lists the expenditures and obligations related to the four broad work areas of the project during the period April 1, 1974 through March 31, 1975.

Classification	Corvallis: Head- quarters	Corvallis: Publi- cations	Brazil	Central America	TOTALS
Salaries & Wages	\$72,601.56	\$15,019.71	\$48,199.61	\$18,657.36	\$154,478.24
Payroll Assessments	9,860.37	2,068.86	6,639.22	2,562.72	21,131.17
Indirect Costs					
on campus	34,434.91	7,123.84	--	--	41,558.75
off campus	--	--	15,481.72	5,992.74	21,474.46
total					(63,033.21)
Consultants	3,199.84	1,300.00	1,494.03		5,993.87
Travel, Transport. & Allowances	14,477.82	--	39,187.95	9,864.91	63,530.68
Other Direct Costs	2,497.67	--	3,268.76	736.05	6,502.48
Equip., Vehicles, Mat. & Supplies	7,128.67	2,723.10	6,334.58	515.91	16,702.26
TOTALS	144,200.84	28,235.51	120,605.87	38,329.69	331,371.91

The first two columns indicate the amount of money expended in support of the Corvallis-based staff and total \$172,436.35. This is 52 percent of the total expenditure. The remaining 48 percent was used in support of the internationally-based staff. The distribution is consistent with the proposed budget for the period and reflects a continued effort to use a major portion of the budget in the work areas away from campus.

The budget for the 1974-1975 period was \$371,452. Total expenditures were \$331,372. Thus a budget saving of \$40,080 was made.

A total of 11.9 full-time equivalent man years (FTE) was employed during the 1974-1975 budget year. Of these 4.6 FTE were employed as secretarial and support personnel. Of the remaining 7.3 FTE, 4 FTE were based abroad while 3.3 FTE were based at Oregon State University.

A listing of project personnel is attached as Appendix VI.

**G. WORK PLAN AND
BUDGET FORECAST
FOR COMING YEAR**

During the remainder of the contract (April 1 through December 31, 1975) the plan of work consists of the following:

CORVALLIS

1. Maintain liaison and correlate activities with major U.S. and institutional weed research agencies.
2. Present a comprehensive one-month weed control short course in cooperation with the Center for Tropical Agriculture (CIAT), Cali, Colombia.
3. Publish and distribute an informational newsletter at least three times to disseminate useful knowledge on weed control.
4. Answer inquiries on weed control from AID Missions, governmental officials of developing countries, and others requesting information.
5. Assist in evaluation and reporting of agronomic and economic data generated by the project.
6. Assist in the construction of qualitative models for the socio-economic evaluation of results of alternative weed control systems.

BRAZIL

1. Select, refine, and repeat promising agronomic experiments from 1974.
2. Expand agronomic experiments into new promising weed control methods.
3. Evaluate and prepare publications on field research conducted by the project.
4. Generate preliminary estimates of optimal weed control systems by farm size.
5. Complete specification of the aggregate qualitative socio-economic model.
6. Finalize parameters of individual farm model on the basis of agronomic investigations and generate final estimates of optimal production systems by farm size.
7. Determine the impacts of achieving economic efficiency on labor, employment, income distribution, and other socially relevant policy objectives.
8. Determine the costs in terms of agricultural production, farm income, etc. of implementing alternative policy objectives.

EL SALVADOR

1. Select, refine, and repeat promising agronomic experiments of 1974.
2. Expand agronomic experiments into new promising weed control methods.
3. Evaluate and prepare publication on field research conducted by the project.
4. Continue efforts to train counterparts in weed control in Central America.
5. Conduct farm surveys to ascertain socio-economic conditions and parameters estimates for aggregate socio-economic models.

The proposed budget for the period April 1, 1975 to December 31, 1975 is listed in the following table:

Classification	Corvallis: Head- quarters	Corvallis: Publi- cations	Brazil	Central America	TOTALS
Salaries & Wages	\$67,575	\$13,129	\$33,584	\$17,689	\$131,977
Payroll Assessments	10,136	1,969	5,038	2,654	19,797
Indirect Costs					
on campus	30,990	6,027	--	--	37,017
off campus	--	--	10,988	5,802	16,790
total					(53,807)
Consultants	300	--	--	--	300
Travel, Transport. & Allowances	41,600	--	58,174	13,571	113,345
Other Direct Costs	5,870	--	7,625	1,730	15,225
Equip., Vehicles, Mat. & Supplies	20,447	9,086	7,403	1,390	38,326
TOTALS	176,918	30,211	122,812	42,836	372,777

Of the total budget 55.6% of the expected expenditures are related to activities of the Crovallis staff made in direct support of the internationally based staff.

H. APPENDIXESAPPENDIX I - BIBLIOGRAPHIC LIST

Burrill, Larry (editor). 1974. EXPERIMENTAL HERBICIDES, STATUS REPORT BY CROP--1974. International Plant Protection Center, Oregon State University. Report 74-6. 74 pages.

An annual updating of data concerning herbicides that are under test but which have not been cleared for commercial use (in most cases). The information, supplied by the manufacturers, is carried in tables that provide common name, manufacturer, and dosage. Also, the type of general and specific weeds controlled are listed, along with time of application (in relation to crop emergence) and other data. The tables appear under major crop groupings and specific types of crop.

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Burrill, Larry (editor). 1974. NEW HERBICIDE EVALUATION--MULTICROP SCREENING TRIAL--SPRING 1974. International Plant Protection Center, Oregon State University. Report 74-7. 30 pages.

Burrill, Larry (editor). 1974. NEW HERBICIDE EVALUATION--MULTICROP SCREENING TRIAL--FALL 1974-75. International Plant Protection Center, Oregon State University. Report 75-2. 14 pages.

NOTE: Report 74-7 and 75-2 are compilations of research data neither intended nor authorized for "publication." They were prepared for limited distribution only.

Test applications of experimental (and some standard) herbicides are applied to field plots to evaluate performance and to indicate potentially useful compounds. A variety of plant species--both crops and weeds--are included in the trials. Observations are made of general phytotoxicity and crop selectivity. The trials are not replicated and therefore can serve as only a preliminary indication as to level of activity and degree of selectivity.

.....

Burrill, Larry. 1974. DEVELOPMENTS IN WEED CONTROL--WORLDWIDE--Paper presented to a seminar of the Institute for Research on Estate Crops, Bogor, Indonesia, June, 1974. Also presented to a seminar of the Central Research Institute for Agriculture, Bogor, Indonesia, June, 1974.

Methods and techniques of weed control constantly change due to economic technologies and institutional influences. Several of the influences were discussed. These include: agricultural input supplies, development costs of herbicides, shifts in weed flora, new weed control technologies, and governmental policy emphasis on small farmers.

Deutsch, Allan. 1974. "Con los plaguicidas--evite peligros." AGRICULTURA DE LAS AMERICAS, 23(3): 12,34,44.

A roundup style article outlining recommended procedures in the various stages of applying, handling, and storing pesticides. Emphasis is on equipment and its maintenance, safety at all times in handling and preparing pesticides, and security in the storing of pesticide containers, and also in the disposal of containers. Includes a brief reference list. (In Spanish).

.....

Doll, Jerry, Carlos Reyes, Herb Fisher, and Juan Cardenas. 1974. SEMILLAS DE MALEZAS TROPICALES - II / TROPICAL WEED SEEDS - II. International Plant Protection Center, Oregon State University, in cooperation with Centro Internacional de Agricultura Tropical (CIAT). 4 pages.

The second four-page leaflet containing full color plates of seeds of 24 weed species, this Spanish/English publication is devoted to dicots. Magnified photos of seeds are accompanied by a table cross-referencing scientific nomenclature with common names in Spanish, English, and Portuguese.

.....

Fisher, H. H. et al. 1974. RESEARCH PROGRAM OF THE EMBRAPA/OREGON STATE UNIVERSITY/AID PROJECT IN NORTHEAST BRAZIL--Paper presented at the 10th Annual Meeting of the Brazilian Weed Science Society, Santa Maria, RGS, Brazil, July 16-19. Also, presented to the 7th Annual Meeting of the Colombian Society for Weed Control and Plant Physiology, Bogotá, Colombia, Jan. 27-28, 1975.

The objectives and goals of the project on "Weed Control Systems for Representative Farms" were presented. The methods to be used and the general plan of work were reviewed. Preliminary results of the experience of project personnel in Northeast Brazil were given.

.....

Garcia, Jose Guadalupe L., Bruce MacBryde, Antonio R. Molina, and Olga Herrera-MacBryde. 1975. MALEZAS PREVALENTES DE AMERICA CENTRAL / PREVALENT WEEDS OF CENTRAL AMERICA. International Plant Protection Center, Oregon State University. Report 74-9. Illus. (full color). 328 pages.

This volume, the third in a series of weed identification manuals, presents 277 of the most economically important weed species encountered in Central America (and other similar geographic areas). Full color plates for each species are accompanied by detailed descriptions in Spanish and English covering family, genus, species, and common names (Spanish), plus habitat, type of root, stem, leaves, inflorescence, fruit, seed, and other characteristics. The publication is intended to provide a practical reference for the identification of weeds by visual comparative methods. A bibliography and glossary are also included.

.....

Medeiros, D. et al. 1974. PRELIMINARY OBSERVATIONS ON SELECTIVITY OF LINURON AND ALACHLOR IN BEANS--Paper presented at the 10th Annual Meeting of the Brazilian Weed Science Society, Santa Maria, RGS, Brazil, July 16-19.

Linuron and alachlor are two herbicides commonly used on beans with success. Preliminary results indicate that there appears to be no significant difference between one hand hoeing, two hand hoeings, and alachlor and linuron applied at the rate of 1.5 and 0.5 kg. a.i./ha. No significant interaction was found between hoeing and herbicide treatments.

.....

Scolari, D.D.G. and E.L. Young. 1974. COMPARATIVE COSTS OF DIFFERENT METHODS OF WEED CONTROL IN CORN AND BEANS--Paper presented at the 10th Annual Meeting of the Brazilian Weed Society, Santa Maria, RGS, Brazil, July 16-19. Also presented to the 7th Annual Meeting of the Colombian Society for Weed Control and Plant Physiology, Bogotá, Colombia, Jan. 27-28, 1975.

The costs of weed control systems vary considerably. In corn the cost varied from a high of CR\$302/ha for a combinational useage of a micro tractor with a rotary hoe and a band application of herbicide to Cr\$75/ha for cultivation with an animal-pulled implement. In beans the cost varied from Cr\$362/ha to Cr\$75/ha for the same two treatments. The most economical system for corn using herbicides was the atrazine or simazine (1.5 kg. a.i./ha) at a cost of Cr\$173/ha applied. Floridifen at the rate of 2 kg. a.i./ha was the most economical herbicide system for beans at a cost of Cr\$198/ha.

World Distribution of INFOLETTER as of December 31, 1974.

Country	#	Country	#	Country	#	Country	#
Abu Dhabi	1	Colombia	211	Ireland	7	Norway	10
Aden	1	Comores Islands	2	Israel	18	Pacific Islands	2
Afghanistan	2	Costa Rica	50	Italy	25	Pakistan	17
Algeria	3	Cyprus	2	Ivory Coast	3	Panama	30
Angola	2	Czechoslovakia	8	Jamaica	9	Paraguay	8
Arab Republic of Egypt	8	DDR	2	Japan	48	Peru	67
Argentina	207	Denmark	8	Jordan	7	Philippines	50
Australia	60	Dominican Republic	8	Kenya	23	Poland	8
Austria	3	Ecuador	41	Korea	12	Portugal	5
Bahamas	1	El Salvador	24	Laos	4	Romania	2
Bangladesh	2	England	105	Lebanon	7	St. Lucia	1
Barbados	2	Ethiopia	19	Leeward Islands	2	Saudi Arabia	6
Belgium	11	Fiji	4	Lesotho	1	Scotland	4
Belize	7	Finland	8	Liberia	7	Senegal	3
Bermuda	1	France	16	Libya	1	Seychelle Islands	1
Bolivia	17	Gabon	1	Malagasy Republic	1	Sierra Leone	4
Borneo	2	Gambia	1	Malawi	5	Singapore	10
Botswana	1	Ghana	19	Malaysia	45	Solomon Islands	3
Brazil	173	Greece	15	Malta	3	South Vietnam	11
Brunei	1	Guam	2	Mauritius	2	Spain	8
Bulgaria	2	Guatemala	33	Mexico	133	Sri Lanka	13
Burma	3	Guyana	2	Morocco	3	Sudan	9
Burundi	1	Haiti	2	Mozambique	2	Surinam	4
Cambodia	2	Honduras	32	Netherlands	14	Swaziland	2
Cameroon	5	Hong Kong	5	New Caledonia	3	Sweden	14
Canada	102	Hungary	4	New Guinea	12	Switzerland	27
Canal Zone	3	India	122	New Hebrides	2	Syria	2
Central African Rep.	1	Indonesia	84	New Zealand	22	Taniti	2
Chad	3	Iran	8	Nicaragua	31	Taiwan	17
Chile	37	Iraq	2	Nigeria	18	Tanzania	11

APPENDIX II - WORLD DISTRIBUTION OF INFOLETTER

Country	#
Thailand	40
Trinidad	14
Trucial States	1
Tunisia	5
Turkey	14
Uganda	4
Upper Volta	1
Uruguay	17
USSR	4
USA	1094
Venezuela	47
Western Samoa	7
West Germany (BDR)	33
Yugoslavia	5
Zaire	3
Zambia	8
TOTAL FOR 1974	<u>3622</u>



IPPC PAPERS

An ongoing series of papers, reprints, and adaptations. Complimentary copies may be requested by number and title from: IPPC, Oregon State University, Corvallis, OR 97331 / USA.

.....

- #1 - 1971. Weed control in cacao. Myron D. Shenk. Reprinted from: WORLD FARMING, October 1971.
- #2 - 1972. New weed control equipment and techniques. Allan Deutsch. Reprinted from: AGRICULTURAL MECHANIZATION IN ASIA, Vol III, No. 2, Summer 1972.
- #3 - 1972. Spray adjuvants make pesticides do a better job. Lyall F. Taylor. Reprinted from: WORLD FARMING, September 1972.
- #4 - 1972. El papel de la ciencia de malezas en paises en desarrollo. Chris Parker. Translation of a paper presented at the annual meeting of the Weed Science Society of America St. Louis, MO / USA, February 1972.
- #5 - 1972. Reviewing the small applicators. Allan Deutsch. Reprinted from: WORLD FARMING, December 1972.
- #6 - 1973. New techniques in weed control. Larry C. Burrill. Paper presented at the annual meeting of the Asian-Pacific Weed Science Society, Rotorua / New Zealand, March 1973.
- #7 - 1973. Weed control methods in rice. Larry C. Burrill. Paper presented at the West African Rice Development Administration plant protection seminar, Monrovia / Liberia, May 1973.
- #8 - 1974. Acción de various herbicidas en el control de malezas del algodonoero en Valle de Portoviejo. Myron D. Shenk et al. Paper presented at the 2nd meeting of the Asociacion Latinoamericana de Malezas, Cali / Colombia, January 1974.

IPPC PAPERS - 2

- #9 - 1974. Small pesticide application equipment--its selection, use and maintenance. Allan Deutsch. Reprinted from: WORLD FARMING, January 1974.
- #10 - 1974. Equipos pequeños para aplicar plaguicidas--su selección, uso y mantenimiento. Allan Deutsch. Reimpresion de: AGRICULTURA DE LAS AMERICAS, Febrero 1974.
- #11 - 1974. Con los plaguicidas--evite peligros. Allan Deutsch. Reimpresion de: AGRICULTURA DE LAS AMERICAS, Marzo 1974.
- #12 - 1974. Problems of herbicide use in peasant farming. John L. Hammerton. Adaptation of a paper presented at the annual meeting of the Weed Science Society of America, Las Vegas, NV / USA, February 1974.
- #13 - 1974. Crop varieties: can they suppress weeds? R. D. Sweet, C. P. Yip, and J. B. Sieczka. Reprinted from: NEW YORK LIFE SCIENCES QUARTERLY, Vol 7, No. 3, July-September 1974.
- #14 - 1974. Biological suppression of weeds: evidence for alleopathy in accessions of cucumber. Alan R. Putnam and William R. Duke. Reprinted from: SCIENCE, Vol 185, July 26, 1974.
- #15 - 1975. Weed control with plant pathogens. R. Charudattan. Reprinted from: AGRICHEMICAL AGE, January-February 1975.



APPENDIX IV

International Plant Protection Center
Oregon State University
Corvallis, Oregon 97331 / USA

Lists of
Selected Publications and Periodicals
to Assist in
Supplementing, Expanding, or Establishing
a Weed Science Library

The attached material has been assembled from several sources by the International Plant Protection Center.

The various lists make no pretense of being comprehensive, nor are they intended to be. They are offered only as information to assist with library enrichment. A useful collection of published material obviously should include numerous other publications and periodicals of a national or local nature, such as extension leaflets, conference proceedings, research station reports, etc.

While older materials generally have been omitted from the IPPC lists, some older items still may be highly pertinent and warrant consideration.

Where possible, the lists include the per copy (or subscription) price of an item as well as the address of the publisher.

The lists are arranged as follows:

LIST I - GENERAL PUBLICATIONS

LIST II - REGIONAL TAXONOMY

LIST III - AQUATIC VEGETATION

LIST IV - CURRENT PERIODICALS

LIST V - CONTACTS FOR ADDITIONAL INFORMATION

January 1975

LIST I - GENERAL PUBLICATIONS

- Andersen, R. N. 1968. GERMINATION AND ESTABLISHMENT OF WEEDS FOR EXPERIMENTAL PURPOSES. 236p. Hardback. English. US\$5. Weed Science Society of America, 113 N. Neil St., Champaign, IL 61820 / USA.
- Anon. 1973. GUIDE TO CHEMICAL WEED CONTROL. Publ. #75. 86p. Paperback. English. US\$.30. Information Branch, Ontario Ministry of Agric. and Food, Parliament Bldgs., Toronto 5, Ont. / Canada.
- Anon. 1974. HERBICIDE HANDBOOK OF THE WEED SCIENCE SOCIETY OF AMERICA. 430p. Paperback. English. US\$5. Weed Science Society of America, 113 N. Neil St., Champaign, IL 61820 / USA.
- Anon. 1973. OUTLINE OF WEED CONTROL. 200p. Hardback. Japanese. US\$5. Yokendo Publisher, Hongo 5-30-15, Bunkyo-ku, Tokyo / Japan.
- Anon. 1974. WEED CONTROL MANUAL & HERBICIDE GUIDE. 108p. Paperback. English. US\$5. Meister Publishing Co., 37841 Euclid Ave., Willoughby, OH 44094 / USA.
- Ashton, F., and A. Crafts. 1973. MODE OF ACTION OF HERBICIDES. 504p. Hardback. English. US\$24.95. John Wiley & Sons, 605 Third Ave., New York, NY 10003 / USA.
- Audus, L. J. (ed.) 1964. PHYSIOLOGY AND BIOCHEMISTRY OF HERBICIDES. 555p. Hardback. English. US\$18.50. Academic Press Inc., 111 Fifth Ave., New York, NY 10016 / USA. Being revised.
- ★ Cardenas, J., et al. 1970. MALEZAS DE CLIMA FRIO. 127p. Paperback. Spanish. US\$3.50. International Plant Protection Center, Oregon State University, Corvallis, OR 97331 / USA.
- Delorit, R. J. 1970. AN ILLUSTRATED TAXONOMY MANUAL OF WEED SEEDS. 175p. Paperback/Hardback. English. US\$5.95/US\$7.75. Agronomy Publications, River Falls, WI 54022 / USA.
- Detroux, L., and J. Gostínchar. 1967. LOS HERBICIDAS Y SU EMPLEO. 488p. Paperback. Spanish. US\$13.(approx.) Oikos-tau, S.A., Ediciones, Apartado Correos 5347, Barcelona / Spain.
- Dunham, R. S. (ed.) 1964. LOSSES FROM WEEDS. Spcl. Rept. #13. 43p. Paperback. English. US\$1. Agric. Extension Svc., Univ. of Minnesota, St. Paul, MN 55101 / USA.
- Fisher, H. H., and E. Locatelli. 1974. BIBLIOGRAFIA PARCIAL DE INVESTIGACION SOBRE MALEZAS Y SU CONTROL PARA AMERICA DEL SUR, AMERICA CENTRAL, EL CARIBE, Y MEXICO, 1942-1972. 179p. Paperback. Spanish/English. US\$3. International Plant Protection Center, Oregon State Univ., Corvallis, OR 97331 / USA.

- Fryer, J., S. A. Evans, and R. J. Makepeace (ed.). 1970/1973. WEED CONTROL HANDBOOK. Vol. I, 494p. Vol. II, 331p. Hardback. English. US\$11.50/\$16.(approx.) Blackwell Scientific Publications, Osney Mead, Oxford OX2 OEL / England.
- Hanf, M. 1972. WEEDS AND THEIR SEEDLINGS. 348p. Hardback. English. US\$7.95. BASF, Agric. Div., St. Francis Tower, Ipswich IP1 1LE / England.
- Huffaker, O. B. (ed.) 1971. BIOLOGICAL CONTROL. 511p. Hardback. English. US\$19.50. Plenum Publishing Corp., 227 W. 17th St., New York, NY 10011 / USA.
- Joshi, N. C. 1974. MANUAL OF WEED CONTROL. 365p. Hardback. English. US\$14.(approx.) Researcho Publications, 75/1A, East Azad Nagar, Delhi-51 / India.
- Kasasian, L. 1971. WEED CONTROL IN THE TROPICS. 307p. Hardback. English. US\$8.(approx.) Agraria Press, 9 Botolph Alley, London EC3R 3DR / England.
- Kearney, P. C., and D. D. Kaufman (ed.) 1969. DEGRADATION OF HERBICIDES. 394p. Hardback. English. US\$18.75. Marcel Dekker Inc., 95 Madison Av., New York, NY 10003 / USA.
- Klingman, G. C. 1966. WEED CONTROL AS A SCIENCE. 421p. Hardback. English. US\$8.95. John Wiley and Sons, Inc., 605 Third Ave., New York, NY 10003 / USA
- Meyer, J. 1971. AQUATIC HERBICIDES AND ALGAECIDES. 177p. Paperback. US\$35. Noyes Data Corp., Mill Rd. at Grand Ave., Park Ridge, NJ 07656 / USA.
- Miller, J. (ed.) 1972. RESEARCH METHODS IN WEED SCIENCE. 198p. Paperback. English. US\$4. Southern Weed Science Society (US), Agric. Extension Annex, Univ. of Georgia, Athens, GA 30601 / USA.
- Muzik, T. J. 1970. WEED BIOLOGY AND CONTROL. 273p. Hardback. English. US\$12.50. McGraw-Hill Book Co., 330 W. 42nd St., New York, NY 10036 / USA.
- Subcommittee on Weeds, Committee on Plant and Animal Pests, Agricultural Board, National Research Council. 1968. WEED CONTROL--PRINCIPLES OF PLANT AND ANIMAL PEST CONTROL, Volume 2; Publ. #1597. 471p. Paperback. English. US\$8. National Academy of Sciences, 2101 Constitution Ave., Washington, DC 20418 / USA.
- Thompson, W. T. 1972. AGRICULTURAL CHEMICAL BOOK II (HERBICIDES). 250p. Paperback. English. US\$10. Thompson Publications, P.O. Box 50160, Indianapolis, IN 46250 / USA.
- Tutui, K. 1970. CONTROL OF WEEDS. 218p. Hardback. Japanese. US\$4. Ie-no-hikari Association, 11 Funagawara-cho, Ichigaya, Shinjuku-ku, Tokyo / Japan.
- Wilkinson, R. E., and H. E. Jaques. 1973. HOW TO KNOW THE WEEDS. 224p. Paperback. English. US\$3.75. Wm. C. Brown & Co., 135 E. Locust, Dubuque, IA 52001 / USA. ●

LIST II - REGIONAL TAXONOMY

- Adams, C. D., L. Kasasian, and J. Seeyave. 1970. COMMON WEEDS OF THE WEST INDIES. Hardback. English. US\$3. Univ. of the West Indies, St. Augustine / Trinidad.
- Anon. 1970. SELECTED WEEDS OF THE UNITED STATES. Agric. Handbook #366. 462p. Paperback. English. US\$4. Supt. of Documents, U.S. Government Printing Office, Washington, DC 20402 / USA.
- Anon. 1970. WEEDS OF CANADA. Publ. #948. 217p. Paperback. English. C\$1. Canada Dept. of Agric., Botany & Plant Path. Div., Ottawa, Ont. / Canada.
- Bar-Droma, M., M. Horowitz, and S. Oshero. 1968/1970. WEEDS OF OUR FIELDS. 190p. Hardback. Hebrew. Isr.P.10. Min. of Agric., Educational Extension Svc., Hakiryia, Tel-Aviv / Israel.
- Barnes, D. E., and M. M. Chandapillai. 1972. COMMON MALAYSIAN WEEDS AND THEIR CONTROL. 146p. Paperback. English. M\$10. Ancom Sdn. Berhad, P.O. Box 465, Kuala Lumpur / Malaysia.
- ★Cardenas, J., et al. 1970. TROPICAL WEEDS/MALEZAS TROPICALES. 342p. Paperback. English/Spanish. US\$3.50. International Plant Protection Center, Oregon State University, Corvallis, OR 97331 / USA.
- Edgecombe, W. S. 1970. WEEDS OF LEBANON. 457p. Paperback. English. US\$8. Herbarium, American University, Beirut / Lebanon.
- Haselwood, E., and G. Motter. 1973. HANDBOOK OF HAWAIIAN WEEDS. 479p. Paperback. English. US\$6. HSPA, 1527 Keeaumoku St., Honolulu, HI 96822 / USA.
- King, L. J. (ed.) 1966. WEEDS OF THE WORLD. 526p. Hardback. English. US\$18. Interscience Publishers Inc., 250 Fifth Ave., New York, NY 10003 / USA.
- Kingsbury, J. W. 1964. POISONOUS PLANTS OF THE UNITED STATES AND CANADA. 626p. Hardback. English. US\$15. Prentice Hall, Englewood Cliffs, NJ 07632 / USA.
- Lin, C. I. 1968. WEEDS FOUND ON CULTIVATED LAND IN TAIWAN. Vol. 1, 505p. Vol.2, 444p. Paperback. Chinese/English. Free. J.C.R.R., 37 Nan Hai Road, Taipei 107, Taiwan / ROC.
- Swarbrick, J. T. 1974. THE AUSTRALIAN WEED CONTROL HANDBOOK. 325p. Paperback. English. A\$4. Herbicide Recommendations, 3A Ipswich St., Toowoomba, Qld. 4350 / Australia.●

LIST III - AQUATIC VEGETATION

- Anon. 1974. AQUATIC WEED IDENTIFICATION AND CONTROL MANUAL. 100p. Paperback. English. No cost. Bureau of Aquatic Plant Research and Control, Department of Natural Resources, Crown Building, 202 Blount St., Tallahassee, FL 32304 / USA.
- Anon. 1969. COMMON AQUATIC WEEDS. Agric. Handbook #352. 43p. Paperback. English. US\$.50. Supt. of Documents, U.S. Government Printing Office, Washington, DC 20402 / USA.
- Aston, H. I. 1973. AQUATIC PLANTS OF AUSTRALIA. 368p. Hardback. English. US\$34.65(approx.) Melbourne Univ. Press, Carlton, Victoria 3053 / Australia.
- ★Bristow, J. M., et al. 1970. MALEZAS ACUATICAS, AQUATIC WEEDS. 116p. Paperback. Spanish/English. US\$3. International Plant Protection Center, Oregon State Univ., Corvallis, OR 97331 / USA.
- Gupta, O. P. 1972. AQUATIC WEED CONTROL FOR EFFICIENT WATER USE. 97p. Paperback. English. US\$2. Rajasthan College of Agric., Univ. of Udaipur, Udaipur / India.
- Mitchell, D. S. (ed.) 1974. AQUATIC VEGETATION AND ITS USE AND CONTROL. 121p. Paperback. English. US\$6.50(approx.) Unesco, Place de Fontenoy, 75700 Paris / France.
- Sainty, G. R. 1973. AQUATIC PLANTS. 110p. Hardback. English. A\$3. Water Conservation & Irrigation Commission, 201-211 Miller St., North Sydney, NSW 2060 / Australia.
- Stryckers, J. 1968. LES VEGETATIONS AQUATIQUES ET PALUSTRES ET LEUR DESTRUCTION. 100p. Paperback. French. Price unknown. Ministry of Agriculture, 36 rue de Stassart, 1050 Brussels / Belgium. ●

★ *REQUESTS ORIGINATING IN LATIN AMERICA FOR THESE TITLES SHOULD BE ADDRESSED TO:* COMALFI
 Apartado Aereo 29688
 Bogota, D.E.
 COLOMBIA.

LIST IV - CURRENT PERIODICALS

- INFOLETTER. Quarterly. English. Free. International Plant Protection Center, Oregon State University, Corvallis, OR 97331 / USA.
- PANS. Quarterly. English. £3 annually. Centre for Overseas Pest Research, College House, Wrights Lane, London W8 5SJ / England.
- WEED ABSTRACTS. Bimonthly. English. US\$52 annually. Central Sales Branch, Commonwealth Agricultural Bureaux, Farnham Royal, Slough SL2 3BN / England.
- WEED RESEARCH. Bimonthly. English. US\$52.50 annually. Blackwell Scientific Publications, Osney Mead, Oxford OX2 OEL / England.
- WEED SCIENCE. Bimonthly. English. US\$25 annually. Weed Science Society of America, 113 N. Neil St., Champaign, IL 61820 / USA.●

LIST V - CONTACTS FOR ADDITIONAL INFORMATION

- ASIAN-PACIFIC WEED SCIENCE SOCIETY. R. Nishimoto, Secty, Hawaii Ag. Exp. Stn., Univ. of Hawaii, Kapaa, HI 96746 / USA.
- ASSOCIACION LATINO AMERICANA DE LA CIENCIA DE MALEZAS. Apartado Aereo 15024, Bogotá / Colombia.
- EUROPEAN WEED RESEARCH SOCIETY. Secretariat, Postbus 14, Wageningen / The Netherlands.
- HYACINTH CONTROL SOCIETY (to become Aquatic Plant Management Society in 1976). P.O. 2237, Fort Myers, FL 33902 / USA.
- INTERNATIONAL PLANT PROTECTION CENTER. Oregon State University Corvallis, OR 97331 / USA.
- WEED RESEARCH ORGANIZATION. Begbroke Hill, Yarnton, Oxford OX5 1PF / England.
- WEED SCIENCE SOCIETY FOR EASTERN AFRICA. c/o T.P.R.I., P.O. Box 3024, Arusha / Tanzania.●

Country	Status	AqWeed	AqEquip	Metodos	Equipm	Trops	WSS/1&2	Frio	Lists	Biblio	Misc
Angola	---	---	---	2	---	---	---	---	---	---	---
Argentina	5	1	11	37	8	5	---	5	2	28	2
Australia	7	2	4	---	10	2	7	---	---	---	---
Bahamas	---	1	---	---	1	1	---	---	---	---	---
Bangladesh	1	---	1	---	2	2	---	---	---	---	4
Belgium	1	2	---	---	1	1	---	---	---	---	---
Belize)	---	---	---	1	1	2	4	---	---	1	---
Bolivia	---	---	---	12	2	---	---	---	---	---	---
Brazil	5	5	7	21	14	20	4	9	1	20	2
Brunei	1	---	---	---	1	1	---	---	---	---	---
Cambodia	---	1	2	---	3	2	---	---	---	---	---
Canada	1	2	3	---	10	3	2	---	---	---	---
CanalZone	---	---	1	---	2	1	---	---	---	1	---
Chile	1	1	1	3	1	1	---	---	---	2	---
Colombia	3	---	---	14	3	---	---	1	1	13	---
Costa Rica	---	2	---	50	3	8	13	---	2	14	26
Denmark	1	---	---	---	---	---	---	---	---	---	---
Dominican Republic	---	---	---	1	2	1	2	---	---	1	---
Ecuador	2	2	---	11	2	2	---	1	---	4	1
El Salvador	1	8	1	1	1	6	1	1	---	3	3
England	7	3	8	---	6	42	---	---	---	6	4
Ethiopia	---	---	---	---	---	3	---	---	---	---	---
France	1	1	---	---	1	1	---	---	---	---	---
Ghana	---	---	---	---	1	---	---	---	---	---	---
Greece	---	---	---	---	2	---	---	---	---	1	---
Guatemala	---	---	---	3	1	1	14	---	---	1	1
Guyana	---	1	---	---	---	---	---	---	---	---	---
Honduras	---	---	---	2	1	25	11	---	---	1	1
India	3	5	4	---	16	7	3	4	---	4	2
Indonesia	4	22	20	---	27	50	8	3	---	---	---
Iran	---	1	1	---	---	1	---	---	---	---	---
Ireland	---	2	---	---	---	2	---	---	---	---	---

Country	Status	AqWeed	AqEquip	Metodos	Equipm	Trops	WSS/1&2	Frio	Lists	Biblio	Misc
Israel	3	2	---	1	2	2	---	1	---	2	---
Italy	---	---	---	---	1	---	---	---	---	1	---
Ivory Coast	---	---	---	---	---	1	---	---	---	---	---
Japan	4	---	---	---	1	2	---	---	---	1	---
Jordan	1	1	---	---	1	---	---	---	---	---	1
Kenya	1	1	1	---	1	3	---	---	---	---	---
Lebanon	---	1	1	---	---	---	1	---	---	---	---
Leeward Islands	1	---	---	---	1	1	---	---	---	---	---
Malaysia	3	10	7	1	7	7	8	1	---	5	1
Malawi	---	---	---	---	1	---	---	---	---	---	---
Mauritius	---	1	---	---	1	---	---	---	---	---	---
Mexico	1	13	2	12	29	80	8	8	---	8	4
Netherlands	---	7	6	---	1	32	---	---	---	4	---
New Guinea	---	---	---	---	---	1	---	---	---	---	---
New Hebrides	---	---	---	---	---	2	---	---	---	---	---
New Zealand	4	---	1	---	2	1	---	---	---	1	1
Nicaragua	3	11	---	2	---	29	10	2	3	3	4
Nigeria	2	1	1	---	2	2	1	---	---	2	---
Pakistan	---	---	---	---	---	---	---	---	---	1	---
Panama	---	1	---	1	1	2	---	1	---	3	---
Paraguay	1	---	---	---	---	---	---	---	---	1	---
Peru	1	6	---	5	---	6	2	4	1	3	---
Philippines	4	5	32	---	12	8	---	---	---	1	---
Poland	1	---	1	---	---	---	---	---	---	---	---
Saudi Arabia	1	---	---	---	---	---	---	---	---	---	---
Senegal	---	---	---	---	1	---	---	---	---	---	---
Seychelle Islands	---	---	---	---	---	2	---	---	---	---	---
Singapore	---	1	1	---	3	---	---	---	---	---	---
South Vietnam	---	1	---	---	1	1	---	---	---	---	---
Spain	---	---	---	---	1	---	---	---	---	---	---
Sri Lanka	---	---	---	---	1	1	---	---	---	---	---
Switzerland	2	1	10	---	2	7	22	---	---	1	---
Sweden	---	---	---	---	---	1	---	---	---	---	---
Tahiti	---	2	---	---	---	2	---	---	---	---	---

Country	Status	AqWeed	AqEquip	Metodos	Equipm	Trops	WSS/1&2	Frio	Lists	Biblio	Misc
Taiwan	---	---	1	---	1	---	---	---	---	---	---
Tanzania	1	1	---	---	1	3	---	---	---	1	---
Thailand	1	5	4	---	5	6	---	---	---	1	---
Tunisia	---	---	---	---	1	---	---	---	---	---	---
Turkey	1	---	---	---	1	---	---	---	---	---	---
Uruguay	---	---	---	5	---	2	---	2	1	1	1
USSR	---	---	---	1	---	---	---	---	---	---	---
United States	122	41	125	4	141	111	30	12	1	93	---
Venezuela	---	1	---	4	3	2	4	---	---	5	---
Western Samoa	1	---	---	---	---	1	---	---	---	---	---
West Germany (BDR)	4	1	---	---	2	3	3	---	---	1	---
West Indies	---	---	---	---	---	---	---	---	---	---	---
Jamaica	---	1	1	---	1	---	4	---	---	6	35
Trinidad	---	---	---	---	---	2	---	---	---	3	---
Other	1	---	---	---	1	2	---	---	---	5	---
Zaire	---	---	---	---	---	1	---	---	---	---	---
Zambia	---	---	---	---	---	1	---	---	---	---	---
TOTALS FOR 1974	208	176	258	194	350	517	162	55	12	253	93

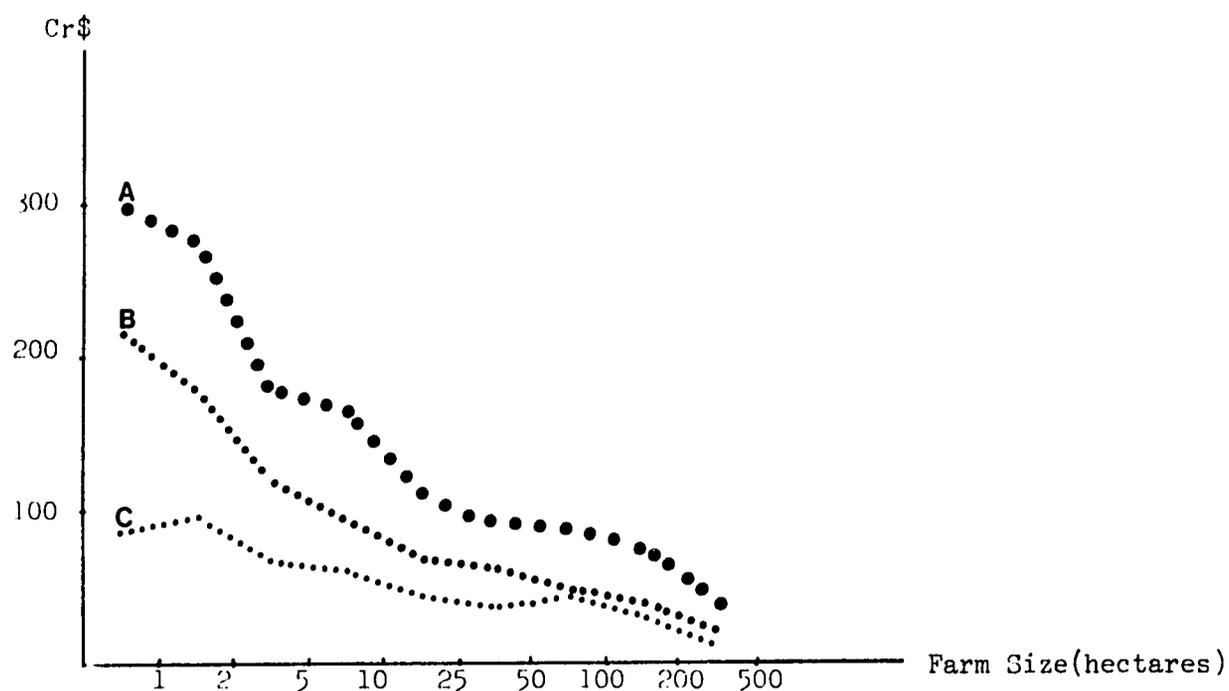
Overall Total 2278

APPENDIX VI - PROJECT PERSONNEL

- Arnold P. Appleby, Corvallis, Weed Control Specialist, 22% FTE,
April 1, 1974 to March 31, 1975.
- Ronald Burr, Corvallis, Extension Weed Control Specialist, 12% FTE,
April 1, 1974 to January 31, 1975.
- Larry C. Burrill, Corvallis, Weed Research Specialist/Support Agronomist,
April 1, 1974 to March 31, 1975.
- Dolores de Casanova, El Salvador, Secretary, April 1, 1974 to March 31, 1975.
- Richard L. Chase, El Salvador, Weed Research Specialist, May 1, 1974 to
March 31, 1975.
- Tracy Colby, Corvallis, Secretary/Publications Specialist, 60% FTE,
July 2, 1974 to March 31, 1975.
- Allan Deutsch, Corvallis, Information/Administration, April 1, 1974 to
March 31, 1975.
- Herbert H. Fisher, Brazil, Weed Research Specialist, April 1, 1974 to
March 31, 1975.
- Frank Fraser, Corvallis, Technician, April 1, 1974 to March 31, 1975.
- Georgena S. Knapp, Corvallis, Fiscal/Translation, April 1, 1974 to
March 31, 1975.
- Stanley F. Miller, Corvallis, Director and Agricultural Economist,
April 1, 1974 to March 31, 1975.
- Barbara Pleskac, Corvallis, Secretary, April 1, 1974 to June 14, 1974.
- Myron Shenk, Brazil, Weed Research Specialist, April 1, 1974 to
March 31, 1975.
- Myrna Wade, Corvallis, Secretary, April 1, 1974 to March 31, 1975.
- Douglas L. Young, Brazil, Agricultural Economist, April 1, 1974 to
March 31, 1975.

APPENDIX VII - GRAPHS

TABLE 1 - MEASUREMENTS OF EFFICIENCY BY FARM SIZE*



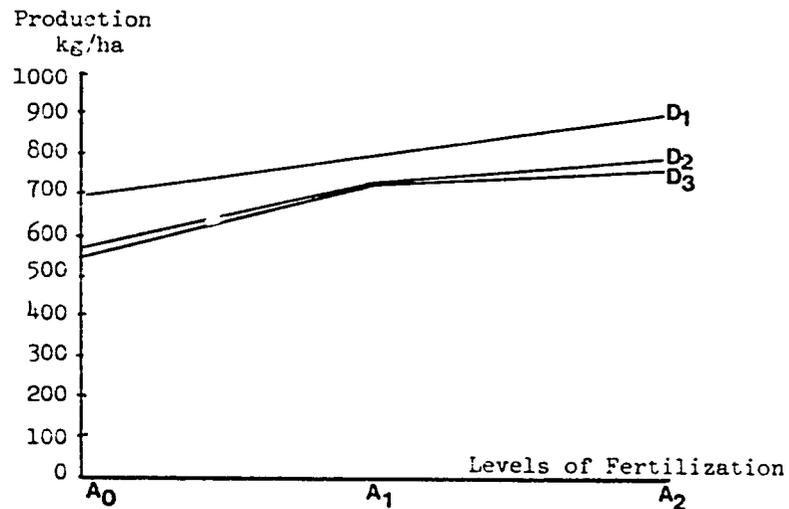
A = Total Value of Production (Cr\$/ha)

B = Value of Production Lost, Consumed or Stored (Cr\$/ha)

C = Value of Production Sold (Cr\$/ha)

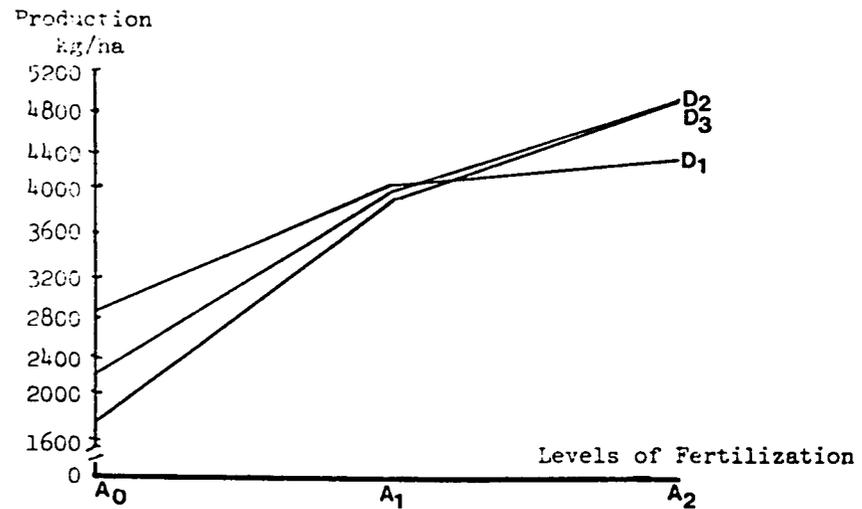
* Derived from statistical survey of I.N.C.R.A., municipality of Caruaru, Pernambuco, Brasil, 1974.

EXPERIMENT III: INTERACTION BETWEEN DIFFERENT LEVELS OF FERTILIZATION AND PLANT DENSITY
 IN BEANS AND CORN. Average Production in kg/ha - 13% Humidity, Caruaru,
 Pernambuco, Brasil, 1974.



BEANS

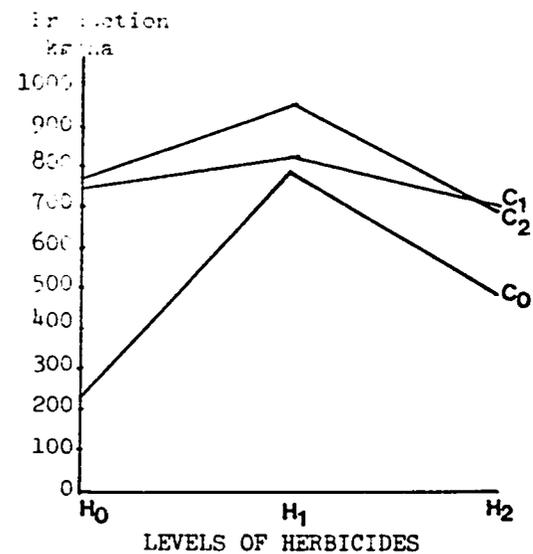
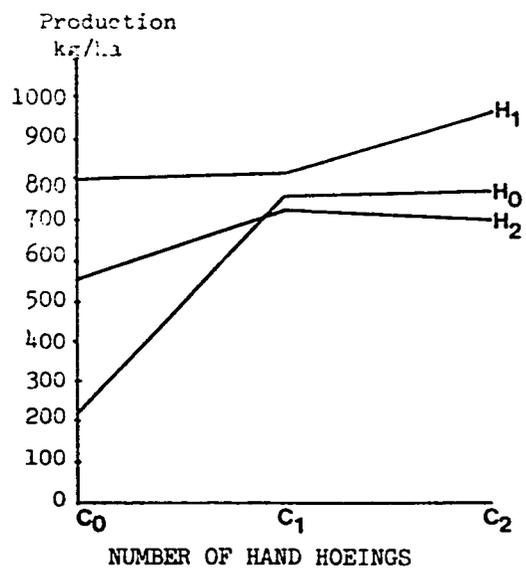
A₀ = without fertilizer
 A₁ = 20-20-40 (N, P₂O₅, K₂O)
 A₂ = 40-40-80 (N, P₂O₅, K₂O)
 D₁ = 125.000 plants/hectare
 D₂ = 166.667 plants/hectare
 D₃ = 250.000 plants/hectare



CORN

A₀ = without fertilizer
 A₁ = 80-40-40 (N, P₂O₅, K₂O)
 A₂ = 160-80-80 (N, P₂O₅, K₂O)
 D₁ = 25.000 plants/hectare
 D₂ = 50.000 plants/hectare
 D₃ = 74.083 plants/hectare

EXPERIMENT I: SUBSTITUTION BETWEEN LABOR (HAND HOEINGS) AND CAPITAL (CHEMICAL CONTROL) FOR WEED CONTROL IN BEANS, UNDER TRADITIONAL TECHNOLOGY. Average Production in kg/ha - 13% humidity, Caruaru, Pernambuco, Brasil, 1974.

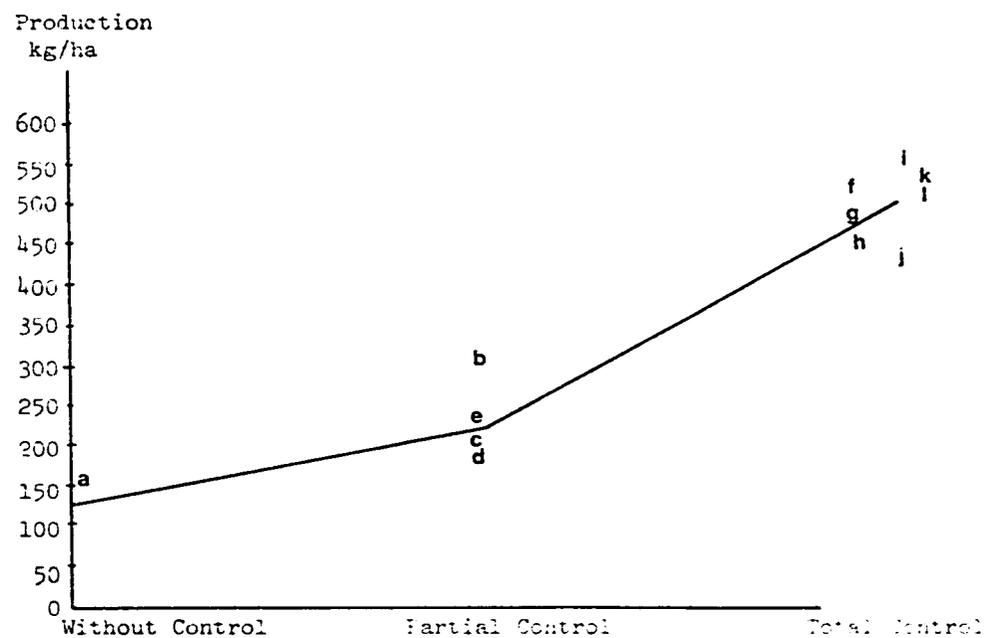


H₀ = without herbicides
H₁ = linuron + alachlor 0.5 + 1.5 kg a.i./ha Pre
H₂ = linuron + alachlor 1.0 + 3.0 kg a.i./ha Pre

C₀ = without hoeings
C₁ = one hoeing
C₂ = two hoeings

EXPERIMENT V: COMPARISON OF MANUAL, MECHANICAL, CHEMICAL AND INTEGRATED METHODS
FOR WEED CONTROL IN BEANS.

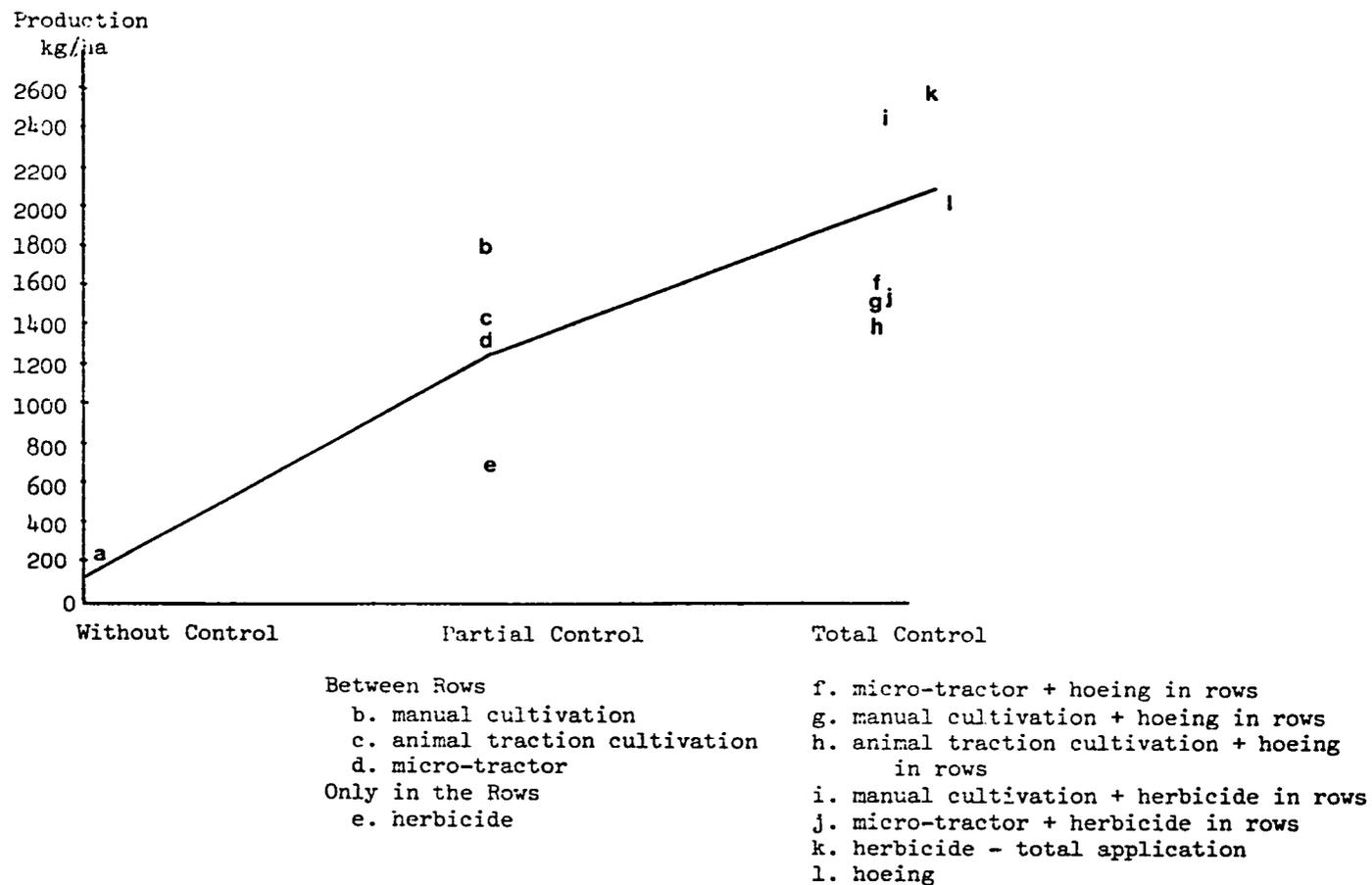
Average Production in kg/ha - 13% Humidity, Caruaru, Pernambuco, Brasil, 1974.



- | | |
|--------------------------------|---|
| Between Rows | f. animal traction cultivation + hoeing in rows |
| g. manual cultivation | g. micro tractor + hoeing in rows |
| c. animal traction cultivation | h. manual cultivation + hoeing in rows |
| d. micro tractor | i. manual cultivation + herbicide in rows |
| Only in the Rows | j. micro tractor + herbicide in rows |
| e. herbicide | k. herbicide - total application |
| | l. hoeing |

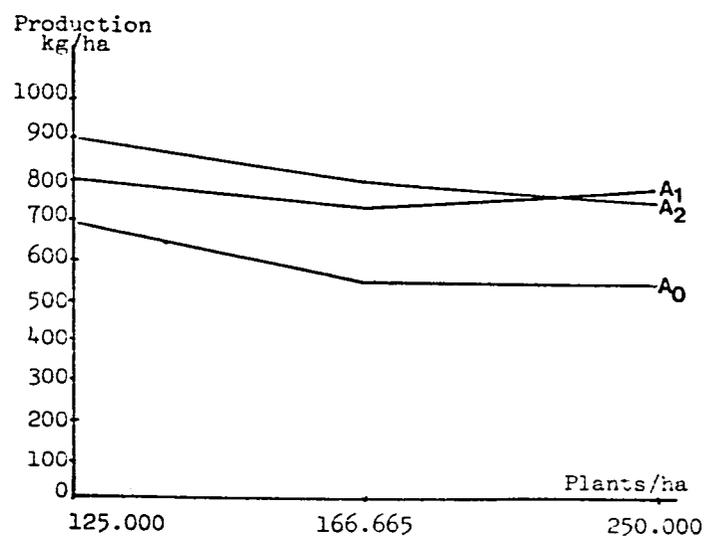
Source: Oregon State Project/EMBRAPA/USAID, Recife, Pernambuco, Brasil.

EXPERIMENT V: COMPARISON OF MANUAL, MECHANICAL, CHEMICAL AND INTEGRATED METHODS OF WEED CONTROL
 IN CORN. Average Production in kg/ha - 13% Humidity, Caruaru, Pernambuco, Brasil, 1974.



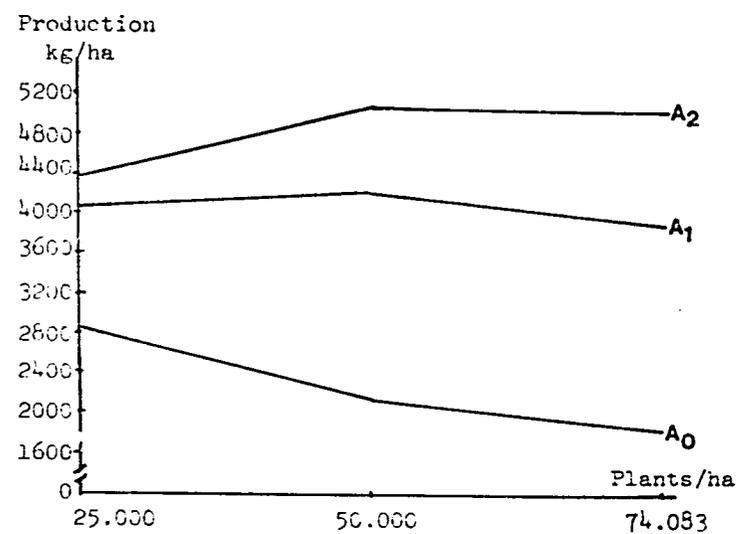
Source: Oregon State Project/EMBRAPA/USAID, Recife, Pernambuco Brasil

EXPERIMENTO III: INTERACTIONS OF DIFFERENT LEVELS OF FERTILIZER AND PLANT DENSITY IN CORN AND BEANS.
Average Production in kg/ha - 13% Humidity, Caruaru, Pernambuco, Brasil, 1974.



BEANS

A₀ = without fertilizer
A₁ = 20-20-40 (N, P₂O₅, K₂O)
A₂ = 40-40-80 (N, P₂O₅, K₂O)



CORN

A₀ = without fertilizer
A₁ = 80-40-40 (N, P₂O₅, K₂O)
A₂ = 160-80-80 (N, P₂O₅, K₂O)