WEED RESEARCH IN SRI LANKA

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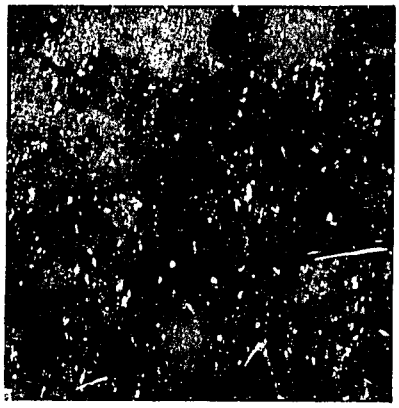

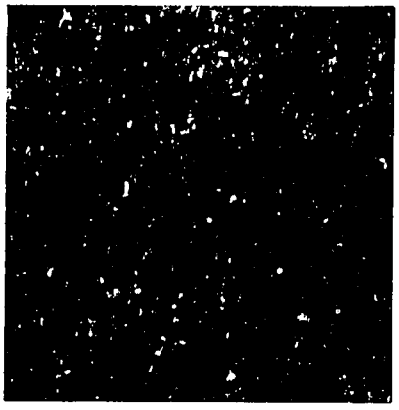
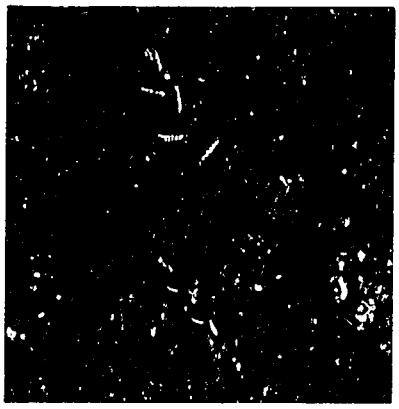

DEPARTMENT OF AGRICULTURE
PERADENIYA, SRI LANKA
1992

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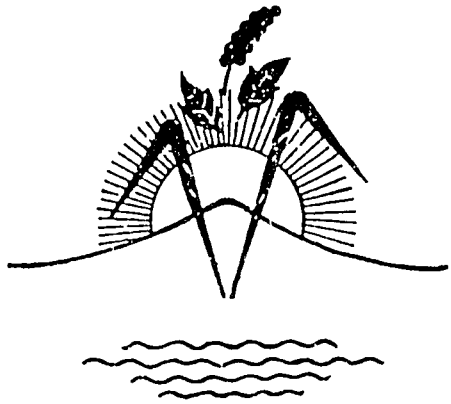

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University of Peradeniya
Sri Lanka

DEPARTMENT OF AGRICULTURE
PERADENIYA, SRI LANKA

MINISTRY OF AGRICULTURAL DEVELOPMENT AND RESEARCH
GATAMBE, PERADENIYA, SRI LANKA
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FOREWORD

Weed research is a relatively new discipline, not only in Sri Lanka but also in all parts of South East Asia. According to research and survey documentation, yield losses due to crop–weed competition are estimated at 25 – 30%, while weed control accounted for nearly one third of the cost of production. Besides, herbicides have been used extensively in the recent years, casuing adverse effects on the environment.

In Sri Lanka, considerable research has been conducted on weeds, and methods of weed control in both annual and perennial crops. This research continues as weed problems have become intensified with the adoption of new farming technologies. To date, there had been no attempt to compile the available literature on weeds and their control to support the research. Professor H. P. M. Gunasena, Professor of Crop Science and Dean of the Faculty of Agriculture of the University of Peradeniya has been requested to accomplish this ardous task by the Diversified Agricultural Research Project of the Department of Agriculture, funded by USAID. In my view, no other person would have been more qualified by training and experience to achieve such as extensive and accurate bibliography on local weed research.

Professor Gunasena obtained a Bachelors degree in Agriculture from the University of Ceylon in 1963, and a Ph.D. degree in agronomy from the University of Reading, U.K. in 1969. He has to his credit 90 research publications in recognized local and foreign journals, more than 100 scientific communications, seven text books, one of which was the winner of a Presidential Award for the best scientific publication, Over 30 postgraduate students from Sri Lanka and abroad have received their M.Sc. and Ph.D. degrees under his guidance. He has represented Sri Lanka at a number of international conferences concerned with agriculture. Further, he is a member of several agricultural Societies and advisory bodies of the Government, including the recently established Council for Agricultural Research Policy (CARP).

This bibliography has two unique features. It is the first of its kind compiled on any discipline in Sri Lanka, and it has assembled all published research on pernicious weeds in annual and plantation crops and on specific weed problems, such as Salvinia. For convenience, the book has been divided into several sections. These include research on general aspects of weeds, weed control in rice, upland crops, tea, rubber, coconut, special weed problems and herbicides, and with a subject and author index. Therefore, this bibliography will be of immense value to agricultural scientists, research students and farmers alike. It will provide background knowledge for planning weed research and management, prevent duplication of research and ultimately contribute to increasing the potential food supply for the expanding population.

In conclusion, Professor Gunasena has admirably succeeded in compiling a complete bibliography on weed research in Sri Lanka. Such a valuable and noteworthy contribution in this important field is worthy of our deep appreciation and gratitude.

Hon. R. M. Dharmadasa Banda
Minister of Agricultural
Research and Development.

INTRODUCTION

Numerous studies in various countries have shown that weeds cause greater losses than all pests combined; Sri Lanka is no exception. Yet, a recent survey showed that herbicide applications comprised of two percent or less of farmer pesticide use on subsidiary food crops. Competition from weeds is probably the single most important constraint on crop production in Sri Lanka, particularly production of subsidiary food crops.

Historically, there has been less emphasis on training in weed science than on other scientific disciplines in the Department of Agriculture (DOA). As a result, the country has fewer well trained researchers in weed science than in other disciplines. In response to an urgent need for weed scientists, the Diversified Agricultural Research Project has provided a scholarship for a DOA research officer to obtain a Ph.D. in weed science.

Effective and appropriate research must be based on a review and assessment of the existing body of knowledge on the subject. Publication of this bibliography provides researchers in weed science with a compendium of all weed research in Sri Lanka. The volume of research is sufficiently small to permit inclusion of an informative summary of weed research in all crops and fields.

The author, Professor H. P. M. Gunasena, is to be congratulated for his foresight and initiative. These attributes, accompanied by his thorough, painstaking and time-consuming effort have produced a book that is a valuable contribution to weed science and to Agriculture in Sri Lanka.

Dr. G. W. Selleck
Chief of Party
Diversified Agriculture Research Project
Department of Agriculture
Peradeniya.

PREFACE

Weeds are a major problem in tropical and sub-tropical agriculture. They reduce crop yield and quality, interfere with harvesting, and increase the cost of production. Weeds also cause economic losses indirectly by serving as alternate hosts to insects and plant pathogens.

It has been estimated that weeds reduce crop yields by 25-30 percent, while weed control accounts for nearly one-third of the cost of production Yield losses vary depending on the prevailing environment, cultural practices, and crop species. The severity of the problem is indicated by recorded cases of complete crop losses in highland agriculture in the Dry Zone of Sri Lanka. Therefore, weed control is a major factor in the management of highland crops in the Dry Zone. Although there are more weed species associated with highland than with lowland crops, they have not been studied extensively. Surveys conducted in lowland rice fields have identified about 120 weed species belonging to 32 families.

The use of herbicides for weed control has become more popular in paddy than traditional methods. Several field surveys conducted on herbicide use indicated their improper use thereby endangering human and animal life and polluting the environment. A thorough knowledge of the chemical composition of herbicides and their use is therefore warranted, and an assessment of the present status of weed control is urgently needed.

Numerous studies on specific weed species and methods of their management have been conducted in both the annual and perennial crop sectors during the past several years. Although many of these have been published locally and abroad, a substantial number remain unpublished. As a thorough knowledge of previous research is essential for designing future weed management programmes, the main objective of this bibliography has been to assemble scattered information into an easily accessible form. It is designed to assist agricutlural scientists, weed specialists, students, plantation managers and farmers. To this end, abstracts have been expanded to contain more information than is normally included. Bibliographies on weed research on tea, rubber, coconut, lowland rice, and highland annual crops have been included to make it a useful source of information to all sectors of agricuture. The weed research conducted overseas by Sri Lankan scientists too, have been included.

This book owes its inception to Dr. G W. Selleck, Chief of Party of the USAID funded Diversified Agricultural Research Project of the Department of Agriculture. He conceived the idea, based on the urgent need for and the usefulness of such a compilation to the agriculture of Sri Lanka. I am also greatly indebted to Dr. Selleck for writing the Introduction to this book.

I owe much to my colleagues in the Department of Crop Science, particularly to B.B. Marambe, D. K. N. G. Pushpa Kumara, and Arunodini Jayasinghe for assisting me in collecting and abstracting weed research publications, and in innumerable important ways. I also express my thanks to Dr. S. D. I. E. Gunawardena, Director of Agriculture; Drs. H. M. E. Herath and S. Amarasiri, Deputy and Additional Deputy Directors of Agriculture (Research); Regional Directors of Research and research officers of the Department of Agriculture;

Directors of Tea, Rubber and Coconut Research Institutes and their staff, Dr. R. Senaratne of the Faculty of Agricutlure, Ruhuna University; and Dr. S. Sandanam, Eastern University, for their cooperation and encouragement, and for providing research information for inclusion in this book. I wish to record my sincere gratitude to Mr. W. M. T. Wanisekara, Miss Srini Warellagama and Miss Manjali Suwaris for the tedious task of typing the manuscript. The financial support for printing provided by the United States Agency for International Development through the Diversified Agricultural Research Project is greatefully acknowledged.

I am gratefully indebted to Hon. R. M. Dharmadasa Banda Minister of Agricultural Development and Research who consented to write the Foreword to this book in recognition of the great importance of weed research in agricultural production systems.

Professor H. P. M. Gunasena
Dean, Faculty of Agriculture

University of Peradeniya,
Peradeniya,
Sri Lanka.
June 1992.

GENERAL ASPECTS OF WEED CONTROL

ALAHAKOON, P. and AMARASIRI, S. L. (1987). Effect of *Lantana camara* Crude Extract on Yield of Oyster Mushroom *(Pleurotus ostreatus)* on Paper Bedding, Proc. Sri Lanka Asso. Adv. Sci. 43 Annual Session, 18.

As yields of oyster mushroom (*Pleurotus ostreatus)* obtained in paper medium by steam sterilization were low, an experiment was conducted at the Regional Agricultural Research Centre, Bandarawela, to determine the effect of addition of *Lantana camara* to the waste paper medium.

One litre of *Lantana camera* crude extract of concentration ranging from 20–100% was added to one kilogram paper beds in aluminium trays. Fifty grams of wheat grain spawn of oyster mushroom was introduced to each treatment and recordings taken of the number and fresh weight of mushroom. The controls were created by streamed and unsteamed paper media.

While the addition of *Lantana camara* resulted in more than an eighteen fold increase in yield of mushroom over the untreated control, steam sterilization gave only a five fold increase. Since the *Lantana* treatment produces a much higher yield of mushroom than the steam treatment, which is the widely accepted sterlization methods, it can be hypothesised that the *Lantana* treatment is superior to steam treatment as a sterilization mechanism.

ALEX J. F. (1987). Weed Control and Integrated Pest Management, Final Report Submitted to Diversified Agric. Res. Project Dept. of Agric. Peradeniya. 1-16.

The report indicates that weed biology and control are carried cut by many agricultural research institutes and universities. A National Committee on Weeds is suggested for coordination of weed research. The other recommendations made in this report are, to modify the national coordinated herbicide screening test for rice, to develop programmes for research on the biology, ecology and control of weeds in subsidiary food crops, to develop and publish a manual on weed identification, to realocate duties of the coordinator of weed research in the Department of Agriculture, to appoint research officers in weed science to the Regional Research Centers, to appoint technicians for weed science, to expand and upgrade research facilities for weed research at Regional Research Centers, to provide research staff with greater access to scientific literature, to encourage safe, accurate and proper storage, handling, application and disposal of all pesticides and empty pesticide containers, to introduce the concept of Integrated Pest Management (IPM) to research and extension officers working on subsidiary food crops of the Department of Agriculture and to foster interaction and cooperation among the Department of Agriculture, the Faculties of Agriculture and Science, Postgraduate Institute of Agriculture of University of Peradeniya and other seats of higher education in Sri Lanka.

AMARASENA, R. W. (1958). Plant Hormones and Their Uses in Agriculture Applications, Weed Control. Agriculture 1(i) 42-43.

The possibility of the use of 2,4 D was suggested for the control of weeds. The substance is a weed killer when administered in suitable concentrations to certain broadleaved weeds. Applied in the soil it may prevent the germination of seeds of undesirable plants. In certain crops the average rate of application of 2,4 D for weed control is about (1 l/ac).

In order to suppress germination completely, in certain species of plants like garden cress, concentrations of 10 ppm of 2.4 D is used. If, however, to kill mature plants by the application of hormone sprays to leaves, concentrations of about 100 ppm will have to be used.

ANON (1932). Cover Crops and Weed Control. Trop. Agriculturist. LXXVIII, 127–128.

Weed control in perennial crops is essential and considered difficult. This can be attained by cultivation but it is difficult and costly. Growing of cover crops is suggested as an alternative. When selecting a cover crop it must be taken into consideration that the cover crops also compete with the main crop and this competition should be controllable. Cover cropping must receive a fuller study. The most suitable cover crop to grow under a particular condition will be one whose natural life confirms to the season and quantitative requirements demanded by the main crop and whose biology allows artificial control.

ANON (1956/57). Admin. Rept. Consrve. FORESTS for Ceylon 11,6, Disposal of Unwanted Trees.

2,4,5–T (butyl ester) 1,2 and 36% in diesoline, killed *Ficus retusa* within a few weeks at all concentrations. *Artocarpus nobilis, Horsfieldia iryaghedi, Dipterocarpus zeylanicus* and *Canarium zelanicum* succumbed readily; *Gamelina arborea* proved very resistant and *Hemicyclia sepiaria* was unaffected. (P. 13).

Control of Imperata grass. *Imperata cylindrica* was almost eradicated in teak plantations by ploughing and sowing with *Tephrosia candida* (P. 35).

ANON (1957/58). Admn. Rept. Conser. FORESTS for Ceylon Arboricide Trials. 1-10.

Promising results in killing out *Ficus retusa* were obtained with brush applications of 2,4,5–T (butyl ester) in 3.2 and even 1% diesoline. Even at 3%, Wira was unaffected. Very satisfactory results were obtained also with; Ruk (*Alstonia scholaris*), Arrida (*Campnospermum* sp.), Del (*Artocarpus nobilis*), Jak (*Artocarpus* spp), Mahogany (*Swietenia* spp), Kekuna (*Canarium* spp), Halmilla (*Berrya ammonilla*) and Kon (*Schleichera* spp).

ANON (1979). Strengthening of Plant Protection Services Phase 2 (Research) Sri Lanka. Weed Control on Agricultural Crops (Herbicides) FAO–AGPP – SRL/78 006 Rome.

Research on weed problems in the major crops in Sri Lanka, including rice, fruits and vegetables, plantation crops and other cash crops and in irrigation canals are reported. Extension programmes and organization including personnel and facilities, needed for dealing with weed control in the major crops are recommended. Establishment of a Weed Control Research Unit is also considered as important.

BANDARA, B. M. C. (1977). Weed Control in Plantation Crops - 500 Series Res Rept. Faculty of Agriculture, University of Peradeniya.

Although the yield losses due to weed competition in plantation crops have not been fully assessed, weed control is recognized as a major cultural practice. Many methods have been used to control weeds, but a combination of several methods were found to be more economical. These are grouped into mechanical, cultural, biological and chemical methods and each group has their own advantages and disadvantages. The weed control practices adapted in the major plantation crops are described The use of chemicals are costly and their import also incur valuable foreign exchange. Therefore, replacement of chemicals either fully or partially has been suggested to overcome foreign exchange problems facing the country.

BAPTIST B. A. (1984) Registration Requirements for Weedicides. Proc. Symp. Weeds and Weedicides. Sri Lanka Assoc. Adv. Sci. 15th September, 45-48.

Herbicides have been brought under the Legislature, Act, The Control of Pesticides Act No. 33 of 1933. This Act provides for licensing of pesticides, regulate import, packing, labelling, storage, formulation, transport, sale and the use thereof, and other connected matters. The official authority for registration is the Registrar of Pesticides who shall be responsible to the Director of Agriculture.

CHANDRASENA J. P. N. R. (1984). Weed Research Requirements for Sri Lanka. Proc. Symp. Weeds and Weedcides. Sri Lanka Asso. Adv. Sci. 15 September, 1-6.

Attention is drawn to the weed problem in Sri Lanka which needs a great deal of new thinking. The need to intensify and maintain research on the biology, ecology and physiology of weed plants, is pointed out, as there is a great scarcity of information on local weeds. In addition to basic biological studies attention must be given to seek and identify all factors that limit or control the growth of weeds in each ecosystem. Excessive use of weedcides which causes crop damage due to improper rates of application, personal danger to users due to persistence, development of resistance to the chemicals in certain plant species, shifts in the balance of weed populations is not recommended. The possibilities offered by biological control of weeds is of importance. Integrated weed control is projected as the best option for weed control in countries such as Sri Lanka.

DASANAYAKE M. D. and FOSBERG F. R. (1981). A Revised Handbook of the Flora of Ceylon, Vol. III Rotterdam, Netherlands A. A. Balkema. ISBN 90–6191–063–3.

The volume includes information on the following families; Ebenaceae, Gentianaceae, Gesneriaceae, Lamiaceae, Lecythidaceae, Martyniaceae, Menyanthaceae, Moraceae, Sabiaceae, Pandanaceae, Sonneratiaceae, Symiplocaceae and Umbelliferae. A botanical description of each family is provided, with keys and descriptions of the constituent genera. Some of these families includes weeds of importance in agricultural lands.

DE SOYZA, D. J. (1933). Weeds. Trop: Agriculturist (Cey.) LXXV 198-205.

The study of life histories of weeds and methods of dessimination have to be considered when selecting control measures. According to the duration of life, weeds may be short-lived or long-lived; the former are classed as annuals and biennials, the latter as perennials. Many of the worst weeds are perennials. Beside seeding they can propagate vegetatively. The first principle in destroying weeds is to control them before they reach maturity and produce seed. Constant weeding at short intervals is necessary because weeds drop their seeds at varying intervals. Some annuals as *Mollugo pentaphylla,* S. Walpatpadagam,*Euphorbia thymifolia,* S. Bindada-Kiriya, *Phylanthus niruri* and *P. urinaria,* S. Pita wakka, flower and seed when quite young. Tillage operations will lead to the immediate germination of a large proportion of seeds which should be followed by systematic repeated weeding. Perennial weeds could be kept under control by continual mowing down and removal of the green aerial parts. The use of weed-killers such as sodium arsenite is also discussed. Weeds can be suppressed by crop rotations as the different cultivation practices could control different kinds of weeds. To lessen the soil erosion which is caused by continuous clean weeding, the use of cover crops such as *Desmodium triflorium,* S. Hin-undupiyali *D. heterophyllum,* S. Maha undupiyali, *Alysicarpus vaginalis, Ipomaea cymosa,* S. Maha-madu and S. Aswenna are recommended.

DIAS, J. C. S. (1979). Energy Input in Weeding. Proc. 11 Sympocia Nacional de Herbologia Oerian, 93-96.

Relative inputs of energy in manual, mechanical, biological and chemical weedings are compared and the economic aspect discussed.

DIAS, I. P. S. (1957). New Nozzles for Weed Control in Flax. Machanisace Zemedelstvi 7 (12) 279-291.

The main disadvantage of the Azota 50 sprayer was its short spray boom. This was overcome by moving 2 nozzles to the end and blocking all but these and the central nozzle. A perforated plate was fitted under the latter. The modified sprayer performed well in flax and cereal weed control.

GOMEZ, A. S. B. (1984). Weedicides and Their Potential, Symp. on Weeds and Weedicides. Proc. Sri Lanka Assoc. Adv. Sci. 15th September. 39-41.

A historical sketch on the development of herbicides is presented. These herbicides have become popular among farmers in the annual and the plantation crop sectors. An ideal herbicide for use would be one with low toxicity and compatible with other pesticides and fertilizers. The granular type has the advantage that they do not require spray equipment. The importance of weed control to prevent crop losses is stressed.

GUNASENA, H. P. M., JINADASA, A. P. JOGARATNAM, T. and PREMAKUMAR V. (1975/76) Quantification of Yield Constraints. Constraints to Higher Yields on Asian Rice Farmers. Interim Report, IRRI.157-187.

During the wet season a yield gap of over 1 t/ha was measured on 4 complex requirements while 8 simpler experiments showed an average gap of 0.6t/ha. Insect control was the primary factor contributing to the gap. In the dry season, results were very erratic due to poor water control. None of three major factors tested, fertilizer, weed control, or insect control stood out as most important. The wet season economic analysis showed that 57.8 kg/ha of N with handweeding and Fenitrothian sprays as most profitable, on the average, although N–91.8 Kg/ha, P–57, 66 Kg/ha and K–24.2 Kg/ha with Saturn G 4 DAT, Handweeding 35–42 DAT and Furadan gave a higher yield. Weed control practices were more expensive than their returns while fertilizer and insect control added to profits. In both seasons the researchers fertilizer treatments resulted in a higher yield than the farmers although farmers used higher rates, apparently indicating inefficient fertilizer use.

GUNASENA, H. P. M. (1984). Weed Control, *In* Principles of Agriculture (Sinhala) M. D. Gunasena & Co. Ltd. 369–396.

In Chapter 10 of the above text, the subject of weed control has been treated exhaustively. It describes in detail the losses caused by weeds. The weeds have been classified as annuals, biennials and perennials. The perennials are further grouped based on their methods of propagation and growth habit. Several important highland and lowland weed species have been described, including their biology which will indicate the appropriate methods of control. The methods of weed control which include mechanical, cultural, biological and chemical have been presented in depth, giving examples in each case.

GUNASENA, H. P. M. (1987). *In* Field Crop Production. 2nd Ed. M. D. Gunasena & Co. Ltd. Colombo. (In Sinhala),

This book describes the cultivation of 44 field crops grown in Sri Lanka. Weed control has been discussed for each crop as a separate section under cultural practices. The recommendations have been comprehensively presented.

JAYATHILAKE, J. (1970). Skin Absorption of Pesticides. Krushi I (2) 7–8 (In Sinhala).

Pesticides get absorbed in to the human body through the skin when handling them, sprinkling, mixing and spraying etc. Eyes, scalp, back of neck, forehead, and scrotal region absorb pesticides faster than the other parts of the body. Therefore, the farmer should take care when handling pesticides. The body should be fully covered and if accidentally spilled immediate washing is necessary.

JAYATHILAKE, J. (1983). Use of Agrochemicals, Krushi 5 (4) 21-24.

Agrochemicals include a variety of chemicals such as pesticides, fungicides, weedicides, rooting hormones etc It is necessary to exercise care when using them to prevent contaminating as they are poisonous. The author describes the steps to be taken in the preparation of pesticides for use and also when they are sprayed in the field. The report also states the precautions to be taken by the farmers when spraying the pesticides and also after they have been used.

LEWIS, C. J. and WATSON, G. A. (1972). Extension Work with Herbicides in the Small Scale Tropical Farm Situations, Proc. 11th Brit. Weed Control Conf. 1078-1083.

Integrating herbicides into plantation cropping presents no special problems and small holders sometimes follow the practice of the large plantations and use herbicides in cash crops. Subsistance farming, however, is labour intensive and introducing herbicides into it involves coping with problems of the multitude of small cultivators following diverse cropping practices, together with the difficulty of providing sufficient incentives to secure the adoption of the new techniques. Minimum cultivation techniques based on Paraquat are used in Japan, Ceylon, Western Malaysia and Philippines.

ONDEJANS, J. H. and STARING W. D..E. (1984). ARSAP Agro Pesticide Index, Economic and Social Comm. Asia and the Pacific. ESCAP, UN Building. Bangkok, Thailand.

Common and trade names of agro pesticides (acaricides, fungicides, herbicides, insecticides bactericides, and fumigants) used in Afganistan, Bangladesh, Burma, India, Indonesia, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka and Thailand between 1979 and 1983 are listed alphabetically under trade names with their chemical grouping.

PARANAGAMA, D. M. (1986). Recent Experiments on the Production of Insecticides from Plant Sources. Govikam Sagarawa (In Sinhala) 30(1/4)31-34.

The article describes the natural mechanisms of plants to overcome pest attacks. The instances quoted are mostly relating to insects, but a few cases of allelopatic effects of plants are presented citing Sorghum, Sunflower, Walnut from abroad and *Pyrethrum* spp. in Sri Lanka.

PARKER, C. (1963). The Development of Herbicide Use in Southern Asia. Proc. 9th Brit. Weed Control Conf. 1964-1270.

The importance and potential of weeds research in India, Pakistan, Ceylon, Thailand and the Philippines is discussed with reference to some of the major weed problems and the present development in herbicide usage.

PEMADASA, M. A. and KANAGATHARALINGAL, N. (1977). Factors Affecting Germination of Some Composites, Ceylon J. Sci. (Bio. Sci) 12(2) 157–168.

An investigation was made of some factors affecting germination of nine species of composites *Ageratum conyzoides, Emilia sonchifolia, Erigeron sumatrensis, Eupatorium riparium, Mikania scandens, Sonchus arvensis, Tridax procumbens, Vernonia cinera* and *Vernonia setigera*. Both the germination and hydration of achenes of all the species were higher when the dispersal unit lands with the achene-proper touching the substrate and pappus directing upwards than when it lands with pappus facing downwards so lifting the achene-proper away from the substrate. Germination is promoted by light and inhibited by burial. The presence of pappus improves both germination and hydration of achenes of *A. conyzoides, E. riparium, M. scandens* and *T. procumbens*. The ecological implications of these results are briefly discussed.

RAMACHANDRAN S., RAJAPAKSE C. N. A. and PERERA M. V. F. (1974). Further Observations of Paraquat Poisoning. Forensic Sci. 4, 257-266.

The clinical features, the course of illness and the biochemical and autopsy findings in four fatal cases of Paraquat poisoning are described.

REEVE, A. T. (1923). The Water Hyacinth and It's Eraducation in West Giruwa Pattu. Trop. Agriculturist LX, 126-217.

The Water Hyacinth *(Eichhornia crassipes)* a native of Brazil was introduced into Ceylon as a garden plant. It has become a serious pest and efforts are being made to prevent it's spread. The tanks and waterways are being clean-weeded. The weed in all cases was pulled out by hand and piled on the bank. Afterwards they were burned or left unburned and subsequently have rotted. The germination of seeds may be delayed for as long as two years. It is necessary to watch for and remove young plants as soon as they appear.

SANGAKKARA, U. R. (1984). Weeds – Their Effects on Productivity Proc. Symp. Weeds and Weedicides. Sri Lanka Assoc. Adv. Sci. 15, September, 7-12.

Losses caused by weeds exceed the losses due to any other category of agricultural pests. Weeds are classified in different ways. They could be grouped as terrestrial and aquatic, woody and herbaceous, as trees, shurbs, broad leaved species, grasses, sedges, or ferns. According to their life-cycles weeds are commonly grouped as annuals, biennials and perennials. Weeds compete with crop plants for nutrients, moisture, light and carbon dioxide. This creates a harmful effect on the growth and yield of crops. Some weeds categoried as parasites such as *Cuscuta spp.* and semiparasites *(Odontities verna)* create direct adverse effects by absorbing nutrients and water from crop plants. Weeds such as *Digitaria sanguinalis, Echinochloa crusgalli, Chenopodium album* cause allelopathic effects on crop plants. They release toxic compounds which have been identified and include terpenoids, steriods, alkaloids and derivatives of benzoic acid. Presence of particular weeds species with tough stems such as *Chenopodium album* can make agricultural operations more difficult and costly. Along with these harmful effects, some beneficial effects have also been highlighted. They contribute to preserving soil structure and regulating fertility.

SENANAYAKE, H. E. (1984). Hazardous and Safe Handling of Pesticides. Krushi 6 (4) 33-37.

Pesticides are not only hazardous to man but also to other animals and the environment. The report gives the number of persons admitted to hospitals in Asian countries due to pesticide (including weedicides) poisoing. General instructions before applying any pesticides, precautions to be taken in mixing and spraying and after application are presented.

SENEVIRATNE S. T. and APPADURAI R. R. (1966). *In* Field Crops of Ceylon. Lake House Investments Ltd., Colombo.

This book describes the cultivation of 41 field crops grown in Ceylon. The control of weeds have been detailed separately for each crop with the current recommendations.

SIRIWARDENA, J. A. DE S., RANAWANA, S. S. E. and PIYASENA, G. A. (1970): Study of the Value of *Salvinia auriculata* for Growing Pigs. Trop. Agriculturist 126 (1) 31-34.

Pigs fed on the water weed performed very poorly compared with those fed on *Brachiaria brizantha* grass as part of the daily ration. It was concluded that *S. auriculata* in the fresh state is bulky and unpalatable and therefore has no practical value for feeding of pigs.

SIRIWARDANA, T. G. D. and AMARASINGHE, L. (1982). Review of Yield Loss Studies in Different Crops in Sri Lanka. Report of a Workshop on Cropping Systems Research in Asia.

Yield losses due to weeds were higher in broadcast sown rice than in transplanted rice grown during 1969-70: yields of Cv BG 11–11 were reduced by 27.3% when broadcasted and by 21.6% when transplanted. Weeds caused greater losses in dryland rice than wetland rice; under dryland conditions yield losses ranged from 66% in 1971-72 to 99.8% in 1975-76. Losses due to weeds in upland crops varied with the crop spp. Chilli was most sensitive to weeds, followed by Seasme, Cowpea, Soyabean and Groundnuts Major weed spp. were *Eleusine indica*, and *Echinochloa colonum* (in chilli) *Digitaria adscendens* (in soyabean) and *Echinochloa colonum* (in maize).

SIVALINGAM, T. (1974). Weed Seeds Through Cattle Manure-A Preliminary Study. Proc. Cey. Asso. Adv. Sci. 30 Annual Session (1) 47-51.

A conventional practice which has become more compelling, with the present scarcity of fertilizers and manures, is the application of cattle manure to crops. Preliminary studies on cattle manure collected from different locations, in and around Polonnaruwa, spells out the hazard of weed seed transference through this medium. Germination studies on the dried dung collected gave a greater proportion of weed growth from weed infested locations than from well managed pastures. Grazing a community or a jungle pasture had the highest incidence of weed seed infestation on the dung samples.

Discussion has been based on comparison of open grazing to zero grazing system and the extent of weed seed dispersal through the medium of cattle manure under these systems.

STARING, W. D. E. (1984). Pesticides: Data Collection Systems and Supply, Distribution in Selected Countries of the Asia. Pacific Region. Economic and Social Comm. Asia and The Pacific. UN. Building Bangkok, Thailand.

Pesticide (including herbicides) data collection systems for Bangladesh, India, Indonesia, Pakistan, Philippines, Korean Republic, South Pacific, Sri Lanka and Thailand are described. The report also presents the supply, distribution and use of pesticides in these countries. There is also a brief overview of the activities of ARSAP. (Agricultural Requisites Scheme for Asia and the Pacific during 1982–1983.

VELMURUGU, V. (1971). Chemical Weed Control in Some Important Crops. Dept. Agriculture Publication.

The booklet gives an account of the losses caused by weeds in the wet and dry zones of Sri Lanka. The traditional weed control by manual methods are compared with the use of chemical weed killers. The booklet lists, the current recommendations of herbicides made by the Department of Agriculture, together with the important properties of herbicides and sources from where they could be purchased locally. This is suitable as a farmers guide to the use of herbicides.

VELMURUGU V. and YOGARATNAM V. (1968). The Role of Herbicides and and Problems Arising Out of Their Use in Weed Control. Cey. Asso. Adv. Sci. 24 Annual Session (1)12.

The importance of weed control and problems arising from the use of herbicides are reviewed. The total area weeded (by hand, harrow and herbicides) in rice decreased from 610,000 to 477,000 ac from 1962/63 to 1965/66. Data on crop losses due to weeds are tabulated. Purchases of herbicides increased from a value of Rs. 1397 in 1962 to nearly Rs. 4.5 m. in 1968. Herbicide recommendations are tabulated.

WAIDYANATHA, U. P. DE S. (1980). New Horizons in Soil Water and Energy Conserving Farming Systems. Proc. Sri Lanka Asso. Adv. Sci. 36(2) 23-29.

Tillage is essential for weed control, although it causes erosion problems. Experiments done in Maha-Illuppallama reveal that non-inverting tillage implement and minimum tillage raise problems of weed control. Post-plant weed control can now be achieved by zero-tillage which is rapidly becoming popular. However, this method is not devoid of problems, and is not suited to all situations and soil types. Continuous use of particular herbicides in some cases has shifted the weed flora towards perennial grasses which are more difficult to control. The acceptance of this technique is determined by the cost of herbicides and it is pointed out that conventional tillage consumes 5 to 10 times more energy and 5 times more labour for crop establishment and weed control.

WEERARATNE, C. S. (1974), Biologically Active Compounds and the Soil. World Crops 26(4) 165-166.

The modifying effects of some herbicides and other pesticides on soil micro-organisms and the processes involved in the biological decomposition of agricultural chemicals in the soil are discussed briefly.

WEERARATNE, C. S. (1981). Effect of Tillage Practices on Soil and Crops. Proc. Asian Reg. Symp. on Problems of Soil Erosion and Sedimentation. Asian Inst. Technology, Bangkok, Thailand. 267–273.

Data are presented on the effects of clean weeding, incorporation of uprooted weeds into the soil, and no weed control on erodibiiity, organic matter content, aggregate stability and yields of okra.

WEERARATNE, C. S. (1983). Pesticides. Economic Review. 8 (10) 3-12 (In Sinhala).

The report presents the methods of weed and insect control in the past and the developments that has taken place in recent years. It includes herbicides, insecticides, fungicides, soil sterilents, nematocides, and acaricides. The herbicides commonly used in agriculture are listed and their effect on plants are discussed.

WEERARATNE, C. S. (1984). Weedicides and the Environment. Proc. Symp. on Weedicides. Sri Lanka Assoc. Adv. Sci. 15th September 42-44.

The author after a brief review on the history of weedicide development discusses the fate of weedicides when applied to soil and plant which includes absorption, volatalization and leaching. Various chemical reactions also occur in both the soil and plant. Herbicides are decomposed in the soil by micro-organisms. Therefore, most herbicides tend to remain in the soil only for a short period, but some compounds remain in the soil over long periods and cause pollution of the environment. Most herbicides when applied at recommended rates are unlikely to cause major undersirable effects to the environment.

WETTASINGHE, D. T. (1971). The Effect of the Use of Herbicides for the Control of Weeds on the Enrironment. The Environment and Agriculture. Tea Quart. 42 (4):201-205.

Introduction of highly active chemicals into the environment interfers with the complex interactions within natural ecosystems and upset the balance of nature'. Some of the side-effects that already have resulted, or may result from the use of herbicides are reviewed. These side-effects result in no more than a temporary upset in the ecological balance, and on the whole, herbicides at normal field rates have had no lasting effects on soil bacteria and fungi. However, further investigations in this field is necessary. When contact herbicides were used for the pre harvest dessication of peas, field beans, potato and cotton, it was found that herbicide residues on the dessicated plant material alters the pattern of colonization of the moribund plant tissues by fungi. Pest incidence is also influenced by herbicide use. Aphid infestations increased on oats sprayed with 2,4-D. 2,4-D brings changes in the biochemical composition of treated plants and the greater acceptability of treated plants to pests get influenced by these changes. It was found that the growth of rice stem borer (*Chilo suppressalis)* on 2,4-D treated rice plants was more rapid than on untreated plants.

With the continual use of herbicides with a similar spectrum of activity, more resistant weeds have become dominant in the weed flora. The development of multidisciplinary approach in evaluating new weed control techniques is urgent.

WHEELER, LOUIS CUTTER (1963). Euphorbeaceae of Ceylon. Nomenclatural Notes. Cey. J. Sci. Biol. Sci. 16 (1 & 2) 65-75.

Nomenclatutal problems of Acalypha, Agynaia, Aporosa, Breynia, Croton, Euphorbia, Gelonium, Givotia, Glochidion, Heavea, Phyllanthus, Podadenia, Putranjiva etc. are summarized. It is shown among other things that Suregada must be used instead of Gelonium, that Synostemon is to be used instead of Agynaia. Putranjiva is reduced to Drypetes and the Ceylon species of Ostodes belong to Fahrenheitia. Some of the species discussed are weeds prevalent in different parts of Sri Lanka.

WIJEWARDENE, R. (1978). Weed Control Equipment for the Small Holder in the Tropics, Proc: Conf. at the International Institute of Tropical Agriculture. 367-370.

This paper emphasises the close relationship between weeding and sowing in arable farming and between tools for tillage, weed control and sowing. Small farmers need special tools if they are to adopt the zero and minimum tillage techniques now being introduced Tools are being developed for weed control, as well as for complementary sowing/planting into mulch covered soil, Substantial reductions in applied energy are achieved with these new systems.

WIJEWARDENE, R. (1980). Energy-Conserving Farming Systems for the Humid Tropics. Agri. Mechanization in Asia 11 (2) 47-53.

A tropical farmer spends about 60% of his time in controlling weeds; more if tillage and land preparations are included. Slash and burn: the original zero-tillage system, does not aggravate soil erosion, whereas tillage to control weeds for next crop does. Herbicides offer a particularly attractive alternative to tillage and desiccated vegetation forms a surface mulch reducing run off and moisture and nutrient losses. The hand held-battery CDA sprayer is specially appropriate for peasant agriculture.

WIJEWARDENE, R. (1980). Systems and Energy in Tropical Smallholder Farming, Proc. Appropriate Tillage Workshop, Zaria, Nigeria. - 73-86.

In general, the product of time and energy remains constant for any particular farming technology. Hence, manual farming is low in energy but high in time consumption. One of 5 constraints on agricultural productivity in the humid tropics is the too large amount of time occupied in weeding Minimum tillage with herbicides would reduce weeding time and also reduce soil erosion. The CDA hand sprayers was adopted by the IITA because of its CLV spray, low cost and simplicity. A no-tillage technique using the CDA sprayer and an auto-feed jab planter required 48 man hours/ha to produce intercropped maize+ cowpea compared with 515 man hours/ha for conventional cultivation.

WIJEWARDENE, R. (1982). Very Low-Volume (V.L.V.) Knapsak Spraying of Agrochemicals. Trop. Pest Management 28(2) 170-174.

The author describes the development of the V.L.V. Knapsak sprayer providing uniform field coverage of agrochemicals using volumes as low as 40 /1/ha. A prerequisite was the regulation of pressure to 1-1.5 bars for the production (through a specially developed nozzle) of 300–400 m sized droplets for low-drift application of herbicides, or of droplets half this size for insecticide application at a pressure of about 3 bars. A deflector type nozzle with 0.6 mm orifice was developed to benefit from this control of pressure by producing droplets of a required size over a very even clearly visible linear swatch of 1 m effective width when held about 40 cm above the target.

WIJEWARDENE, R. (1984). Techniques and Tools for Weed Management. Proc. Symp. Weeds and Weedicides. Sri Lanka Asso. Adv. Sci. 26 Annual Session 26-30.

Weeds growing in paddy fields can be controlled by regulating the flood level. In tea, rubber and coconut plantations weeds can be controlled by shade. In the bush-fallow system weeds were shaded out by high shade of the regrowing taller trees. In conservation farming where minimum tillage is practiced, pre-plant and post-plant weed control operations are performed using herbicides. Mulching is another method of smothering weeds as well as protecting the soil surface. The importance of legume covers (live mulches) under plantation crops of rubber, coconut,oil-palm and cocoa is well established. Some of the best legume live mulches recommended include *Pueraria phasioloides, Centroscma pubescence, Arachis prostrata, Calapogonium muconoides and Mucuna utilis.* The primary aim of the live-mulch concept is the replacement of a complexity of weeds by one, fast-growing and easily manageable weed – the live mulch. Attention is focussed on Avenue (Alley) cropping system where fast growing trees like *Leucaena leucocephala* (Ipil Ipil), *Gliricidia maculata, Tephrosia candida, Cajanus cajan* and *Sesbania* spp. are established in avenues spaced (2–4m) apart. The inherent ability of this system to suppress weeds such as *Imperata cylindrica* and other light demanding weeds is of considerable importance.

WEED CONTROL IN RICE

AMARASINGHE, L. (1984). Methods and Techniques of Weed Control in Rice in the Dry Zone of Sri Lanka. Proc. Symp. Weeds and Weedicides, Sri Lanka Assoc. Adv. Sci. 15, Sept. 13-20.

There are about 70–80 weed species recorded as rice weeds in Sri Lanka. As there are numerous methods and techniques for controlling weeds in rice fields, it is appropriate to provide several options to the farmer so that he can choose the one that best suits his conditions. The removal of the weeds which grow in rice fields during the fallow period is usually accomplished either by dry-land or wet-land tillage. These methods are considered to be time, labour and water consuming, whereas minimum tillage techniques require only one cultivation after weeds are dessicated with Paraquat. Recent investigations at Maha Illuppallama show that tillage supplemented with herbicides have a profound advantage in saving time and water. Success of zero tillage depends on the efficacy of herbicides and the type of weeds in the locality. Application of post-planting weed control methods largely depends on the critical period for crop-weed competition. Recent investigations reveal that any post-planting weed control should be aimed at eliminating weeds from first 10–50 days of crop growth. Other determining factors are method of crop establishment, rice variety and plant density. As control of weeds by standing water is not always possible the needs of applying direct methods arise. The most commonly and widely practiced method of post-planting weed control is the use of herbicides. Propanil and MCPA are the widely used herbicides in paddy, however, they posses certain limitations. Recent investigations have found more promising herbicides that could be used under conditions where Propanil or MCPA cannot be applied. Finally, the need of an integrated approach is pointed out for effective control of weeds in wet, dry and intermediate zones.

AMARASINGHE, L. (1985). Rice Weeds in Minor Tank Paddy Fields and Their Effect on Crop Yields. Krushi 7 (4) 17-24.

The information regarding weed biology in different soil-drainage classes, under minor tanks in Dry Zone of Sri Lanka are very meagre, but is very important in evolving efficient weed control programmes.

A survey was carried out in paddy fields of three typical minor tank villages, Walagambahu, Mawathawewa and Pandikulam in Anuradhapura district during 1979/80 Maha and 1980 Yala seasons. Sampling was carried out from fields where weed control measures were not adopted to the standing crop (in 1979/80 Maha season) and from three drainage classes, well, moderately and poorly drained (in 1980 Yala).

About 30 different weed species were reported in the above fields with a similar species distribution. The contribution of grasses, sedges and broad leaved weeds were also similar. The grasses comprised of annuals and perennials while *Cyperus* population mainly consisted of annuals.

Weed growth showed a gradual decline from crest to bottom of each catena. In well drained soils, grasses and broad leaved weeds were prominent along the catena, than in other soil classes. The majority of *Cyperacious* weeds were annuals which are mainly directed towards imperfectly and poorly drained soils.

A significant negative correlation was recorded between weed incidence and grain yield for all drainage classes. About 75% of farmers used herbicides of which 90% used MCPA. Only a few farmers used 3,4 DPA with MCPA. The rate of applications varied but not at the optimum dosage.

The application of MCPA alone showed yield increases of 50% and 100% over the control, in well drained and poorly drained soils, respectively. In well drained soils, the application of both 3,4 DPA and MCPA increased yield by 150% over the control.

AMARASINGHE L. (1986). Alternative Herbicides to Propanil and MCPA for Weed Control in Wet–seeded Rice. Trop. Agriculturist, Sri Lanka 142, 89-99.

Emulsifiable concentrates of herbicides Oxyfluorfen (Goal), Oxadiazon/Propanil (Ronstar PL) and Piperophos/2,4 D (Rilof H) were tested and compared with Propanil and MCPA for their weed control efficacy in wet-seeded rice. Oxyflurofen applied pre-emergence and Piperophos /2,4 D and Oxadiazon / Propanil applied post-emergence controlled the dominant weeds including grasses and sedges as effectively as Propanil and MCPA. Oxadiazon / Propanil and Piperophos/2,4 D showed insignificant toxicities in rice and gave comparable rice yields to Propanil and MCPA. Oxyflurofen was found to be fairly phytotoxic on rice when applied as a spray mixture and the rice yields were significantly reduced. When applied as a sand mixture. Oxyfluorfen caused no appreciable crop damage and the rice yields were also equal to Propanil and MCPA. The practical advantage of the herbicides over Propanil and MCPA are briefly discussed.

AMARASINGHE, L. (1987). Alternative Herbicides to Propanil and MCPA for Weed Control in Wet-Seeded Rice in the Dry Zone of Sri Lanka. Unpub 1-19

This paper summarizes the results of four field experiments using Oxyfluorfen, Oxydiazon/Propanil and Piperophos/2, 4–D. The herbicides were compared with Propanil followed by MCPA. The first three experiments, were conducted at the Maha Illuppallama Agricultural Research Station where the dominant weed species found were *Echinochloa colona, Echinocloa crusgalli, Leptochloa chinesis, Cyperus iria, Cyperus difformis, Fimbristylis miliaceae* and *Fimbristylis dichotama* and less significantly *Sphenoclea zelanica* and *Monochoria vaginalis*. In the first experiment conducted in Maha 1981/82, where Oxydiazon/Propanil applied at 8–10 days after rice emergence (DARE) at 0.16/0.06, 0.32/0.12 and 0.48/0.18 kg a.i./ha controlled the majority of the weeds except at their lowest rate of application as effectively as Propanil and MCPA. Their residual effect lasted over 4–5 weeks. Oxyfluorfen applied in a drained field 3–4 days after rice emergence at 0.12; 0.18 and 0.24 kg a.i/ha had similar effects. The effect of Piperophos /2,4–D applied on 1–2 cm of standing water 6–8 DARE at 0.25/0.13; 0.33/0.17 and 0.41/0.21 kg. a.i/ha was relatively slow.

Oxyfluorfen and Piperophos/2,4-D were further evaluated in Yala1982. Oxyfluorfen applied as a sand mixture at 0.06, 0.12 and 0.18 kg a.i/ha 3–4 and 6–8 DARE on 1-2 cm of standing water was not effective on emerged weeds. Piperophos/2,4-D applied at 0.33/0.17 and 0.41/0.21 kg a.i/ha under the same conditions as before showed slow efficiency. In another experiment each herbicide was tested at given rates– Oxyfluorfen at 0.12 kg a.i/ha as a sand mixture 2 days before sowing (2 DBS); at 0.12 kg a.i/ha as a spray mixture 2 DBS at 0.12 kg a.i/ha as a spray mixture 3/4 days after sowing; Piperophos/2,4–D at 0.41/0.21 kg a.i/ha; Oxadiazon/Propanil at 0.24/0.09 kg a.i/ha and Propanil/MCPA at 2.8/0.08 kg a.i/ha. All herbicides significantly reduced the weed population and was equivalent to that of the Propanil/MCPA treatment. Herbicides showed a farily high toxicity, but less when applied with sand. Herbicides increased yield than the controls.

The most effective herbicides were further tested on farmers fields in the Mahaweli H area, three on well drained soils and four on poorly drained soils. The total weed growth varied between locations. The herbicides controlled weeds effectively at all poorly drained locations and was equal to Propanil and MCPA. However, they were inferior on well drained soils due to the difference in the weed flora. The grain yields were comparable with that of the standard herbicide treatment. In addition, Oxyfluorfen, Oxydiazon/Propanil and piperophos/2,4–D can be applied during rainy conditions. These herbicides could be adopted as alternatives to Propanil and MCPA in controlling weeds in wet seeded rice.

ANON(1952). Weed Control in Paddy. Departmental Notes. Dept.of Agriculture. Trop. Agriculturist 108(3)196-199.

An account is given of the control, by means of suitable cultivation, of the following weeds of rice: *Echinochloa colona, E. frumentacea, E. crusgalli, E. stagnina, Coix gigantea, Ischaemum rugosum, Fimbristylis miliaceae, Cyperus dehiscens, Aeschynomone indica* and Batadella. Seeds of *Echinochloa* spp. can be separated from rice grains by flotation in water.

ANON (1952). Weed Control in Paddy. Published as a Dept. Leaflet. Trop. Agriculturist. (Cey.). CVIII (1), 196-199.

The most troublesome weed species that occur in paddy fields including wild rices (S. Uruwi, T. Pandinel) are discussed. Besides competing with rice for nutrients and other resources, weeds harbour harmful insects and fungi. Grasses like Maruk *(Echinochloa* spp.), Kirindi *(Coix gigantea)* and Gojerawalu *(Ischaemum rugosum)* are practically indistinguiable from paddy till they flower. Four species of Maruk, *Echinochloa crusgalli, Echinochloa colona, Echinochloa frumentacea* and Battadella which are troublesome particularly in the wet zone propagates itself both vegetatively and by seed. The seedlings of Kudametta *(Fimbristylis miliacea)*, Thunessa *(Cyperus iria)* and Thunhiriya *(Cyperus dehiscens)* appear soon after the paddy is sown, flower in about a month; shed their seeds and establish a second generation in the same season. Another widespread weed is Diya Siyambala *(Aeschynomone indica)* which can easily be recognized and removed.

Preparatory tillage, impounding water, harrowing the growing paddy and transplating are interpreted as measures of weed suppression and an increase in the efficiency of these practices can contribute to better weed control.

ANON (1978). Upland Rice: Weed Control. High-Lights of Research. Dept. of Agriculture of Sri Lanka. 9-10.

Control measures adopted so far have concentrated on eliminating the dominant weeds that appear first. On - going research at Maha Illuppallama has demonstrated that controlling the dominant weeds gives rise to other weeds which may have been in a suppressed state of development. Different kinds of weeds demand different chemical herbicides to control them. Hence a Propanil-MCPA mixture was recommended. But while this treatment was found to give good weed control for a short period soon after spraying, there was subsequent weed growth due to the limited residual action of this combined weedicide on previously ungerminated weed seeds.

Latest results show that Oxidiazon 25% EC at 2 kg ai/ha applied soon after the 1st rains, the first rains come in 15 DAS thus the necessary residual effect to give effective weed control for a longer period than Propanil/MCPA. Weed counts taken one month after the 1st rains have confirmed this. The Oxidiazon weedcide treatment may be rated as good two hand weedings. The post sowing application of Oxidiazon is recommended because pre-sowing application of the same weedicide gave poor results, probably due to the evaporation and breakdown of the herbicide in the two weeks prior to the onset of the rains.

ANON (1980). Half Yearly Research Report. Agricultural Research Station, Maha Illuppallama, Yala Season.

1. *Efficiency of Herbicides:*

   Webamix, Norton, Hedanol M 30% (granules), MCPA/3,4 DPA mixture (1:3) Propanil on Lowland Rice variety BG 34-8.

Webamix, Propanil and Propanil/MCPA ccntrolled all the weeds at early stages of paddy. Hedanol and Norton controlled mainly the grasses while the latter two weedcides controlled sedges.

II. *Effect of Propanil on BG* 11-11.

Propanil at 3.0 and 1.5 kg a.i/ha was tested on rice variety BG 11-11 in an experiment to study the effect of interrupted and uniterrupted standing water levels and rates and times of herbicide application on the control of weeds in lowland paddy. Propanil was sprayed at two different periods, 1 and 2 weeks after emergence.

Standing water levels had caused a greater reduction in the weed flora from the very early stages

Assessment of weeds in Walagambahuwa

A survey was done to asses the weeds in Walagambahuwa Cropping Systems Project. The three main drainage classes included perfectly, moderate and ill drained soils. Chemicals used were MCPA+3, 4 DPA. Variability in the increase of grain yield of rice with MCPA among the different soil classed shows that sedges are more important to control in ill drained soils than in the well drained soils. Investigations on the control of *Cyanodon dactylon* with Round Up, Paraquat, Dalapon and their mixtures revealed that weed kill after two weeks of spraying varied with different rates of Round Up. Maximum kill /(85%) was obtained at 2.5 l of Round Up per hectare. Other herbicides failed to give a successful control of the grasses.

ANON (1980-86). Canadian International Development Agency Project.

Maha 1980/81

The effect of different land preparation methods on the weed control in lowland paddy was studied. Weedicides used were Paraquat and Round Up. Land preparation methods included two tillage operations–preparatory tillage and puddling.

Results indicated that use of chemicals has given equal results as traditional methods in weed control. It is apparent that weedicides could be adopted to reduce the number of tillage operations in initial land preparation.

Maha 1981/82:

Experiments were conducted to study the effect of different post-planting control methods in lowland paddy. Chemical methods included application of 3,4 DPA (4 1/ha) at 12–14 DAE followed by MCPA (2 1/ha) at 20–25 DAE. Mechanical methods applied were the use of the Japanese rotary weeder (12–14 DAE) by strip crusing followed by interrow cultivation (12–14 DAR) with weeder (10–25 DAE).

Yala 1981:

The efficacy of different 3.4 DPA (36% EC)/MCPA (40%) mixtures 3:1,4:1,5:1, and 6:1 on weed controlling in lowland paddy were tested. The weed flora consisted mainly of *Echinochloa sp, Cyperus iria, Cyperus difformis* and *Fimbristylis miliaceae. Cyperus rotundus* was not controlled by any of the weedicide mixtures, while other weeds were controlled by all weedicide mixtures.

Yala 1982:

Goal and Rilof–H were tested on lowland paddy at different rates and were compared with 3,4 DPA, hand-weeding and unweeded checks. The application rates were-Goal-250,500,750 ml/ha at 3–4 and 6–8 days after emergence (DAE) and Rilof at 1.0 and 1.25 1/ha at 6–8 DAE.

Results showed that all the weedicides had given a significant yield increases over the unweeded check. Goal, at 3–4 DAE was more effective than at 6–8 DAE. Rilof-H at 1.25 1/ha showed a good control of weeds.

Yala 1983 :

Hedanol Cobex, Machete and Rilof-H were applied at different times on lowland broadcast paddy. Results were compared with 3,4 DPA followed by MCPA and hand weeded treatments. Results showed that Hedonal and Cobex were more effective in controlling weeds. Rilof-H and Machete gave similar results as 3,4 DPA.

An experiment was carried out to study the effect of weedings at different times on the grain yield of broadcast rice. Plots were hand weeded at 10 day intervals.

Results indicated that the critical period of weed competition lies between 10–50 days after the crop esfablishment.

Yala 1985 :

Sofit, Rilof-H, Goal, Machete, Ronstar PL and 3,4 DPA followed by MCPA were used in an experiment conducted to study the effect of herbicides on weed control and grain yield in transplanted rice. All the herbicides gave a good suppression of weeds. Sofit, Machete and 3,4 DPA treatments were more effective. Grain yield data showed that all the herbicides except Ronstar PL have increased grain yield over the unweeded control.

Sofit, Rilof-H, Goal, Machete and Ronstar PL were tested on lowland broadcast rice in 6 locations in the Mahaweli H area. 3, 4 DPA followed by MCPA, a hand weeded treatment and an unweeded control were also included.

The most dominant weed was *Echinochloa crusgalli.* An increased tillering was observed in the herbicide treated plots. This was due to the reduction in the weed competition. Machete, Sofit-300, Goal (5m), Arrosolo, Ronstar PL, Bihedanol, Ordram–10G and MY–93 were tested on lowland broadcast rice and compared against 3,4 DPA followed by MCPA treatment. Execpt MY-93, all the other herbicides gave a good weed control during the first 2–3 weeks. Highest weed weight and the lowest yield was recorded in treatment MY-93 followed by unweeded control.

Maha 1985/86 .

The above herbicides were again tested in Maha 1985/86. Except Goal, Ordram and MY-93 other herbicides gave a good control over *Echinocloa* spp. The lowest yield was recorded in the unweeded control.

Sofit, Rilof-H, Goal, Machete, Ronstar PL and 3,4 DPA followed by MCPA when tested in lowland transplanted rice gave good weed control. Goal and Ronstar PL showed slight scorching There was no significant difference recorded among treatments.

In an experiment, effect of herbicides and methods of establishment on weed control were tested using the rice variety BG–276-5. The methods included broadcasting (seed rate 100 kg/ha) transplanting of dapog seedlings and transplanting with seedlings rainfed on a wet bed (spacing 15 × 20 cm). Herbicides used were Goal, Machete and 3,4 DPA followed by MCPA. Weed flora consisted of *Echinochloa crusgalli, Cyperus iria, Cyperus difformis* and *Fimbristylis miliaceae.* Results showed a clear difference in weed emergence among different crop establishment methods. In transplanted rice stand weed growth was relatively poor. A significant difference was recorded between the controlled and herbicide treatments in broadcast paddy. All 3 herbicides effectively controlled weeds in broadcast paddy. Transplanting provided effective means of weed control.

ANON (1980). Comparative Weedicide Studies for Lowlands Paddy at Walagambahuwa. Highlights of Research, Maha Illuppallama. Dept. of Agric. 15.

For Lowland Paddy – Webamix, Hedanol and Propanil/MCPA have been shown to have phytotoxic effects on paddy, reducing stand and delaying recovery growth, while Propanil alone at 3 kg. a.i./ha or 1.5 kg. a.i./ha have equally good weed control but without phytotoxic effects.

At Walagambahuwa – Weed incidence decreased from well drained to ill drained paddy with grasses and herbaceous weeds predominating in the former and sedges in the latter. Consequently MCPA alone has given good control in the ill drained soils but in well drained soils 3,4 DPA is also necessary to destroy the grasses. More emphasis will have to be given to differential weed control strategies in future.

ANON (1982). Alternative Weedicides to 3,4 DPA, Highlights of Research, Dept. Agric. 8,9.

Experiments have been conducted at Makandura, Maha Illuppallama and Angunakolapallessa to evaluate the performance of alternative post-emergent weedicides to replace 3,4 DPA, which has been reported as not being too effective against the ubiquitous *Echinocloa* grass weeds found in paddy fields. The alternative weedicides tested were Machete, Rilof, Rilof H, Pefit, Ronstar (Oxidiazon) and Avirosan.

At Makandura, although the treatment differences were not statistically significant, Avirosan (1l/ha) gave the best results followed by Rilof (1.25 1/ha). They were applied at 6 DAS. At Maha Illuppallama too, Avirosan was found to be more effective than the others when applied at 0.5--0.75 l/ha.

At Angunakolapalessa however, 3.4 DPA was found to be equally effective as Rilof H (1.5/ha) applied at 17 DAS and Ronstar (0.6 kg. ai/ha) applied at 3 DAS.

While these weedicides have the advantage that they can be applied into standing water unlike 3,4 DPA which requires that the fields to be drained, care must be taken to see that there is at least 2" of standing water to offest serious phytotoxic effects on the crop.

ANON (1986). Chemical Weed Control for Irrigated Rice. Highlights of Research, Dept. Agric. 28, 8-9.

Research findings at the R.R.S. Maha Illuppallama indicated that the Machete Sofit, Arrosolo followed by MCPA, 3,4 DPA, Ronstar PL followed by MCPA, 3,4 DPA, followed by Bihedanol and Odram at given rates and times of application were equally effective to reduce weed competition in irrigated rice to a level that does not affect normal panical production.

Degree of toxicity had varied. Machete showed scattered stunting which later recovered with tillering. Ronstar and Goal caused little to moderate leaf scorch which disappeared after sometime. Toxicity exhibited were not deleterious to crop growth, except in the case of Ronstar.

Weed flora consisted mainly of grasses of the *Echinochloa* species and sedges such as *C. iria, C. difformis, C. rotundus* and *Fimbristylis* spp.

Degree of weed control varied after 2-3 weeks. Goal, Arrosolo, Machete, Sofit, Ronstar and 3,4DPA showed longer duration of weed control than the others.

ANON (1987). New Recommended Herbicides for Rice. Highlights of Research Dept. Agric. 31, 6-7.

The CARI Peradeniya reported that two new herbicides may be recommended for weed control in rice, namely, Ronstar PL and Arrosolo, These recommendations have been made after 3 consecutive seasons of testing under National Co-ordinated Herbicide Screening tests.

APPADURAI, R. R. (1968). Weed Control in Rice in Ceylon. Proc. 9th Brit. Weed Control Conf. 693-696.

Of the 1.5 m. acres of paddy in Ceylon, only about 30% is in fact weeded. Methods of stand establishment determine largely the success achieved with different methods of weed control. Chemical weed control using MCPA at 0.75 lb a.i./ac and Propanil at 3 lb a.i./ac, was similar to hand weeding and raised yields of rice two fold under irrigated culture, compared to unweeded control. Chemical weed control also offers the greatest promise in the case of rainfed rice. A pre-emergence application of PCP at 4 lb. a.i. / ac. followed by post emergence application of Propanil at 2 lb a.i. / ac gives very effective control. The semi dry method of rice culture is full of promise, provided weeds can be controlled chemically. The use of Paraquat could help to effect considerable economy in water use, and make double or even treble cropping in a year.

AUMA, E. O. (1971). Studies on the Growth of Lowland Paddy *(Oryza sativa)* with Special Reference to Stand Establishment and Weed Control. M.Sc. Thesis, University of Ceylon, Peradeniya (Unpublished).

The growth of the rice plant, methods of stand establishment and weed control, and the interactions of the above factors are reviewed. Var.H-4 had lower leaf area indicies during most of the growth, lodged and the distribution of drymatter was in favour of stems when compared with improved Var. IR 8. In several experiments it was found that there was no significant differences between methods of stand establishment. In some experiments methods of weed control were non significant, while in another 2,4,D, IPE increased grain yield due to differences in the accumulation of drymatter in panicles. The prominant weeds were monocotyledonous and in these experiments the weed stand was insufficient to compete with the rice crop. The grain and total drymatter yields were closely correlated.

AUMA, E. C. and GUNASENA, H. P. M. (1971). Effect of Method of Stand Establisment and, Weed Control on the Growth of Lowland IR"8" Rice.Indian J. Agric. Sci. 42 (11) 1041-1046.

The method of weed control had no influence on the final grain yield of 'IR 8' rice, but the yield obtained with random transplanting was more than that obtained with row transplanting. Grain yield was linearly correlated with panicle number, grain number and total drymatter of panicles.

BANDARA, J. M. R. S. and NANDARAJA, V. (1979). Reaction of Some Common. Weeds in Sri Lankan Rice Fields to *Corticium sasakaii,* Int. Rice Res. Newsl 4 (3) 1-1.

Two virulent isolates of *Corticium sasakii* PI1 and PI2 were used to test the ability to infect several weeds common in rice fields Eight species of weeds were grown in the green house at 23–29°C. After 7 weeks *C, sasakii* inoculum grown in sterilized rice seeds was incorporated into the plants substrate. All the weeds tested except *Eriocaulon* spp. and

Monochoria vaginalis were susceptible to sheath blight. Symptoms were similar to those in rice plants. The *Echinochloa* species were more susceptible to infection than the other species tested. The weed population on bunds and hedges during the period of cultural operations would facilitate the pathogen's survival and help to continue the disease cycle. The cycle could be easily interupted by cleaning the bunds and eliminating graminaceous weeds, particularly *Echinochloa* species.

BANDARA, K. M. C. (1980) Evaluation of the Effect of New Weedicides for Control of Weeds in Rice. Res. Rept. Maha 1986/87, Agric. Res. Stn. Girandurukotte.

The rice variety used in this experiment was BG 94–1. Weedicides tested were Sofit – 300, Fusilade followed by (fb) MCPA, Arrosolo fb MCPA, Ronstar - PL FOE 1976/70 WP fb MCPA, BAS 514H, Red Star Doublex, M4-93 fb MCPA, Satunil and 3,4 DPA fb MCPA. Results show that different weedicides had not caused significant differences between grain yields of rice. However, the % weed coverage in hand-weeded plots and the unweeded control ranged from 0.62 to 35.6 at 4 weeks after seeds were sown, while it ranged from 0.31 (in the 3,4 DPA fb MCPA treated plots). to 48.7 (unwedded control) at 8 weeks after seeds were sown.

BANDARANAYAKE, M. A. W. and UPASENA, S. H. (1987). Studies on the Role of Water in Weed Control of Puddled Paddy. Proc. Sri Lanka Assoc. Adv. Sci. 43, Annual Session 12–13.

In fields where weed infestation is very serious and control is difficult, a series of integrated methods always gives better results than a single direct method. It is well known that water plays a major role in weed control. Although water is indisoensable the water management authorities are reluctant to encorage farmers to use water for weed control because the perception is that water is required in very excessive amounts to do so.

A trial was designed and conducted at the Regional Research Centre, Girandurukotte to investigate this situation. The experiment was a split plot design with different irrigation levels; 2 levels of standing water; rotational irrigation; and persistant saturated soil moisture without standing water; as the main treatments and 3 direct weed control methods and a control as the sub treatments. This trial was conducted in two yala and maha seasons. (1985 and 1986).

The results infers,

(a) Only when paddy is transplanted; standing water in the field can be used as a direct, weed control method. For this water supply should be reliable.

(b) In the absence of standing water; hand, mechanical or chemical weeding is effective when the paddy is transplanted.

(c) When paddy is not transplanted only the chemical control is effective and for better results the application should be done precisely according to the instructions.

(d) Paddy cultivated in the poorly drained soils do not consume excessive amounts of water to maintain standing water in the field as a direct weed control measure both in maha as well as yala seasons.

(e) Paddy in moderately drained soils needs less water for weed control only during maha seasons. (In most of the old irrigation systems the well drained soils behaves as moderately drained soils due to cultivation of puddled paddy for long years).

BASNAYAKE, B. M. S. (1984). Weed Problems and Methods of Control in Rice Cultivation in Sri Lanka, 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

Rice forms the staple diet of most of the people in Asia and many other tropical countries. A larger fraction of the paddy cultivated lands are geographically concentrated in the dry zone. Since the climatic conditions are more suitable in those areas the production can be achieved by means of modern technology.

In this present review the entire attention has been drawn only on weed management in rice. Many methods have been suggested to control weeds. But various problems arise when we apply these methods individually. Fertilizer also enhance the weed growth as well as rice plant growth.

When we consider chemical methods, they are not economical, most enhance the environment pollution and are toxic to human beings and some of the biological control agents. Because of above reasons adapting chemical control only is not successful.

Biological control agents are specific for special weeds, hence we can avoid all above disadvantages by adapting integrated weed control methods.

DE SILVA, A. (1986). An Evaluation of the Method of Weed Control Against Maintenance of Different Standing Water Levels in Irrigated Rice. Res. Rept. Maha 1986/87. Agric. Res. Stn. Aralaganwila, 327-241.

Experiments were carried out using the rice variety BG 400-1. Treatments included 4 levels of irrigation. (10 cm of standing water, 5 cm of standing water; Once in 5 days rotational irrigation; Saturated moisture level, and four different weeding treatments. (hand weeding; rotary weeding, chemical weeding and no weeding).

Data were obtained on the time of flowering (at 50% flowering), number of tillers and mean yield of rice. Data on time of flowering showed that there was no considerable difference between treatments on 50% flowering. Plots maintained at saturated moisture level reached 50% flowering earlier than the other treatments, and this may be due to the periodic water stress conditions prevailed in these plots. Data on total number of tillers and number of effective tillers per hill showed no significant difference between treatments.

Yield data showed that the treatment with saturated moisture level without weed control yielded the lowest. Either the water level or the method of weed control had no effect on the yield of rice. However, this could be attributed to the neck blast and conditions that prevailed in the experimental field.

DHANAWANSA, U. H. (1982). Pre Emergent Weed Control in Dry Sown Rice. Proc. Sri Lanka Asso. Adv. Sci. 38 Annual Session (1) 22.

Chemicals recommended for weed control in rice in Sri Lanka are of the post-emergent type. In rainfed rice farming, post-emergent chemical weed control is not popular among farmers because they do not want to risk the danger of moisture stress by draining out the water in the rice fields. On the other hand, rice fields are sometimes too dry or there is too much of rain when the critical period of weedicide application is due.

Post emergent weedicides are applied after sowing but before germination. Essentially, availability of moisture for satisfactory germination of rice coincides with pre-emergent weedicide application. Therefore, one of the above constraints become operative unless there are too heavy rains that would wash-off the chemicals. Besides, application of chemicals on a vegetation free ground is far more convenient and labour saving.

Preliminary investigations were carried out at the Makandura Research Centre, Katupotha Cropping System Project and in farmer's fields in Maha 1981-82 and in Yala 1982 with the objective of testing various pre-emergent chemicals at different concentrations. Satisfactory weed control was obtained with the following: Machete (Butachlor 60%) 2.0 1-ha; Rilof-H (Piperophos, 2,4-D-IPE) 2.0 1/ha, Goal (Oxyflurofen 28%) 0.5 1/ha, Dual (Metolachlor 50%)2.0 1/ha, Ronstar (Oxadiozon 25%) 5.0 1/ha and Galex (Metolochlor 50%+Metabromuron 50%) 3.0 1/ha. Phytotoxic effects have not been observed with the chemicals used above.

DHANAWANSA, U. H. (1984), Weed Management in Low Country Intermediate Zone Rice Tracts. Annual Res. Conf. (Cereals and Grain Legumes) Dept. of Agriculture, 54.

A large proportion of the rice tracts of the Low country intermediate zone are dry sown. Also, these rice tracts get flooded during critical periods when post emergence weedicide applications are due. Theretore, what is primarily required for such tracts are effective pre-emergence or post-emergence weedicides that could be applied within a week or so after emergence but before the fields get flooded. Besides, in rainfed tracts where farmers do not want to drain out water from their fields, the present post-emergence weedicide recommendations become inoperative. None of the above constraints become operative when pre-emergence weedicides are used, unless there are too heavy rains that would wash off the chemicals. Also application of chemicals on a vegetation-free ground is far more convenient and labour saving. Some weedicides could be applied without recourse to a sprayer.

The followigg pre-emergent treatments gave satisfactory weed control. Machete (Butachlor 60%). 2 1/ha, Rilof-H (Piperophos+2,4 · PE) 2 l/ha, Goal (Oxyfluorfen 24%) 0.5 1/ha, Dual (Metolachlor 50%) 2 1/ha Ronstar (Oxadiazon 25%) 5 1/ha and Galex (Metolachlor 50%+Metabromuron 50%) 3 1/ha.

In other investigations aimed at reducing cost of 3,4 DPA applications, the use of ultra low volume sprayers resulted in equally effective weed control with a lower dose (4 1/ha) compared to the Department recommendation (6-1/ga). Further reduction in the dose was achieved by mixing 4 kg urea with 3 l of 3, 4 DPA/ha or 8 kg urea with 2 l of 3,4 DPA/ha applied at 8 days after sowing.

DIAS, G. R. W. (1956). Implemental and Mechanized of Rice Production in Ceylon. Trop. Agriculturist (Cey.) 112, 53-59.

The section on weed control compares the time required to hand-weed rice (140 hr/ac) with that taken using the Burmese harrow (16 animals hr+8 man hr/ac) or the Japanese weeder (48 man hr/ac).

DIAS, I. P. S. and SOMAPALA, A. D. (1969). Zero Tillage in Rice Cultivation. Proc. Ceylon Asso. Adv. Sci. 25th Annual Session (1)44.

This paper presents the results of investigations carried out over the last six seasons at the Rice Research Station, Ambalantota on the techniques of zero tillage in rice cultivation. The technique incorporated one of the total weed-killers Gramoxone in the control of weeds as well as the killing of the previous seasons' stubble. The data on rice yields obtained in these investigations over six consecutive seasons of zero tillage clearly indicate the possibility of this technique for weed control in rice cultivation.

ELIAS, R. S. 1969. Rice Production and Minimum Tillage. Outl. Agric.6 (2) 67-71.

Reviews the development of a minimum tillage technique for rice production in Ceylon, Malaysia and Japan. Results of some representative trials are discussed.

GUNASENA, H. P. M. (1971). Evaluation of New Herbicides for Broadcast Sown Lowland Rice. *(Oryza sativa)* **L) 1. J. Nat Agric. Soc. Cey. 8:13-22.**

All herbicides evaluated effectively controlled weeds except *Monochoria vaginalis* and *Isachne australis*. The population of these weeds however was small. The evidence indicates that unlike *Echinochloa* species, *Monochoria vaginalis* is less competitive to rice and the presence of a few of these might be of little importance under field conditions. The application of the herbicides on the surface of the soil before seeding was highly toxic to rice at the higher rates of application than when incorporated into the soil. The rice injury symptoms were manifested as chlorosis, leaf tip burn, distortion and twisting of leaves, marginal necrosis, brittleness of the culms, excessive tillering at lower rates while at highest rate the death of rice seedlings. The application of herbicides on the surface of the soil controlled weeds effectively but reduced grain yield as a result of crop injury. The post-emergence surface application of MON-0385 at 5 days after sowing was much superior at the lower rates of application when compared with the standards and increased the final grain yield of rice. This was due to less crop injury and effective control of weeds. The result of these investigations show that MON-0385 could be used for weed control in broadcast sown lowland rice cultures. It is not suitable for application as a pre-emergence herbicide but should be used in post-emergence control of weeds. It has several advantages over the herbicides that are presently in use for weed control in lowland rice cultures. They are (1) could be applied to standing water, (2) not necessary to expose weeds to obtain sufficient contact and (3) does not require a period of dry weather after application and hence suitable for use in the wet monsoon season during which rice is grown in Sri Lanka.

GUNASENA, H. P. M. (1971). Evaluation of New Herbicides for Broadcast Sown Lowland Rice *(Oryza sativa* **L)** **- II J. Nat. Agric. Soc. Cey. 8, 25-30.**

The data reported in this paper confirms the results of the previous experiments and as suggested earlier MON-0385 was more effective in controlling weeds found in lowland paddy fields when used in post-emergence rather than in pre-emergence application. The application of MON-0385 at 2.0 kg/ha a.i. at 5 or 14 days after sowing was highly phytotoxic and produced a completely sterile seed bed while the application of 1.0 kg/ha a.i. showed no evidence of crop injury, and controlled 75-80 per cent of the weeds. As found earlier the rate or the time of application of this herbicide had no effect on *Monochoria vaginalis*. However, the presence of a few of these weeds might not reduce the grain yield of rice significantly. The application of MON-0385 at 1.0 kg/ha a.i. gave the highest grain yield and evidence from the growth data indicates this to be related to the higher total dry-matter produced by this treatment. MON-0385 showed considerable promise for weed control in lowland broadcast sown rice culture. It could be used at the rate of 0.5 kg/ha a.i. applied at 5 or 14 days after sowing. If the higher rate of 1.0 kg/ha a.i. is to be used the time of application should be delayed to about 10-14 days after sowing, but this will be more costly in terms of the herbicide.

GUNASENA, H. P. M. (1973). The Effect of the Method of Stand Establishment and Weed Control on the Growth and Yield of Lowland Rice 'IR-8' *(Oryza sativa.* L. J. Trop, Agric. and Vet, Sci. 2:199-204. (Karl Marx University, Leipzig, German Democratic Republic).

An experiment was carried out with three methods of stand establishment (broadcasting, row seeding, transplanting at random) in order to test five methods of weed of control on lowland rice. They comprised of an unweeded control, hand-weeding, and the application of 2,4D IPE, CP 53619, and 3,4-DPA+MCPA, respectively. The effect was measured of the treatments on the number of plants/m^2, the tillering, dymatter production and drymatter of the panicles, grain yield, leaf area index, and weed growth. No significant differences were found in the drymatter production (total) between the various treatments. The highest yield was obtained with 2,4-D IPE. There was a stronger weed growth in the directly sown plots as compared with the transplanted ones, but there were no differences between the methods of planting as regards the effect of the treatments.

GUNASENA, H. P. M., and AUMA, E, O. (1973). Effect of Method of Stand Establishment and Weed Contol on Growth and Yield of Lowland 'IR-8' Rice. J. Nat. Agric. Ceylon 9/10 63-72.

The results of an earlier experiment suggested that the grain yield of lowland 'IR-8' rice may be increased by planting in denser stands. In the present experiment this possibility was tested in combination with several methods of weed control. The methods of stand establishment, however, had no effect whereas the herbicide 2-4D iso–propyl ester influenced the distribution of dry-matter into the panicle and increased the yield of grain. The grain yield was higher when was rice grown in the dry season (February–may) than in the wet season (August-December) and this was attributed to increased solar radiation.

GUNASENA, H. P. M., and KANNANGARA, H. W. (1974). Evaluation of Herbicides for Rain-fed Rice *(Oryza sativa* L.) J. Nat. Sci. Coun. Sri Lanka 2(2): 161-164.

An experiment was conducted at the Agricultural Research Station. Maha Illuppallama to evaluate herbicides for rainfed upland rice. The herbicides used were Benthiocarb, Butachlor, C-288, Preforan, A-820, USB 3153, applied at 1.0 kg a.i./ha 15 days after sowing. The herbicides controlled both mono and dicotyledenous weeds when compared with the unweeded control. All herbicides except Preforan, Benthiocarb and A-820 controlled over 93% of the weeds upto 25 days after rice emergence (DARE). At 42 DARE, C-288 gave 95% weed control, followed by USB 3153 (63%) and Butachlor (63%), while Preforan, controlled only 15%.

In the subsequent samples only C-288 controlled over 77%, whereas the other herbicides controlled less than 30% of the weeds. A few species *(Echinochloa* spp. *Eleusine indica* Gaeth and *Panicum* spp.) appeared in the plots treated with C-288. Butachlor and USB 3153 had more dicotyledonous weeds at 14 DARE while this effect was maintained for Butachlor at 25, 65 and 82 DARE. *Mimosa pudica, Celossia argentea* L, *Acanthesperma hispida* L. and *Aeschynomene indica* L were the most prominent in these treatments. In all other treatments the proportion of monocotyledonus weeds was higher than dicotylendonous weeds. The unweeded control produced zero grain yield. C-288 increased yield by 8% over other herbicidal treatments. A linear correlation between final grain yield and panicle weight represented by the equation Y=94.42+6.70 was reported.

GUNASENA, H. P. M., and ARCEO, L. M. (1981). Weed Control Studies with Butachlor in Direct Seeded Rice in Sri Lanka. Proc. 8th Asian-Pacific Weed Sci. Soc. Conf. 1981-27-32.

In Sri Lanka where 75% of rice acreage is direct seeded. Use of tillage and flooding with water are not satisfactory in controlling weeds. The herbicides that effectively control lowland rice weeds are gaining wider acceptance among farmers. 3,4 – DPA and MCPA have been widely used as post-emergence herbicides. Machete (Butachlor) a pre-emergent rice herbicide has shown considerable promise. Four trials with Machete in direct seeded rice were conducted in the wet and dry zones during May–September 1980 and October 80/February 1981. Three rates of Machete applied at 2 days before seeding and 6 days after seeding were evaluated. Machete tank mixed with 3, 4 DPA, 2, 4 D IPE and 2,4 D IBE was also evaluated. Results showed that machete applied 2 days before seeding provided better crop tolerance than 6 days after seeding. Weed control and yield at 6 days after sowing application were slightly better than 2 DBS application. Machete at 2 days before sowing gave the highest yields among treatments.

GUNASENA, H. P. M., RAJAPAKSE, N. C., and INDRAJITH, D. R. (1980-81). Studies on Chemical Weed Control in Direct Seeded Rice in Sri Lanka. J. Nat. Agric-Soc. Ceylon. 17-18, 47-59.

Experiments were conducted in the wet and dry zones of Sri Lanka to test the efficacy of Machete, Machete+2, 4D IPE, Machete+3,4 DPA and 3,4 DPA alone in lowland rice weed control. Herbicides controlled weeds compared with the unweeded control, but the degree of weed control depended on rates and times of herbicide application. Rice grain yields substantially increased when weeds were controlled.

GUNASENA, H. P. M., DANIEL, M., and DAYARATNE, H. (1982). Evaluation of New Herbicides for Lowland. Direct Seeded Rice in Sri Lanka. J. Nat. Agric. Soc. Ceylon. 19, 59-70.

Two experiments were conducted in the dry and wet zones of Sri Lanka to test the efficacy of Avirosan and Rilof H in lowland direct seeded rice weed control. Machete and Propanil were used as standard treatments. All herbicides tested controlled weeds effectively when compared with the unweeded control at both locations. At concentrations above 1.0 kg ai/ha both Avirosan and Rilof H caused considerable crop injury whereas at lower concentrations weeds were effectively controlled with insignificant damage to the crop. The rice grain yield was not affected by treatments, however, the herbicidal treatments increased yield by 1.0 mt/ha compared with the unweeded control.

GUNASENA, H. P. M., JAYAWEERA, C. S. and GUNARATNE, P. G. (1986). Comparison of Rates of Machete Formulations for Lowland Rice Weed Control. Sri Lanka J. Agric. Sci. 23(2) 56-59.

Two experiments were conducted at Peradeniya and Maha-Illuppallama to compare Machete formulations at different rates for lowland rice weed control. Machete was applied two days prior to broadcast sowing of rice. All Machete formulations caused some crop injury at the initial stages of growth, which disappeared after 30 DAS. Machete had no effect on plant height, tillers per plant, leaf area, drymatter and grain yield of rice. The grain yield were higher at Peradeniya than at Maha-Illuppallama and at both locations Machete EN at 0.75 ai/kg/ha gave the highest grain yield.

GUNAWARDENA, I. E. (1974). Influence of Weeds of Fallow Rice Fields on Subsequent Growth of Rice. Trop. Agric. CXXX 1-5.

The growth and root development of rice was studied in three pot experiments with respect to added fresh organic matter (OM), duration of submergence of soil before planting, degree of soil drainage and anaerobic decomposition of products of *Isachne globosa* O. Kantz.

In experiment one, two rice Vars. H-4 and Murungakayan 302, were grown on sandy humic soils. The freshly harvested vegetative material of *I. globosa* was added at 8% and 5% by weight of air dried soil. The submergence duration ranged from 0–3 weeks through one week intervals. Two drainage treatments, were supplied at a rate of 0.2"/day. All pots were uniformly treated with a mixture of concentrated super phosphate, ammonium sulphate and muriate of potash at 1.5 gm/pot containing 3 kg air dried soil. Each pot consisted 3 plants of 21 day old seedlings of rice, planted in one hill.

The OM drastically reduced root production in both rice varieties. Neither period of submergence nor drainage produced beneficial effects in presence of OM. Murugakayan 302 showed marked reduction in root production, in absence of drainage, when grown on humic soil. The root and tiller production (at all growth stages) were significantly correlated in Murungakayan 302. The results showed the deleterious effects of freshly added OM on growth of rice in submerged soils.

In experiment two, increasing levels of *I. globosa* OM were tested on growth of Murungakayan 302 on humic soils. The OM ranged from 0-4% by weight of dried soil and were added one week before planting. Twenty one day old rice seedlings were planted at 3 plants/pot. Fertilization was similar to that of experiment one.

Increase in OM reduced tillering and root production when it exceed 2% and OM increased ferrous ion in the soil percolates.

In experiment three, humic soil percolates which consisted 0.5-10% fresh OM and soluble decomposition products were tested on root production of three week old Murungakayan seedlings. Part of each percolate was distilled. The 10% OM distillate was tested with $NaHCO_3$ and chromatographed.

GUNAWARDENA, S. D. I. E. (1976) Rice Agronomy–Ecology of Paddy Field Weeds in Beminiwatte APC and Weed Control Studies Div. Botany. Rept. Res. Div. (1975/76 Maha). CARI 6-7.

Cyperaceae and Gramineae have been found to be the major floristic components of weeds in paddy fields in the Beminiwatte APC area.

Aeschynomene indica was the tallest weed, *Fimbristylis miliaceae* was most prevalent while *Cyperus iria, F. miliaceae* and *Isachne globosa* were the commonest members of weed association in that area.

Under broadcast lowland condition K 223/2,24 D IPE, K 1441/2, Ronstar, Molinate/K2E 2079 4A ATA 6867/KVE 20794, Modown, USB 3584 and USB 35/84/2, 4D IPE were the most promising weedicides.

GUNAWARDENA, S. D. I. E., and SIRIWARDENA, T. G. D. (1978): New Chemicals for the Control of Rice Weeds. II Weed Control in Transplanted Rice. Trop. Agriculturist. CXXXIII (2) 131-142.

A number of new weedicides either as granular or emulsifiable concentrate formulations were tested for their suitability in controlling weeds of transplanted rice. These tests

were conducted in different agro-climatic regions. Machete, Tok, Treflan-R. 2-4D IPE and Swep were found to be promising. The rates, times and methods of application of these chemicals for obtaining effective weed control have been determined and are discussed.

GUNAWARDENA, I. E. and YOGARATNAM, V. (1968). Use of Weedicides in Broadcast and Transplanted Rice. Cey. Assoc. Adv. Sci. 24 Annual Session (1) 35.

Investigations on the effect of time of application of 3,4–DPA (3 lb a.i./ac) in broadcast rice showed that delayed application of the weedicide resulted in poor weed control and low grain yield. The best results were obtained when the chemical was applied early after sowing. Highest yields and almost complete weed control resulted when 15 lb a.i.ac 3,4–DPA was split applied in 5 equal doses at fortnightly intervals beginning one week after sowing. Covariance analysis of the data showed that late application of 3,4 – DPA did not affect yield directly but indirectly through its effect on weed control. 3,4–DPA could cause leaf scorch in rice grown under upland culture but this damage does not lead to a reduction in yield. 3,4 – DPA is suitable for use in transplanted rice.

Tests were also conducted to assess the suitability of a number of pre-emergence weedicides for weed control in transplanted rice. Among the weedicides tested Linuron, Chloroxuron and PCP (granules) were found to be most promising. Chloroxuron gave good weed control and highest yields at all test locations, but based on cost benefits ratios Linuron and PCP were superior to Chloroxuron in the intermediate and wetzone locations, respectively. In these tests Linuron and Chloroxuron were used as wettable powder formulations and were applied by a specially developed sand mix technique. When applied by this technique the phytotoxicity of these weedicides to rice was considerably lower than when they were used as blanket sprays.

The relative merits of these weedicides are discussed in relation to their costs.

GUNAWARDENA, S. D. I. E. and YOGARATNAM V. (1968). Chemical Control of Weeds in Rice, in the Intermediate and Wet Zone of Ceylon. In Rice Comm. Working party on Rice Production and Protection. Twelfth Session. Peradeniya, Ceylon. Agenda Item 8, 1-7.

Trials were conducted with broadcast and transplanted rice in the intermediate and wet zone of Ceylon using 3,4 DPA (Propanil), MCPA and Molinate, Ramrod (Granular formulations), Pichlobenil, Chloroxuron and Linuron (W. P. Formulations).

Equally efficient weed control in broadcast rice was obtained with 3 lbs a.i./ha of 3,4 DPA and 0.75 to 1 lb./ a.i./ac of PCP or PCP-Urea in both zones, Paraquat applied as a preplant treatment effectively controlled *Isachne australis* and improved efficiency of post plant weedicide applications. Pre-emergent weedicides Pichlobenil and Chloroxuron were phytotoxic to broadcast rice.

In transplanted rice 8 lbs a.i./ac of PCP or PCP-Urea, 3 lbs/a.i./ac of Chloroxuron, or 0.5 lbs a.i./ac of Linuron applied one week after planting into standing water gave efficient weed control in both zones. Chloroxuron and Linuron were applied by sand mix technique which considerably reduced phytotoxicity to rice seedlings of the weedicides tested. Linuron is to be preferred to all others for transplanted rice because of the low cost.

INDRAJITH, D. R. (1979). Chemical Weed Control in Direct Seeded Rice-500 Series. Res. Rept. Faculty of Agriculture, University of Peradeniya.

An experiment was conducted to evaluate the efficacy of the weedicide Machete and the Machete/Propanil combination in lowland broadcast sown paddy in the Dry zone of Sri Lanka in the Yala Season, 1980.

Machete was applied in 3 different concentrations (0.75, 1.00, 1.25 kg/ha (ai) at 2 days before sowing (2.D.B.S.) and 6 days after sowing (6.D.A.S.) Propanil singly (3.00 kg/ha (ai)) and tank mix combination of 2 different concentrations of Machete (0.75, 1.00 kg/ha ai) + standard Propanil (3.00 kg/ha ai) were applied at 18 D.A.S. while Machete 1.00 kg/ha ai at 6 D.A.S. followed by Machete + 2,4-D IPE (1.00–0.8) applied at 25 D.A.S.

Machete/Propanil combination and Machete followed by 2,4–D IPE suppressed weed flora composed of *Ischaemum rugosum, Oryzae perrinis, Echinochloa crusgalli, Cyperus iria,* C. *difformis* and broad leaves effectively without harmful effect to the crop. Machete (1.00, 1.25 kg/ha ai) applied at 6 DAS and Propanil gave better results also. However, Machete 1.25 kg/ha ai applied at 6 DAS killed 7% of the rice seedlings.

A significant increase in tiller number per plant was recorded in plots treated with Machete/Propanil combination, Machete followed by Machete+2,4 D IPE, Machete at 6 DAS and hand weeding in companrison with unweeded control at 40 DAS.

A significant reduction in leaf area index (L) was found in plots treated with Machete in comparison with the unweeded control at 10 DAS. Negative results were obtained in plots treated with Machete/Propanil combination, Machete followed by Machete+2,4-D IPE, Propanil, hand weeding and Machete 6 DAS at 25 DAS. No significant difference in dry weight (paddy) and thousand grain weight were recorded.

A significant increase in straw and grain yield compared to unweeded control were recorded in plots treated with, Machete/Propanil combination, Machete followed by Machete+2,4-D IPE, Hand weeding, Propanil Machete at 6 DAS and Machete (1,00, 1.25 kg.ha) at 2 D.B.S.

Machete followed by Machete+2,4 DIPE (5.3 t/ha), Machete/Propanil combination (0.75+3.00 kg/ha ai) (5.3t/ha), (1.00+3.00 kg/ha ai) (5.8 t/ha) gave an even better yield than hand weeded (5.2 t/ha) treatment.

JAYASEKERA, E. H. W., and VELMURUGU, V. (1966). Weed Control in Rice. Proc. Symp. on Research and Production of Rice in Ceylon. 132-138.

Experiments were carried out at the Dry Zone Research Station, Maha Illuppallama to evaluate chemical herbicides for rainfed and irrigated rice.

In rainfed rice (Maha 1963/64) Pentachlorophenol (PCP) as a pre-emergence application followed by 3,4 dichloro propionanilide (3,4-DPA) two weeks later has effectively controlled weeds. PCP was applied at 5 doses 0, 0.89, 1.78, 3.56 and 7.12 kg a.i./ha 3,4–DPA at 1.73 kg a.i./ha. PCP at 1 and .1.78 kg a.i./ha had little effect on weed growth, but higher rates (3.56 and 7.12 kg a.i./ha) reduced weeds considerably. 3, 4 DPA alone had little effect on weed growth. PCP at all dosages tested, when followed by 3,4-DPA resulted in a marked reduction of the weed population. Both herbicides were not toxic to rice. The optimum dosage for satisfactory weed control and high rice yield appears to be PCP at 3.56 kg a.i./ha followed by 3,4-DPA at 1.78 kg a.i./ha.

Studies with irrigated rice indicate that weeds can be controlled by using 3,4-DPA at four dosages (0, 1.78, 3.56, 7.12 kg a.i./ha) two weeks after sowing. 3,4-DPA at

1.78 kg a.i./ha reduced weed growth markedly, at 3.56 and 7.12 kg a.i./ha it reduced weeds still further. 3-4-DPA at 1.78 kg a.i./ha gave significantly higher yields than the untreated control. Further increase of dosage gave only a small yield increase.

In another experiment 3,4-DPA at 3.12 kg a.i./ha applied at diffetent dates after seeding was investigated. The results showed that 3,4-DPA applied at 1 and 2 weeks after sowing reduced weed growth significantly but less effectively at 3 weeks or later. The cost of application of 3,4–DPA is discussed.

JAYASENA, P. A. (1987). The Effect of Weed Control in Rice Sown at Different Seed Rates With and Without Inoculation of Azolla. 500 Series Res. Rept., Faculty of Agriculture, University of Peradeniya.

The experiment was conducted at the Rice Research Station, Ambalantota, during the Yala season of 1987, to study the effect of weed control in rice sown at different seed rates, with and without inoculation of azolla. Variety BG 94–1 was used. A split plot design with three replicates was used. Weeding regimes (unweeded, herbicide application and azolla inoculation) were the mainplot and seed rates (7,10,15,20 and 25 g m^2) were the subplot treatments.

The average plant density increased with the seed rate, and it was significant between the plots. While the average weed stand count also decreased with the seed rate, only between some plots it was significant, Under unweeded condition, tillering has decreased with seed rate as the seed density increased. This was significant between plots.

If the visual assessment of weed population at 6 and 8 WAS is examined, it can be seen that weed coverage has decreased with the increase of seed rate.

The weed dry weight has decreased, in general, with the increase of seed rate. This was significant among some plots. There was no change on heading records and also no lodging.

There was increase of grain yield with the increase of seed rate in unweeded plots, higher yields were obtained from herbicide applied plots, under low seed rates. There was increase in yield in general, with increase with seed rate in azolla.

While the grain yield can be increased by increasing seed rate under unweeded condition, the grain yield can also be increased by decreasing the seed rate, when the herbicides are applied. When the azolla is applied, the grain yield can be increased by increasing seed rates.

KARUNARATNE, C. R. (1957), A Combined Automatic Seed Drill, Fertilizer Distribution and Weeder for Mudland Paddy. Trop. Agriculturist 113 (1) 87-89.

A hand operated machine for seeding, fertilizer distribution and weeding is illustrated and described.

LUBIGAN, R. T. and AMARASINGHE, L. (1988). Weed Control Studies in Paddy Rice. Paper Presented at Seminar, Department of Agriculture, Peradeniya.

Two studies have been conducted at Thoranegama, Bulnewa in the Mahaweli H system on weed control. The objectives of the first study was to determine the weed species composition in farmers fields, to compare farmers weed control practice with a promising herbicide and to determine the yield losses due to weeds in these fields. The conclusions were; there was a variation in the weed species associated with soil types and planting methods. The herbicide reduced the number of weeds and species composition. For effec-

tive weed management, a combination of methods will be necessary to avoid a population shift to weeds difficult to control.

In the second study conducted to determine weed control practices of farmers for broadcast and transplanted rice, it was found that farmers are aware of crop losses due to weeds. Only chemical and hand weeding is available for weed control in broadcast paddy However, as hand weeding is difficult the use of a row seeder, or an increase in seed rate has been suggested. Although farmers apply herbicides at the correct time, the rates applied are below recommendations, hence farmer training will be needed.

MAHEEPALA, S. A. S. (1987) Phototoxicity Effect of Herbicides on Azolla Dual Cultured with Rice. 500 Series Res. Rept. Faculty of Agriculture, University of Ruhuna.

Azolla–Anabaena complex will be a cheap source of nitrogen if it could be successfully dual cultured with rice.

Experiments were carried out to test the phytotoxic effect of herbicides on *Azolla.* At the beginning of the experiment multiplication rate of Azolla under local conditions was tested in a monoculture and building time was found out as 7-7.5 days.

Three different concentrations of five different herbicides or herbicidal combinations were arranged in a split – plot design with three replicates. Azolla was dual cultured with rice in all experimental plots. Observations related to the phytotoxicity on *Azolla,* population of *Azolla,* population of weeds and rice plants were taken.

Recommended concentration is available to use in a dual culture of Azolla and rice, where as 1.33 × recommended and 2× recommended concentrations are not suitable due to their phytotoxicity on *Azolla.* Machete and M. C. P. A., due to ineffective control of weeds which leads to low grain yields, should not be used in a dual culture of *Azolla* and rice although they are less phytotoxic to *Azolla.* 3.4. D.P.A. and combination of 3.4 D.P.A. followed by M.C.P.A. should not be used in a dual culture of *Azolla* and rice since 3.4-D.P.A. is severely phytotoxic to *Azolla.* Arrosolo, controlling weeds effectively, giving high grain yields and being mediumly phytotoxic to *Azolla,* shows a potential to be used in dual cultures of *Azolla* and rice.

METTHEWS L. J. (1986). Weed Control Component of Intergrated Pest Control in Rice in South–East Asia. Int. Rice Comm. News 35 (1) 53–60.

The importance of weed control in rice cultivation, and various factors affecting weed density in crops (rotations, land preparation methods, cultivations used, direct sowing or transplanting, fertilizer applications and water regime) are discussed. Information on weed control in Bangladesh, Thailand, Malaysia, Indonesia, Philippines, Sri Lanka and India is presented. Recommended integrated weed control activities in the FAO/ Integrated Pest Control Programme are also described.

MITTRA, M. K. and PIERIS, J. W. L. (1968). Paraquat as an Aid to Paddy Cultivation. Proc. 9th British Weed Control Conf. 668-674.

In trials established in Ceylon in August 1966, traditional methods of land preparation consisting of 2 & 3 cultivations and taking upto 30 days to complete, were compared with minimum tillage techniques taking 10 days in which weeds were killed with Paraquat at 1.12 kg/ha followed by one cultivation. During the next 3 seasons the yields following minimum tillage were similar to those from normally cultivated plots but were lower if Paraquat was omitted. Limited trials suggest that the method, timing and level of nitrogen application recommended for normal cultivation are also suitable for minimum tillage.

Using minimum cultivation, the time and water required for land preparation is reduced, more efficient use can be made of labour, animals and machinery, and the timing of land preparation is more flexible. In continuous cropping trials in which sowing followed harvest in the shortest time possible. the use of minimum tillage increased grain production over normal cultivation from 13–17 kg/ha/day in the wet zone and from 18–22 kg/ha/day in the dry zone.

MOOMAW, J. C., DE DATTA, S. K., SEAMAN D. E. and YOGARATNAM, P. (1968) New Directions in Weed Control Research for Tropical Rice. Proc. 9th British-Weed Control Conf. 2, 675-681.

Recent research on weed control in tropical rice has brought two concepts to the point of practical application.

(1) The pre-emergent and early post-emergent grass control activity of phenoxyacetic acid herbicides suggests their use in combination with selective herbicides to increase weed control spectrum and to permit the use of lower rates and less costly grass herbicides. Granular formulations which are easy to apply, of two such combinations EPTC/MCPA and Trifluralin / MCPA, are now commercially available for application to flooded rice shortly after transplanting. Similar combination of Nitraline, Propachlor, Pyriclor with either 2,4–D or MCPA are also promising and may be developed for transplanted tropical rice.

(2) Minimum tillage techniques using Paraquat, Pyriclor and a few other chemicals have successfully reduced tillage operation and occasionally made zero tillage feasible for transplanted rice. In the absence of perennial grasses and excessive accumulation of plant material, land preparation may also be replaced chemically in direct seeded rice.

PAIVA, F. P. (1978). Chemical Weed Control in Lowland Paddy. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

An experiment was conducted to evaluate the efficacy of the weedicide "Machete" in lowland broadcast sown paddy applied singly and also in combination with Propanil. Machete was applied in 3 different concentrations at 6 DAS while Propanil was applied at normal concentration at 12–14 DAS. The tank mix combination of Machete and standard Propanil were applied at 2 different concentrations at 14 DAS.

Results indicate that little crop injury (10%) were detected in plots treated with Machete 1.25 kg/ha (ai), 1 kg/ha (ai) and in Machete 1 kg/ha (ai) + Propanil 3 kg/ha (ai). No significant differences in plant height (paddy), dry weight (Paddy), shoot number (paddy) were recorded. However plots treated with Machete 0.75 kg/ha (ai) were significantly shorter in culm height when compared with unweeded and hand weeded plots. Significant reduction in culm height was also recorded in plots treated with Machete 0.75 kg/ha (ai) + Propanil 3 kg/ha (ai) in comparison with unweeded and hand weeded plots, at 28 DAS. These differences did not persist at 42 DAS.

Significant reduction in leaf area was recorded in plots treated with Machete 0.75 kg/ha (ai) + Propanil 3 kg/ha (ai) in comparison with unweeded and hand weeded plots at 21 DAS. Significant increase in leaf area was recorded in plots treated with Machete 1 kg/ha (ai) + Propanil 3 kg/ha (ai). These differences however did not persist after 21 DAS.

Treatments controlled weeds effectively in comparison with unweeded plots, the most effective being tank mix combination of Machete 1 kg/ha (ai) + Propanil 3 kg/ha

(ai). Machete used singly at 1 kg/ha (ai) and Propanil used singly at 3 kg/ha (ai) too gave very effective weed control.

PAUL, W. R. C. and FERNANDO, M. (1941). An Investigation of Methods of Separating *Echinochloa* Seeds from Seed Paddy. Trop. Agriculturist (Cey.) XCVI (2) 82-87.

Methods of freeing seed paddy from contaminating Maruk seed have been investigated.

Winnowing, though provide a high degree of control, is a slow and laborious operation.

A series of three immersions in water and subsequent decanting provides complete control and is recommended.

Cultural methods of eradicating Maruk from infested fields during the interval between harvesting and sowing or transplanting the subsequent paddy crop are briefly reviewed.

Every Maruk plant should be uprooted from the standing paddy as soon as it is recognized in the flowering stage as otherwise the ear heads mature and the seeds are shed in the field and germinate or become mixed with the seed paddy during harvesting.

PAUL,W.R.C., and SENARATNE, J.E. (19[illegible]). The Species of *Echinochloa* in Ceylon and Their Occurrence and Distribution as Weeds of Paddy Land. Trop. Agriculturist (Cey.) 96, 1 :35-41.

Four species of Echinochloa viz. *E. colona, E. frumentacea, E. crus-galli* and *E. stagnina* have been found in Ceylon and occur as noxious weeds under the common local names of Maruk (Sinhalese) and Kuthiraivali (Tamil). They serve as an alternate host to the paddy fly.

A description of each species, its distribution and relative seriousness are given.

All species grow rapidly from seed and from stolons produced at the base of the parent stems, soon after these have flowered. Flowering takes place early and at this stage each species can be readily recognized in the standing paddy.

PERERA, S. E. (1979). Studies on the Chemical Control of Weeds. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

A study was made on the herbicide Glyphosate (a water soluable formulation of the isopropyline salt of glyphosate *N*–phosphomethyl glycine) to evaluate its performance at low rates (0.5 lbs ai/ac) as a blanket spray, and to evaluate mixtures with various herbicides or other additives to control broadleaved weeds in rice. The other herbicides used were MCPA (2-methyl–4–chlorophenoxy acetic acid), Diuron (3-(3–dichlorophenyl) l–methyl–l, butylurea, 2-4–D (2, 4–Dichlorophenoxy acetic acid) Tordon 22K (4-amino–3,5,6– trichlorpicolinic acid), Paraquat (l,l–dimethyl 4,4 dipyridylium dichloride) and additive Urea and Ammonium Sulphate. Significant differences were recorded on plant height, culm height, in early growth stages but these differences did not persist. Crop injury was minimal in all treatments The results on leaf area, total tiller number and dry matter yields were non significant. The effect of herbicides on weeds varied. Glyphosate alone gave no effect on the total number of weeds while out of all other treatments Glyphosate+MCPA gave the lowest number of weeds. Glyphosate alone gave complete control of grasses although the results were non significant. It also reduced the number of broadleaved weeds to a certain extent but showed poor control of sedges, similar to other herbicides used. The addition of MCPA or Diuron to Glyphosate gave good control of broadleaved weeds.

RAJAPAKSE, N. C. (1978-80). Studies on the Chemical Control of Weeds in Direct Seeded Lowland Rice. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

A study was undertaken to evaluate Machete and Machete+Propanil mixtures in weed control in lowland rice at different frequencies and dosages. Machete was applied in 3 dirrerent rates (0.75, 1.008, 1.25 kg/ha) at 2 days before sowing (DBS) and 6 days after sowing (DAS). Machete+Propanil combinations were applied at 2 different rates (0.758, 1.0 and 3.0 kg/ha) at 20 DAS Machete+2,4D combination was applied at 6 DBS and followed at 25 DAS.

All treatments controlled weeds effectively when compared with unweeded control. The most effective being combination of Machete+2,4D. But this mixture caused more crop injury while Machete+Propanil combination controlled weeds effectively without any crop injury. Machete at 1.25 kg/ha also gave good control of weeds.

Results indicate that severe crop injuries were recorded in plots treated with Machete+ 2, 4D at 6 DAB+25 DAS. Machete at 1.25 kg/ha also showed less crop injury after the application. No crop injury was detected in plots treated with Machete+Propanil combinations at 20 DAS and Propanil alone.

Significant differences were observed in plant height, dry matter production and leaf area index among the treatments. Highest values were recorded in Machete+Propanil combinations, Propanil alone and Machete at 1.00 kg/ha plots. Lowest values were obtained in the plots treated with Machete+2,4D.

No significant differences in 1000 grain weight, grain yield and straw yield were observed. However, those plots which were hand weeded,sprayed with combinations of Machete+Propanil (0.75+3.0 kg/ha), Machete 1.0 kg/ha+Propanil 3.0 kg/ha gave higher yields. All treated plots gave higher yields than the unweeded control.

RAJAPAKSE, R. H. S. and KULASEKARA, V. L. (1980). Survival of Rice Bug *(Leptocorisa oratorious)* on Graminaceous Weeds During the Fallow Period Between Rice Cropping in Sri Lanka. Int. Rice Res. News letter 5(5) 18-19.

A survey was carried out to find the alternative hosts of the rice bug in southern regions of Sri Lanka. The pest was detected feeding on graminaceous weeds and laboratory trials were carried out on the insect's survival on many weed species. Since weeds grow in rice fields throughout the year, eliminating them on bunds and in rice fields will help in effective insect pest management. Weed hosts are listed.

SENANAYAKE, N. and PATHIRANA, R. S. R. P. (1985). Effect of Methods of Application of Different Herbicides on Weed Control of Wetland Rice. Sri Lankan J. Agric. Sci. 22 (2) 84-88.

Three methods of application of five herbicides were evaluated. The data indicated that tank mix application of 3-4 DPA (4 l/ha) and M.C.P.A. (3 l/ha) at 14 DAS and Fusilade (25 ml/ha) and M.C.P.A. (2 l/ha) at 12 DAS were unsuccessful in controlling weeds. The herbicide "Goal" (500 ml/ha) could be used either by spraying or using the sand mix technique without any significant loss in yield. However, weed population data indicated that the sand mix application was more efficient. Data also indicated that the herbicide Machete is successful only by spraying, even though grain yields do not show statistical differences between spraying and sand mix application. Fusilade/MCPA, sand mix application of "Goal" and "Machete" results in death of rice plants. The death of rice

plants in Fusilade/MCPA combination was higher. Other treatments except the standard and unweeded control showed phytotoxic symptoms of yellowing and drying of leaf tips.

SENANAYAKE, N., PATHIRANA R. S. R. P. and WIJESINGHE, N. (1986). Effect of Duration of Weed Competition on Growth and Yield of Rice. Sri Lanka J. Agric. Sci. 23 (2) 106-116.

The effect of duration of weed competition on the growth and yield of rice under broadcast conditions was investigated during Maha 83/84 and Yala 1984 using rice varieties AT 16 and BG 34-8 respectively. Data indicated that both varieties were highly sensitive to weed competition. The grain yield showed a significant drop in Maha 83/84 and a non significant drop when the duration of weed competition was extended over 20 DAS. Extending the duration of weed competition upto P.I. and flowering stages decreased flag leaf length, 1000 grain weight, percentage filled grain, panicle length and tiller number respectively, during successive seasons.

SENANAYAKE, N. (1986). *Aeschenomene indica* **L. "Can It be Considered a Paddy Weed Any Longer" . Krushi, 9 (1/2): 13-14.**

Aeschnomene indica, L. a legume, is a broad leaved weed found in lowland paddy fields in the low country wet zone.

The root nodules and suspeciously the stem nodules and irregular swellings on stems are found to be fixing atmospheric nitrogen. The plant also provides high light penetration to rice canopy due to its height and sparse foliage. Furthermore, the tap root of the plant helps to extract the nutrients from the deep layers of soil profile. Thus the competition rendered on rice for space, light and nutrients are minimum.

Hence, further investigation is needed to estimate the nitrogen fixation capacity of this weed and to find ways of increasing nitrogen fixing activity where the plant used as a nitrogen supplement to paddy.

SIRIWARDENA, G. (1981). Weed Control in Paddy (In Sinhala) Govikam Sagarawa. 25/1/2/3/4, 68-72.

The report describes the ways in which weeds adversely effect the rice crop and the associated loss of yield. Weeds have been classified into annuals, perennials and grassy weeds, etc. giving examples for each group. Weed control methods (eg. preventive measures, use of variety, irrigation water, weeders and herbicides) are discussed.

SIRIWARDENA, T. G. D.and GUNAWARDENA, S. D. I. E. (1974). New Chemicals for the Control of Rice Weeds I. Weed Control in Broadcast Rice. Trop Agric. (Cey.) 130 (1)15-33.

Results are given of experiments in Sri Lanka from 1972 to 1974 to test new herbicide products with special emphasis on granular formulations. Weeds consisted chiefly of *Ischaemum rugosum* and *Cyperus iria.* Successful treatments included the following.

(1) DWL 19805 (Cyanazine 50% wp) at 1.5 lb/ac applied as soil mixture to the puddled and levelled fields 7 days before sowing or to 1-2 inches of water at 6-7 days after sowing (DAS);

(2) C-288 (Piperophos+dimethamitryn 4:1 3.3% granules) at 0.75 to 1.0 lb/ac applied to 1–2 inches water at 6–7 DAS;

(3) M 3432 (S–benzyl N, M–di–s–butyl thiolcarbamate) EC. at 2 lb/ac applied to drained fields at 6–7 DAS, the day before flooding with 1–2 in. water;

(4) Linuron W. P. at 0.25 lb/ac applied as soil mixture to 1–2 in water at 6–7 DAS;

(5) Butachlor granules at 10 lb/ac applied as (2);

(6) Thiobencarb granules at 0.5 lb/ac applied as (2);

(7) VCS 438 (Methazole) applied as (1);

(8) (9) & (10)

(10) High molecular weight esters of 2,4–D and MCPA in granular formulations each at 0.75 lb/ac, applied as (2).

UPASENA, S. H., SIKURAJAPATHY, M. and SENEVIRATNA, T. (1980). A New Cropping System Strategy for the Poorly Irrigated Ricelands of the Dry Zone Trop. Agriculturist. 136, 51–58.

Improved farming methods including fertilizer applications on 12 ha of lowland paddy in Walagambahuwa village raised the rice yield from 1.2 to to 2.5 t/ha. During the survey, rice cvs. were evaluated during 1976-81 together with tillage methods; weed control and fertilizer practices. Yields were similar whether 1 to 2 tillage operations were carried out after sowing provided there was adequate weed control. Addition of PK fertilizer to the usual 30–40 kg N/ha applied by farmers increased rice yield from 2.00 to 4.75 t/ha during 1979/80. In another trial yields of 3.07, 2.75 and 2.78 t/ha were obtained by broadcasting seed followed by herbicide use, transplanting rice with hand by broadcasting seed followed by herbicide use, transplanting rice with hand weeding or sowing seed in rows with mechanical weeding respectively.

VELMURUGU, V. (1965). Chemical Control of Weeds in Rainfed and Irrigated Rice. Proc. Cey. Asso. Adv. Sci. 21 Anual Session (1) 34.

The reduction in yield of paddy specially in rainfed rice cultivation is partly attributed to the lack of efficient control of weeds. The paper deals with the recent experiments conducted at the Agricultural Research Station, Maha Illuppallama on the use of PCP (Pentachlorophenol) and 3,4,–DPA (3,4–Dichloro propionalide) on rainfed rice. The experiments demonstrates the effective control of weeds obtained by these chemicals in rainfed and irrigated rice.

VELMURUGU, V. (1980). A Review of Weed Control in Rice. Proc. Rice Symp. Peradeniya. 109:134.

Some important findings of research carried out by the Department of Agriculture are reviewed. Field experiments conducted at Maha Illuppallama on the critical time of weeding in rainfed rice with Dikwee – 328, 62–355 and BG 34–8, revealed that weeding treatments had different effects on all three rice varieties. A minimum of 5 weeks of weed free period from sowing was sufficient for Dikwee 328, while 8 weeks was required for the other two cultivars BG 34–8 and 62–355. Chemical herbicides were evaluated on broadcast and transplanted rice at eight agro-climatic zones. The doses tested were MCPA-G (2.24 and 3.36 kg/ha.), Chlorxuron -WP (1.12 kg a.i./ha), Linuron-G (0.28 kg a.i./ha), 3-4 DPA-EC (3.36 kg a.i./ha and PCP-G (8.96 kg a.i/ha . Weeds were controlled by over 50% in all locations. The chemicals had no effect on growth of the transplanted rice at Maha Illuppallama, Karadian Aru and Ambalantota. A similar trend was observed for Nalanda, Bombuwela, Karapincha and Labuduwa.

In another experiment on the seed rates and weed control on growth and yield of lowland irrigated rice, pattern of weed growth varied according to plant density. Weeds were controlled by more than 70% at a seed rate between 125–75 kg/ha than at 50–25 kg/ha.

In other trials on irrigation and weed control land was prepared under dry conditions and crops established by broadcasting and row-seeding followed by two herbicide applications. Machete at 2.24 kg a.i./ha and PCP at 3–4.48 kg a.i./ha and 3,4 DPA at 3.36 kg a.i./ha showed the superiority of the combined use of both pre and post emergent weedicides. On puddled and either broadcast or row seeded followed by Banvel W (2.24 kg a.i/ha) and 3,4–DPA (3.36 kg a.i/ha) the results showed no significant difference in yield.

An experiment on minimum tillage techniques as a deviant of shifting cultivation consisted of three different times of spraying. Paraquat at 1.12 and 2.24 l/ha on non-tilled land and followed by 0 or 4.48 l/ha of 3,4–DPA with three controls – normal tillage followed by either PCP–3,4–DPA or hand weeded or unweeded. Results showed no significant differences between levels of Paraquat/3,4–DPA combinations and normal tillage followed by either chemical or hand weeded controls. There was no difference between the time of spraying of Paraquat.

VITHANA, M.K.D. (1985). Chemical Weed Control in Puddled Direct Sown Rice – 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

The experiment was conducted to evaluate the efficacy of the weedicide Machete EN, EC, 5G formulations and MCPA/Propanil combination in lowland broadcasted paddy in dry zone of Sri Lanka during June–September 1985.

Machete was applied in three different formulations (EN, EC, 5G) at three concentrations. They were 0.75, 1.00, 1.25 kg ai/ha and Propanil/MCPA combination was applied at the rate of 0.8/3.0 kg ai/ha.

Propanil/MCPA was effective in controlling grasses and Machete EN and EC had excellent control of broad leaved weeds. Machete EN at 0.75 kg ai/ha also controlled broad leaved weeds. On the whole, propanil was found to be most suitable for controlling most weeds. High values for drymatter production and plant height were also obtained with MCPA/Propanil combination. Machete EN at 1.25 kg ai/ha caused severe damage to the crop.

There were no significant differences in grain yield, but Machete EN at 0.75 kg ai/ha gave the highest grain yield.

WASALA, W. M. D., JAYAWARDENA, S. D. G. and PATHIRANA, R. S. R. P. (1985). Chemical Weed Control in Broadcast Rice. Proc. Sri Lanka Asso. Adv. Sci. 41st Session (1) 24.

More than 75% of the total rice extent in Sri Lanka is direct sown. Efficient weed control in direct seeded rice could be achieved by proper land preparation and efficient water management. However, ideal conditions do not prevail always to control weeds by water management. Therefore, chemical weed control becomes important in obtaining high yields. 3,4 DPA and MCPA have been used over many years to control weeds in rice.

New herbicides with different chemical properties and modes of action have been developed recently. This investigation reports finding on the efficiency of the following pre-emergent and post-emergent herbicides tested in the mid-country wet zone: Machete, (Butachlor 60%), Goal 2 (Oxyluorfen 24%); Sofit–300 (Pretilachlor 30%+Safener 10%); Rilof–(Piperophos 33%+2,4–D 17%); Bi-Hedanol (MVPAM 60%+2,4-D 10%).

Although some of these herbicides cause toxicities to the rice crop it could be minimized by proper land preparation and water management practices.

WEERAKOON, W. L., GUNAWARDENA, S. D. I. E. (1983). Rice Field Weed Flora of Sri Lanka. Trop. Agriculturist (Sri Lanka) 139:1-14.

One hundred and thirty four species representing 32 families were recorded from paddy fields in the three major climatic zones of Sri Lanka. In floristic composition Cyperaceae and Gramineae constituted the major components of weed flora. *Fimbristylis miliaceae, Isachne globosa* and *Cyperus haspan* were the abundant weeds. Most weeds were common to both wet and dry zones of Sri Lanka.

Seven types of life forms of weeds were observed to exist in hydrophytic, hygrophytic and mesophytic habitats of paddy fields.

WICKRAMASEKERA, G. V. (1937). Some Weeds of Paddy Lands. Trop. Agriculturist (Cey.) (LXXXVIII) 263-265.

Ischaemum rugosum salib. (Maruk) *Echinochloa crusgalli* Linn. (Wel marukku S.,) *Coix gigantea* Koen. (Kirindi S.) are some of the widely spread weeds of paddy lands. Methods for controlling these weeds suggested are: uprooting and destroying, use of weed seed free seed paddy, fallowing, cultivation of short age varieties followed by economic crops such as green gram or vegetables or even a green manure crop and weedings of bunds and irrigation channels.

WIJEKOON, W. M. S. (1986). Monitoring of Weed Flora and Density on Irrigated Primary Valley in Lower Walawe Area. 500 Series Res. Rept., Faculty of Agriculture, University of Ruhuna.

The experiment was carried out during 1986 Yala season in a farmer's field at Angunukolapelessa to monitor the weed flora and weed density in an irrigated primary valley in lower Walawe area.

Data were obtained from the three drainage classes, namely well drained, imperfectly drained and poorly drained.

The count of weed spp, dry weight of each weed group, dry weight of rice plants from weeded and unweeded plots were taken at each weeding.

According to the results obtained, the species distribution and abundance of the weeds on different soil drainage classes were different. The weed control measures adapted should therefore, vary depending on the drainage class. Control of grassy weeds seems to be more important on well drained soils while more emphasis has to be given to sedges in imperfectly and poorly drained soils.

WIJESINGHE, N. (1984). Effect of the Weed Competition Duration on Growth and Yield of Wetland Rice. (Variety BG 34-8). 500 Series Res. Rept. Faculty of Agriculture,. University of Peradeniya.

The experiment was carried out at Research Farm, Regional Research Station, Angunukolapelessa, during the Yala season of 1984, to study the effect of weed competition duration on growth and yield of wetland rice, variety BG 34-8

The measurements of plant height, tiller number, weed dry weight, dry weight of rice plants from weeded and unweeded plots were taken at each weeding. Yield/plot, yield components such as panicle length, number of panicles/plant, number of filled grain at harvest and 100–grain weight were recorded.

According to the results obtained, there is a significant decrease in tiller number at harvest, number of panicles/plant and flag leaf length with increasing weed competition duration. However, grain yield, 100 grain weight and number of filled grains at harvest did not show significant differences among treatments. Data also indicated that 100 grain weight and panicle length was affected by the intensity of weed competition more than by the duration.

WEED CONTROL IN UPLAND CROPS

ABEYRATNE, E. F. L. (1956). Dry Land Farming in Ceylon. Trop. Agriculturist CXII, 191-229.

There is heavy weed growth when lands are left fallow and control measures are needed if such lands are to be cultivated. When disc ploughs are used for burying weeds with the repeated use of the harrow for levelling, a clean land is exposed to splash erosion. Several experiments were conducted to check splash erosion and reduce run–off. These included mechanical methods such as sub soiling, contour listing, mixed cropping and mulching. The results of these experiments are discussed. Some tillage experiments were also conducted and conclusi ns reached were; in a well distributed rainfall the main function of tillage is weed control and that all tillage operations to some extent deteriorate the soil. Therefore, tillage has to be minimized and some protection should be given to the soil by continuous cover or mulches. The use of chemicals such 2,4, D and MCPA for control of weeds in maize, sorghum and minor millets, DNBP for control of weeds in legumes and TCA for control of pernicious perennial weeds such as *Cynodon dactylon* have shown promise. They appear to have the greatest scope for the control of weeds without tillage.

ABEYRATNE, E. F. L. (1961). Weed Control in Annual Crops in the Dry Zone. Proc. Cey. Asso. Adv. Sci. 17 Annual Session (1) 17.

Problems of weed control in annual crops are discussed with special reference to the control of weeds in irrigated and dryland rice.

Grasses on dryland rice fields, and grasses and sedges on irrigated rice fields dominate the weed flora. The importance of early weeding is stressed and preliminary results are presented on the use of new herbicide Stam F 34/3,4, DPA (3,4, dichloro Propionanilide) in the control of grasses and sedges in rice fields.

AMARASINGHE, L. (1984). Weed Management Studies, Tech. Rept. Sri Lanka Dry Zone-Canada Project. 72–79.

In the dry season 1983 (Yala), black gram and soybean were grown as intercrops with maize for control of weeds under rainfed conditions. Two weedings at 14 and 28 days after planting reduced weed population compared with one weeding. The intercrops also caused a pronounced reduction in weed growth and they were equivalent to one weeding, besides the yield advantage. Black gram suppressed weeds more than soybean due to its aggressive growth.

In 1982/83 wet season changes in weed population in relation to continuous cultivation in chenas were studied. Continuous cultivation increased weed, flora, particularly the grasses than dicotyledonous weeds and need for weeding in chenas was stressed. If weeds are to be eliminated by fallowing a period of 8-10 years may be required which is not possible due to the pressure on limited extents of land.

In another study weeding regime and plant spacing on the yield of finger millet, a crop susceptible to weeds was studied. The growth was heavy in unweeded plots. The weeds present were *Digitaria adscendense, Cynodon dactylon, Dactyloctenium aegyptium, Tridex procumbense, Celosia argentia, Cleome aspera, Acanthospermum hispidium* and *Chorchorus* spp. As wider spacing of finger millet increased weed growth, narrow rows and interrow weeding was recommended.

Pre-emergent herbicides Lasso, Ramrod, Sencor and Goal were tested for weed control in soybean in 1984. All herbicides controlled weeds up to 4–5 weeks and were not phytotoxic except Sencor which caused yellowing of foliage in the 2nd week

after application. This effect disappeared after a few weeks without any set back on the crop.

ANON (1958). Dept. of Agriculture, Cey, Admin, Rept. P. 151, Weed Control.

In recent trials, the highest yields of maize sorghum, highland paddy and cotton have been obtained by pre-emergence application of either PCP 12% at 2 gal/ac or Dinoseb 17% at 1 gal/ac, followed by 2 or 3 mechanical weedings at 10–15 day intevals beginning 10–15 days after sowing.

ANON (1960), Dept. of Agriculture, Cey, Admin. Rept. 184–278.

Eight years work at Maha Illuppallama have shown that hand or mechanical hoeing and intercultivation with tillage implements is inadequate and inefficient under the prevailing conditions of high rainfall, soil type and vigorous weed growth, and that badly timed or excessive tillage is highly destructive of soil structure. Annual grasses are the dominant weeds of arable upland crops.

Maize: Simazine and Atrazine at 2 lb/ac gave complete season-long control of all annual weeds in maize, and 1 lb/ac gave control for about 60 days; *Cynodon dactylon, Panicum repens* and *Cyperus rotundus* were resistant to both herbicides.

Cotton: Diuron at 1 and 2 lb/ac had no effect on germination and growth of cotton, but both controlled annual weeds for nearly 2 months, A rate of 1.5 lb/ac in 50 gal water is recommended. *C. dactylon* is resistant to Diuron.

Groundnut: PCP at 3 lb/ac applied pre-emergence were promising in preliminary trails, EPTC at 3 lb/ac gave good control of annual weeds.

Sugarcane: Diuron, Monuron and Simazine were the most promising in a pre-emergence trial.

ANON (1979/80). Half Yearly Research Report – Agricultural Research Station Maha Illuppallama

1979-80/Maha:

I. Efficiency of Glyphosate in Zero and Minimum Tillage for Controlling Weeds, *Cynodon dactylon* and *Cyperus rotundus* in Highland Crops (Cowpea and Maize). Glyphosate at 0.75 kg a.i./ha was sprayed before planting. Minimum tillage operations were applied after 2 weeks of planting. Minimum weed occurance in maize was found to be in zero-tillage block while in cowpea it was in the traditional block. Maximum yield was observed in minimum tillage block in both crops.

II. Effect of Plant Type/Seed Rate and Time of Application of the Herbicide on the Control of Weeds in Highland Rainfed Paddy.

The taller rice, var. 62-355 and short rice Var. BG-34 - 8 were used in these experiments. Seed rates were 100 and 200 kg/ha. Propanil at 3.0 and 1.5 kg a.i./ha was sprayed at one and 2 weeks after seed germination. Major weeds present were *Aeschenomene americana, Echinochloa colona, Fimbristylis miliaceae* and *Cyperus iria.*

A lesser weed flora was encountered with the tall variety. Lower rates of the herbicide has given a good control of weeds when applied 7 days after the emergence.

Thus, in highland paddy a good control of weeds could be achieved by using 1.5kg a.i./ha of Propanil after 7 days of the emergence of paddy.

III. Effect of Plant Type and Residual Effect of Herbicide on the Control of Weeds in Highland Paddy.

Two rice varieties–BG 34–8 (short) and 62–355 (tall) were sown at 100kg/ha. Herbicide Oxidiazone at 0.5, 1.0, 1.5 and 2.0 kg a.i/ha was sprayed after the first rains. The area was highly infested with *Aeschynomene americana*. The results showed that Oxidiazone at 1.0 to 2.0 kg a.i/ha controlled grassy and Cyperus weeds to some extent. The rates used were not high enough to provide a good control of *Aeschnomene americana*.

Two paddy varieties–BG - 62-355 and BG–34-8 were tested at a 100 kg/ha seed rate to study the effect of plant type, previous season's weed management and present season's weed control. Chemical used was 3,4 DPA. Treatments included. 1). Previous season's weeds were controlled + 3.4 DPA sprayed in the present season, 2). Previous season weeds were controlled+3,4 DPA not sprayed in the present season; 3). Previous season, no weed control+3,4 DPA sprayed in the present season, 4) Previous season, no weed control+3,4 DPA not sprayed in the present season.

The maximum weed flora was found in unweeded plots in both seasons, while the reverse was true for plots that were sprayed with 3,4 DPA in both seasons.

Maximum grain yield was also in 3,4 DPA treated plots. Taller plant type showed a better weed control than short plant type.

1980–Yala:

IV. Weed Emergence Studies.

Results of the experiment conducted to monitor the weed emergence showed that 80–90% of the flora was composed of grasses. The rest were mainly dicots. There were hardly any sedges. Weed emergence in highlands appeard to be more quick and grown in a single flush.

V. Effect on Herbicides on Weed Control in Gingelly.

Several pre-emergent weedicides – Sencor, Tribunil, Oxidiazon, Modown, Ramrod and Norton were tested at two different rates on gingelly.

Results indicated that most of the weedicides were highly phytotoxic to gingelly. Poor germination was recorded in Senor, Oxidiazon and Modown treatments. Tribunal, Ramrod and Norton improved germination, yet it was significantly lower than that of the control.

VI. Effect of Zero Tillage on Highland Crops.

Experiments were conducted to study zero-tillage techniques on the establishment and weed control of highland paddy, green gram and cowpea. Round Up (3 1/ha)/ Machete (3 1/ha) was applied on paddy while Lasso (4 1/ha) was applied on cowpea and green gram.

Results showed that Round Up completely killed the weeds–*Echinochloa colonum, Paspalum conjugatum, Mimosa pudica, Aeschynomene indica,* several dicots and sedges. Machete effectively controlled the emergence of weeds in paddy for about four weeks. Germination and establishment of cowpea and green gram was good and weed incidence very low.

1980/81 *Maha:*

I. Effect of Seed Rate and Plant Type on Weed Control in Highland Paddy.

The effect of increased seed rate of different plant types on weed control in highland paddy was investigated. Chemicals used were 3,4 DPA (4 1/ha) at 10 days after emergence (DAE) and MCPA (2 1/ha) at 25 DAE. The weed flora mainly composed of *Echinochloa colona, Digitaria adscendense, Alloteropsis cimicina* and several dicots. Different seed rates adopted were 100,200,300 and 400 kg/ha. Grain yield data showed that taller plant type Var. 62–355 gave a significant yield increase over the shorter plant type BG 34-8 at increased seed rates.

II. Efficiency of Upland Weeders.

The efficiency of several upland weeders were evaluated and compared with chemical weed control in highland paddy. The weeding operations were carried out at 14 and 28 days after emergence with each implement. Chemical weed control was done with 3,4 DPA and MCPA. The weed flora was similar to that in experiment I.

III. Efficiency of $3\frac{1}{2}$ Month Rice Varieties in Weed Control under Highland Conditions.

Investigations were conducted to study the efficiency of several 3-31/2 month paddy varieties in controlling weeds under highland conditions. Treatments included application of 3,4 DPA followed by MCPA and two hand weedings.

Results showed that all the 8 varieties gave a maximum yield under hand weeding while in unweeded checks yield losses were tremendous and varied from 70–100%. However, the use of weedicides didn't give an equal degree of weed control with different varieties. Taller plant types were more advantageous in respect of weed control than the short types.

ANON (1980). Zero Tillage with Upland Rice, Greengram and Cowpea. Highlights of Res., Maha Illuppallama, Dept. of Agric- 15.

A previously planted upland rice area was sprayed with Round Up (3.0 1/ha) and one week later MI 12 and MI 40/2 were planted with an injector planter. Pre-emergent weedicides were used – Lasso (4 1/ha) for cowpea and green gram and Machete (3 1/ha) for rice.

The applied rate of Round Up completely killed the weeds. Subsequent weed incidence in the legumes was low due to smothering effect of well developed canopy, but in the case of upland rice considerable weed growth was observed around primordia initiation, because tillering was poor. Poor tillering was attributed to bunched planting of seeds.

ANON (1980/86). Canadian International Development Agency Dry Zone Project. Maha 1980/81 :

Investigations done on weed control in highland paddy using chemicals 3,4 DPA (41/ha) and MCPA (21/ha) and mechanical methods – inter-row weeding using Swiss hoe, FMRC seeder and Lithao calmut revealed that chemical control was superior over mechanical control. In all the locations tested, unweeded plot gave lowest yields.

1981 - Yala :

An experiment was conducted to evaluate the critical period of weed competition in gingelly. In one treatment, weeds were allowed to grow for 7,14,21,28,35,42 and 49

days and rest of the growing period the plots were kept weed free. In another set, crop was grown weed free for 7,14,21,28,35,42 and 49 days and afterwards plots were kept unweeded. According to the results, presence of weeds from 7 to 28 days caused a significant yield loss.

1983 – Yala:

Adoption of legume intercrops in maize as a weed control measure was studied. A significant reduction in weed growth was observed.

1984–Yala:

Derrional 50% W. P. was tested in a preliminary testing of herbicides for weed control in chillies, Derrinol at 1,2 kg a.i./ha was sprayed before planting. Results showed that this herbicide controlled the grassy weeds but not the broadleaf weeds.

1985 – Yala:

The effect of Goal and Machete and their combinations with 3,4 DPA and MCPA on weed control in upland rice was studied. All the herbicides and herbicide combinations gave good weed control up to 2 to 3 weeks. Goal alone controlled the weeds for about 4 weeks while Machete was not effective. Goal followed by MCPA and 3,4 DPA followed by MCPA showed some promise in rice growth after 8 weeks.

ANON (1981). Establishment and Maintenance of Minor Export Crops. Tech. Bull. 13, 1-13.

The report details the establishment and maintenance of minor export crops. Weeding is emphasised during early stages of growth. The weed growth at the base of the plant is recommended to be slashed or pulled out to conserve the fertility of the soil.

APPADURAI, R. R. (1967). Weed Control in Field Crop Culture in Ceylon. Pest Articles and News Summaries Section (PANS). 13(2). 123–126.

Weeds, particularly annual weeds, cause serious reductions in crop yields in the field crops grown in Ceylon. The relatively high rainfall that is experienced during the cultivation season, coupled with ineffective methods of weed control, have contributed in large measure to reduced crop growth and poor yields. With regard to the rice crop, it has been estimated that only 30% of the total acreage cultivated is weeded at all. In spite of a trebling in fertilizer use during the last decade or so, rice yields per acre have not shown proportionate increases, mainly due to this factor. Increasing attention has been paid, in recent years, to improving the methods of weed control adopted with field crops, and chemical methods of weed control are gradually replacing traditional methods which are both labour intensive as well as time consuming. A survey of what has been achieved in recent years shows considerable promise and should result in increased field crop production in the near future. In this article the progress that has been made with weed control in some of the more important field crops is outlined briefly.

BANDARA, K. M. C. (1986). Research Report, Maha 1986/87. Agric. Res. Stn. Girandurukotte. 100-106.

Experiments were conducted to test the different pre-planting weedicides under minimum tillage conditions in the following:

(a) Ipil cover + Grass cover.
(b) Gliricidia cover + Grass cover.

(c) Grass cover.

Objectives of these experiments were to ascertain, (a) Crop growth and yield as affected by the different perennials and grass cover;

(b) growth of weed population and their effect on crop yield.

The weedicides used were Faraquat at 3 1/h., Paraquat followed by Tribunil 3 kg/ha, Round Up at 3 l/ha and Fusilade at 2 l/h in all frame works and all crops.

Results showed that the weed population under different frame works and different crops had given different weed dry weights at both 14 and 28 days after planting (DAP). Round Up has given a better weed control, while Fusilade has given a better control of grasses over other weedicides.

CLEMENTS, R. H. G. (1984). Weed Management in Multiple Cropping Systems. Proc. Symp. Weeds and Weedicides, Sri Lanka Asso. Adv. Sci. 21-25.

Weeds constitute a major constraint to increased agricultural production in the tropics. Sequential cropping could result in different weed problems demanding a different weed control approach. Crop rotation minimizes the undisturbed development of weeds. In rice based cropping systems good pre-plant weed control could be obtained by applying pre-plant herbicides, tillage and flooding. Use of highly competitive crops or varieties is another means of achieving weed suppression. Intercropping can serve as a method of weed management as the growing of a number of crops in close proximity to one another results in greater competition against weeds and reduces the need for weeding. The weed supressing ability depends on component crops selected, crop varieties, plant density and spatial arrangement of crops, fertility and moisture status of soil and supplemental use of herbicides. There is a greater need to carry out ecophysiological studies in this field.. It has been suggested that an intergrated system of weed management based on no-till, live-mulch system and the use of leguminous shade trees prove beneficial in upland cropping in the dry zone. Integrated weed control systems based on a combination of cultural and chemical methods need to be developed for each cropping system.

DAYAWATHIE, K. (1985). Relative Weed Competitive Efficiency of Cultivated Crops. 500 Series Res. Rept. Faculty of Agriculture, University of Ruhuna.

The experiment was carried out at the Research Farm, Regional Research Station, Angunukolapelessa, during the Yala season 1985, to study the relative weed competitive efficiency of cultivated crops, kurakkan, meneri, thanahal, maize, cowpea, green gram, soybean, groundnut, gingelly, cotton and okra.

Data were obtained for plant height and weed density for all crops. Weeds in the experimental site were also identified. Yield and yield components for each crop was measured.

According to the results obtained, members of a particular crop group, e.g. pulses, coarse grains etc. are having different weed competitive efficiencies. Based on vegetative growth as measured by plant height, okra, thanahal, groundnut and soybean could be grouped in to high, kurakkan and cowpea as medium and cotton, gingelly and meneri as low weed competitive efficiency crops. On the other hand final product,yields indicate thanahal and kurakkan as high soybean, maize, cotton and okra as medium and cowpea, gingelly and meneri as low weed competitive efficiency crops.

DE ZOYSA, G. (1976). Effect on Plant Population and Frequency of Weed Control on Yield of Cowpea *(Vigna catiang)* Var MI–35, 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

A study on effect of plant population and frequency of weeding on the yield of cowpea *(Vigna catiang)* variety M.I. 35 was carried out during Maha season (1975) on the University farm at Dodangolla.

Thirty cm inter row spacing increased total pods and seeds on an unit area basis resulting in higher seed yield compared with 45 cm inter row spacing. Fifteen cm within row spacing increased pod number per unit area and final seed yield over 30 cm.

Completely weed free treatment gave the highest yield followed by weed free for 20 days and 10 days suggesting that for cowpea a weeding three weeks after emergence would be sufficient for near maximum yield.

Narrow inter row and within row spacing had an adverse effect on weed growth. Therefore the combination of plant density and weed control affords an opportunity of controlling weeds more effectively.

DIAS, I. P. S. (1967). Cotoran – A promising Dimethylurea Compound as a Pre-Emergence Herbicide on Cotton *(Gossypium* sp.*)* Cey. Assn. Adv. Sci. 23 Annual Session (1) 28–29.

Two seasons work with a new herbicidal compound Cotoran on cotton, is reported.

In the 1st season–Maha 1965/66, this compound at 1 and 2 lb a.i./ac was tested against Diuron and Simazine at 2 and 4 lb a.i./ac. All these were used as pre emergence herbicides. In addition cultural practices such as different mulches were also evaluated against the chemical treatments. Hand weeded plots and unweeded plots served as controls in a replicated randomized block field trial.

In this trial conducted on rainfed cotton at the Central Experimental Station, Hambantota, both levels of Crotoran was significantly superior to all other treatments with the exception of the hand weeded plots. In addition to it's efficacy as a pre-emergence weed killer, Cotoran also appeared to have a wide latitude in its phytotoxic effects on cotton. In contrast, both levels of Diuron and Simazine proved quite phytotoxic to cotton, with attendant drastic reduction of yields.

The effects of Cotoran were so dramatic that in the following Maha season 1966/67–Cotoran by itself was subjected to further investigations. 3 levels of Cotoran 0.5 1.0 and 2 lb a.i./ac were tried out again on a pre-emergence basis, using hand weeded and unweeded plots as controls. These 5 treatments were used as sub-treatments in a splitplot design having 3 levels of fertilizer NPK as main treatments, in order to investigate fertilizer herbicide interactions, if any.

The pre-emergence herbicidal properties of Cotoran were evident in this season too. The higher rates of 1 and 2 lb a.i./ac give yields comparable to the clean weeded plot and these three treatments were significantly superior to the lowest level which in turn proved superior to the unweeded control. No fertilizer–herbicide interactions were evident.

At the 10th week stage of the crop a quantitative assessment of the weed flora was made by actually weeding all the plots at this stage. This data also demonstrated the efficacy of the higher levels of Cotoran in the suppression of weeds.

In spite of the weed free state of the crop from the 10th week the yield differences demonstrated the importance of effective elimination weed competition in the early phase of the crop.

ELKADUWA, W. K. B. (1977). Chemical Weed Control in Field Crops. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

Weed is a plant out of place. There are many definitions for the term weed but all those are related to its' undesirable nature. One of the worst enemies of the farmer as such it causes losses at various levels, and at different times in different situations.

Most widespread influence of weeds come from the competition with the crop and yield reduction caused in turn. In addition weed affect the quality of products, harvesting etc. Weeds are very troublesome and aggressive due to the fact that they are well adapted to the environment and very persistent. Weeds can be classified according to their life span, growth habits etc. All these studies of the characteristics of weeds are important in the selection of a weed control measure under a particular set of conditions. In some cases eradication is desirable and possible but in other cases control is the desirable and practical way to economize the agriculture.

Chemical weed control is achieved by using herbicides. With the evolution of herbicides, lot of herbicides have come to the market but only a very few are commonly used. Herbicide usage is very economical and it has many advantages over other measures of weed control. Herbicides can be classified in many ways according to the chemical nature, mode of action or time of application. Different types of herbicides can be used in different ways under different conditions. Formulation of a herbicide is very important because it effects the properties of a herbicide and assures the effectiveness under different circumstances. In the application of herbicides climatic factors, soil factors, crop itself and weeds have an important role to play in effective weed control.

FERNANDO, G. W. E. (1981). Potential for Conservation Farming in the Dry Zone of Sri Lanka. Trop. Agriculturist, 137, 137-145.

To maintain sustained production and minimize depletion of natural resources in the Dry Zone, possible farming systems to replace the traditional system of bush fallow farming were investigated. In a comparison of conventional methods of tillage with minimum tillage and zero tillage, no significant yield difference in maize, rice, mung bean or cowpea were obtained. Straw mulching increased cowpea yields and decreased weed population, while live leguminous mulches showed promise for good crop performance and weed control.

HOLMES, C. H. (1941). Weeding in the Up-Country Timber and Fuel-Plantations. Trop. Agriculturist (Cey.) XCVI (5) 274-294.

This note is concerned with weeding in the timber and fuel-plantations of the Up-country Division and experimental investigations conducted in the period 1935 to 1940 with a view to determining the minimum intensity, frequency, and period of weeding consistent with the satisfactory establishment of plantations in reasonable time.

Brief notes on the Up-country plantations, historical back-ground of the practice of clean weeding and a description of its nature are given and the average total formation costs per acre on weeding for the decade previous to the initiation of the experiments estimated.

The principal locality, and climate factors bearing on the question of the type of weeding likely to be most suitable are examined and discussed. The rainfall conditions during the experimental period have not been specifically favourable to the control of weed growth but have rather tended to be otherwise as shown by average rainfall statistics given.

The results obtained from observations carried out in 30 mainly larger stage–II experimental plots, to allow of costings, replicating 5 different treatments at 6 different plantation centres are examined and summarized separately for reforestation and afforestation centres. All measurements have been statistically evaluated and given in summary from.

The main conclusions are:

(a) That the period of weeding under average conditions to be considerably shorter than it has been in the past and need not generally be extended beyond 2 or at most 3 years.

(b) That though clean weeding throughout has generally given significantly better results in the early life of the plantations, it does not maintain this advantage over the lower grades of weeding even in the 5th year from planting. Even where it does maintain this initial advantage significantly there are indications that the less-weeded plots are likely to overcome their intial handicap in time.

(c) That strip-weeding in the first year and patch-weeding in the 2nd (if necessary in the 3rd year) has in the main been no worse than clean weeding throughout, in the case of reforestation areas. This treatment is, therefore, recommended in view of other advantages principally of soil conservation and costs.

(d) That clean weeding in the first year followed by strip-weeding in the 2nd year has actually been no worse than continued clean weeding in the afforestation areas. For other cogent reasons, principally for maintenance of the already impoverished soils of the patana grasslands, this form of treatment ought to replace the present district management practice of clean weeding throughout the period of formation.

(e) Consequent on the above conclusion, total formation expenditure on weeding need be but a small fraction of what such cost appears to have been in the past.

JAYANANDA, H. H. M. (1979) A Row Spacing–Weed Control Study in Soybean *(Glycine max* (L) Merr.) **500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.**

In a country like Sri Lanka where high cost animal protein cannot be consumed by the average population, soybeans play an important role in supplying essential proteins. Weeds compete with soybean causing reductions in yield. It is necessary to keep the soybean fields weed free during the early stage of crop growth, to increase various agronomic characters and yield. . .

Plant density and plant arrangement become important in controlling weeds. Narrow rows control weeds better. But if we depend on manual weed control there should be at least 30-40 cm. between rows depending on implements that are to be used. If chemical weed control is very effective, narrow rows are possible.

A study was conducted at the University Farm, Meewatura, to study the effect of row spacing and method of weed control on soybean yield. The results showed that, soybean planted at the spacing of 30 cm. between rows and 5 cm. within the row with one application of Lasso (Pre-emergent–Alachlor) just after seeding and one hand weeding about 14 days after seeding, it is possible to get high yields.

But pre-emergent herbicide Lasso is not effective against broad leaf weeds like, *Euphorbia* species, *Ipomea* species and perennial weeds like *Cyperus rotundus* and *Cyno-*

don dactylon. Therefore other herbicides should be included in studies for control of these troublesome weeds, if manual methods are not adopted.

JAYARATNAM, B. (1985). Control of Annual Weeds in Pineapple. Proc. Cey. Asso. Adv. Sci. 41 Annual Session (1): 23.

Manual control of annual weeds in pineapple is labour intensive, less efficient and results in the removal of bone leaves and weakening of the plant. To get over this problem farmers apply coir dust as a mulch, which is a costly operation.

Five chemicals, Diuron, Goal, Sencor, Gesapax and Bromacil were evaluated at two levels and were compared to coir dust mulching and manual weeding at Makandura during 1983-84.

Among the chemicals, Diuron (Karmex) suppressed the weeds best and the weedfree period was comparatively long. Diuron application at 6 kg/ha gave the highest average fruit yield. Coir dust mulching followed by some mopping–up gave the second highest fruit yield. Manual weeding resulted in low yields probably due to damage to lower leaves of the plant. Repeated application of chemicals resulted in a shift from multi species to few species of mainly broad leaved weeds.

JAYARATNAM, B. (1985). Control of Annual Weeds in Maize and Cowpea Planted as Solecrops and Intercrops. Proc. Sri Lanka Asso. Adv. Sci. 41 Annual Session 23-24.

This study was conducted in an upland condition, during Yala with irrigation at Maha Illuppallama to evaluate the effect of pre-emergence herbicide combinations (Linuron and Butachlor) at different rates (Linuron and Butachlor at 0. 0.5+0.6; 1.0+1.2; 2.0+2.4 kg a.i./ha) on weed control and yield of maize, cowpea and maize+cowpea intercrop. Concentration of herbicides combination required (Linuron 2.0+Butchlor 2.4 kg a.i./ha) to achieve yield similar to hand weeding in maize solecrop was lowered (to Linuron 0.5+Butachlor 0.6 kg a.i./ha) by the introduction of cowpea as a smother crop. The yield of maize is highly correlated negatively with the weed weight under maize solecrop (r=0.905). The level of weed management had little effect of maize yield when intercropped with cowpea (r=0.22). Maize grain yield was not affected by the introduction of cowpea at all management levels.

Although cowpea yield was 42% less in the maize-cowpea intercrop, total productivity increased by 20.3% at all weed management levels, except unweeded control. Land Equivalent Ratio of intercrop was greater than unity except under unweeded condition. Weed growth was reduced by intercropping maize and cowpea. Effect of intercropping contributes greately (67.25%) to the weed control compared to herbicidal control.

JAYARATNAM, B. (1986). Chemical Weed Control in Pineapple. Annual Res. Conf. Fruits, Vegetables, Root and Tuber Crops. Dept. Agric., Peradeniya 21.

Manual weed control in pineapple is labour intensive, less efficient and can cause damage to the plant. Application of coir dust mulch as practiced by some farmers is a costly operation, and therefore the feasibility of chemical weed control was investigated in an experiment during 1983-84 at the Agricultural Research Centre, Makandura.

Two levels of each of 4 herbicides Diuron, Goal, Sencor and Gesapax were tested against coir dust mulching and hand weeding as standards.

Diuron treated plots gave the best and longer period of weed control, and higher yields than the other treatments. Between levels of Diuron, 4 kg/ha and 6kg/ha showed similar weed suppression upto 60 days after spraying. Among other chemicals, Sencor was better than Goal and Gesapax in controlling weeds.

Coir dust mulching followed by "some mopping up" gave 2nd highest fruit yields. Hand weeding resulted in low yields, probably due to damage to lower leaves of the pine-apple plant during weeding operations. Repeated herbicide application resulted in a shift from multispecies to a few broad leaf weed species in the crop.

KARUNANANDARAJAH, S. (1977). The Study of Weeds Under Different Cropping Systems. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

The study of weeds under three cropping systems of coffee, pepper and vegetables was carried out in Dodangolla University Farm situated in Kandy district.

In the estimation of soil stored weed seeds and their germinating ability under coffee and pepper, it was found that weed seeds which were stored in the soil layer of 30–45 cm below the surface have a high level of germinability.

In the vegetable area the soil layer of 15–30 cm below the surface shows high percentage of germinable weed seeds.

On the study of distribution of weed species and their vertical growth habits, the following weed species were most prominent and highly distributed. *Cyperus kyllingia* – coffee area, *Echinochloa colonum* – pepper area, *Cyperus rotundus* – vegetable area. Almost all species which were abundantly found have shallow root systems and short growth duration.

KIRINDE, S. T. W. (1957). Weed Control in Dry Land Farming. Trop. Agriculturist (Cey.) 113 (2) 131-146.

The fundamental need for weed control in the Dry Zone has been stressed on and off for many years. Recent work at the Dry Zone Research Station, Maha Illuppallama, has indicated that owing to the peculiarities of the soil and climate, tillage for weed control and seed bed preparation results in splash erosion in the Maha and in wind erosion in the Yala. Cover crops and mulches keep down weeds to an extent while affording protection against erosion, but the actual degree of weed control is not appreciable. Hence for weed control without damage to the soil manipulation, herbicidal chemicals are the only alternatives for the Dry Zone.

It has also been found that early weeding, i.e. within ten days of sowing, is the most beneficial to the crop; but as it is often impossible to weed mechanically during early days of crop growth owing to adverse soil and climate conditions, a pre-emergence weedkiller sprayed just after sowing would appear to be the most satisfactory method of weed control. However, as a result of the use of pre-emergence treatment there is an accumulation of weedy grasses when the effect of the chemical wears off, hence to get rid of these, at least two mechanical weedings have been found essential; while this operation is undesirable from the point of view of erosion control, it has to be adopted until such time as a chemical is found that is exclusively toxic to weedy grasses.

Research on the above lines is being carried out at Maha Illuppallama, but a more fundamental approach to weed control is necessary if the probelm is to be scientifically tackled.

KIRINDE, S. T. W. (1958). Weed Control Problems in the Dry Zone. Trop. Agriculturist (Cey.) CXIV (3) : 175-181.

There are two distinct aspects of weed control in the dry zone, that in irrigated paddy, and that in the unirrigated, annual highland crops. But the problems in the former are not strictly problems of dry zone agriculture, because the conditions under which irrigated paddy is produced are practically the same in all parts of the island.

A large number of annual dicotyledonous and grass species go to form the highland weed flora. It is the grass component, however, that offers more serious competition to the growing crop. The only perennial weed of importance is *Cynodon dactylon,* which has spread to such an extent as to create a special problem in land management.

Of the various methods of highland weed control, the best appears to be the use of a pre-emergence chemical followed by two or three mechanical weedings; this operation achieves the triple function of giving early weed free growth, eliminating the dicotyledons and eradicating the grasses.

Since contemporary husbandry practices in the dry zone are not of a very high standard, the fundamental aim should be to impress on the cultivator the benefits of weed control as such, rather than insist on the use of any particular chemicals.

KIRINDE, S. T. W. (1959). Some Effects of IPC and CIPC on Groundnuts. Trop. Agriculturist (Cey). CXY, 7-13.

Groundnuts grown in pots were treated with IPC and CIPC at each of the following stages:– (a) pre-emergence, (b) emergence, (c) 4–leaf stage or 7–8 days from emergence, (d) 5-leaf stage or 14-15 days from emergence and (e) flowering or 24-25 days from emergence.

The chemicals were applied in the form of a dust at the rate of 1.0 lb./ac. active material; common responses evoked were death of seeding, stunting, chlorosis and curling of leaflets. Resistance to the effect of the chemicals increased with the age at application but whereas CIPC depressed the final yield in terms of nut number and weight by application at all five stages, IPC depressed yield compared with untreated controls only by application at or earlier than the 4-leaf stage.

PAKER, C. (1968). Weed Problems in India, West Pakistan and Ceylon. PANS (C) 14(3) 217-228.

Results of a survey done on weed control practices on a number of crops in India, West Pakistan and Ceylon are reported. The weed problem in these countries is serious and the use of herbicides or other new methods are pointed out. In Ceylon dry-zone upland rice fields are vastly infested by *Echinochloa* sp., whereas in the intensively nursed terraces in the hills this problem is less than serious. Weed infestation in most areas are kept under control to some extent by hand weeding, "wheel-hoeing", "bushening" etc. or occasionally by herbicides. In Ceylon MCPA is the standard recommendation. In upland rice it has been less successful but under the conditions at Maha-Illuppallama, Paraquat appears very promising as a contact pre-emergence treatment.

In maize, Simazine and Atrazine have been provided well for control of annual weeds.

In sorghum it was shown that Simazine was damaging but Atrazine was safe at 1 or 2 lb/ac.

Experiments done to dertermine the competitive effects of weeds in groundnuts indicate that it was vital to remove weeds quite soon after emergence if the crop was not to be permanently affected At Maha Illuppallama it was found that applying Linuron at 1 lb/ac is most promising. At Maha-Illuppallama Prometryne was barely selective on grass-weeds in soybean while good results have been obtained with Diphenilamine in chillies.

In the tea estates Paraquat is the most widely used herbicide. Tests to determine optimum doses and time of application of herbicides are still being carried out.

Imperata cylindrica, Cyperus rotundus, Cynodon dactylon and *Panicum repens* were the dominant among perennial weeds while *Oxalis latifolia* at high elevations in tea is regarded as useful in preventing erosion. More work is needed on the optimum choice of herbicides and timing of application in all three countries.

PERERA, L. A. (1984). Weed Control Studies on Corn/Legume Intercropping System. Dissertation Abstracts, International B (Science and Engineering) 45 (2) 422.

In field trails in 1981-82 at Maha Illuppallama, Sri Lanka, the effect of herbicide application, hand weeding and cropping systems were investigated in maize, soyabeans and cowpeas grown alone or in cereal/legume intercrops. Maize yield under intercropping was not reduced as long as the optimum population of 46,000 plant/ha was maintained; seed yields of the legumes were reduced by over 50% but combined yield from intercropping made it the most productive system. Given early weed control, intercropping reduced the weight of weeds by competing more effectively with them than single cropping. Intercropping was not advantageous with no weed control. The economics of the practices used are discussed.

RANAMUKAARACHCHI, S. L., SURASENA, J. M., NAWALAGE K. and GODAWITA, K. (1989). Post-emergence Weed Control in Brinjal *(Solanum melongine* **L.). Sri Lanka J. Agric. Sci. 26, (2) 142–149.**

Mechanical (manual weeding twice and thrice, mowing and intercultivation) and chemicals (Glyphosate, Quizalofop – ethyl, Glufosinate ammonium, Fluazifop-butyl with and without Alachlor, Alachlor+Linuron, and Metolachlor) methods were adopted to control post-emergence weeds in Brinjal.

Manual weeding thrice at 6, 9 and 12 weeks after transplanting (WAT) gave the highest pod (5.2 mt/ha) and seed yields (0.1 mt/ha). There were no significant differences between manual weeding thrice (up to 12 weeks), intercultivation, Glufosinate ammonium and Quizalofop – ethyl + Linuron combination. The lowest pod and seed yields of 1.73 and 0.03 mt/ha, respectively, were given by the unweeded treatment. The lowest total weed dry weight (0.22 mt/ha) was produced by the treatment weeded once + Alachlor (1.5 kg a.i./ha) + Linuron (1.0 kg a.i./ha) which showed a 93% weed control when compared with the unweeded control strip left adjacent to the treatment. The highest weed dry weight of 2.81 mt/ha was given by the unweeded treatment.

RANAMUKKARACHCHI, S. L., K. NAWALAGE, and J. M. SURASENA (1989). Post-emergence Weed Control of Brinjal *(Solanum melongine)* **L.) Proc. Sri Lanka Assoc. Adv. Sci. 45:48–49.**

An experiment was conducted at the Government Seed Farm, Pelvehera, during October 1987 through March 1988 to develop an economical weed control programme

for brinjal grown for seed production. Four selected post emergence herbicides namely Glyphosate (1.0 kg/ha a.i.), Glufosinate ammonium (1.0 kg/ha a.i.), Quizalofop-ethyl (0.2 kg ha a.i.). and Fluazifop-butyl (0.375 kg/ha a.i.) alone and combination with Alachlor (3.0 kg/ha a.i.), Alachlor (3.0 kg/ha a.i.)+Linuron (1.5 kg/ha a.i.) or Metolachlor (3.0 kg/ha a.i.) were tested together with hoeing at different time periods, inter-cultivation and mowing. Weed control treatments were made at 6 weeks after transplanting (WAT) following hoeing once at 3 WAT. The performance of above treatments were evaluated using weed dry weight, yield and yield components of brinjal and total gross income.

The lowest weed dry weight of 236 kg/ha was obtained with hoeing once (at 6 WAT) followed by application of Alachlor+Linuron. However, post-emergence herbicides Glyphosate, Quizalofop-ethyl, Glufosinate ammonium and Fluazifop-butyl when combined with Alachlor+Linuron, also gave similar results.

Pod yield, individual pod weight, total seed weight and gross income were also increased when hoeing was followed by Alachlor+Linuron application. These yield parameters and income were also comparatively similar in the treatments where the post-emergence herbicides had been combined with Alachlor+Linuron.

RANAMUKAARACHCHI, S. L., J. M. SURASENA, K. NAWALAGE., (1989). Effect of Some Selected Pre-emergence Herbicides on Weed Dry Weight and Seed Yield of Blackgram *(Vigna mungo* L.), Proc. Sri Lanka Assoc. Adv. Sci. 45: 47–48.

An experiment was conducted at the Government Seed Farm, Pelvehera during Maha season 1987/88 to evaluate the potential of some effective pre-emergence herbicides in order to develop an economical weed control programme for blackgram grown for seed production.

Seven selected pre-emergence herbicides of Metolachlor, Alachlor, Oxadiazon, Oxyfluorfen, Methabenzthiazuron, Linuron and Metribuzin at different rates were compared together with manually weeded and unweeded plots. The performance of treatments was evaluated using weed dry matter, and seed yield and its components of blackgram.

Metolachlor at 4.5 kg/ha a.i. gave the lowest weed dry weight at 4 weeks after seeding (WAS). But comparatively similar weed dry weight values were given by Metolachlor at 1.5–2.0 kg/ha a.i., Alachlor at 1.5–4.5 kg/ha a i., Oxadiazon at 1.0–2.0 kg/ha a.i., and Metribuzin at 0.5–1.0 kg/ha a.i. However, Metribuzin caused phytotoxicity on blackgram plants. Metribuzin, and Methabenzthiazuron were inferior to other chemicals tested, but Metolachlor gave the lowest weed dry weight even at the harvest. It contained a longer residual activity under rainfed conditions.

The highest seed yield and gross income were given by Metolachlor at 1.5 kg/ha a.i. There was no difference between the above treatment and Alachlor, Oxadiazon and Linuron at the tested rates and manual weeding.

RANASINGHE, M. A. S. K. and MAHSOON, M. M. (1982). Role of Broad Leaf Weeds as Alternative Hosts to the Beneficial Insect Fauna in Vegetable Plots. Proc. Sri Lanka Asso. Adv. Sci. 38 Annual Session Session. (i):23.

Weeds are considered to be undersirable plants with no value to the farmer. However, some flowering weeds have been found to harbour various insects which are natural enemies of other pest species This study showed the presence of several beneficial insect

species i.e. predators and parasites on broad–leaf weeds growing in the vegetable plots located in the farming areas near Peradeniya. Beneficial insects belonging to 18 different families were found on weeds belonging to 5 families including *Amaranthaceae* and *Euphobiaceae*. The small scale farmers may be benefitted by the selective retention of some weeds growing around his vegetable plot that enhance the beneficial insect fauna.

SENANAYAKE, N. and PATHIRANA, R. S. R. P. (1985). Effect of Weed Competition Duration on Growth and Yield of Mung Bean ***(Phaselous aureus Roxb.)*** **Proc. Sri Lanka Asso., Adv. Sci. 41 Annual Session, 24.**

Effect of weed competition duration on growth and yield of mung bean was investigated during the Maha season 84/85. The results indicated that increased duration of weed competition leads to decrease in grain yield and the yield components; number of pods per plant, number of seeds per pod and 100 seed weight. Among the yield components most affected was the number of pods per plant. Grain yield data indicated a statistically significant yield drop in the treatment weed-free period 35 DAS. Crop-weed competition duration of 6 days and 35 days results in 200 .8% and 100.6% yield increase over unweeded control respectively.

VELMURUGU, V. (1967). Pre-emergence Herbicide Experiments on Ground Nut *(Arachis hypogea)* **and Sorghum** *(Sorghum vulgare)*. **Cey. Assn. Adv. Sci. 23 Annual Session (1) 27-28.**

Groundnut was subjected to heavy weed infestation during the entire period of its growth in the field. Early control of weeds becomes necessary and enables the crop to spread and cover the field so as to smother any subsequent weed growth. In sorghum weed control is often a serious problem and it reduces the yield considerably.

Experiments with several herbicides as pre-emergence applications were carried out on goundnut and sorghum at the Agricultural Research Station. Maha Illuppallama.

Amiben (3-Amino-2,5,-dichlorobenzoic acid), Lorox (3- 3,4,dichlorphenyl) 1-Methoxy-1-Methyl urea) and PCP (Pentachlorophenol) appeared safe at the rates used on groundnut while Eptam (Ethyl di n-propylthio carbomate) suppressed the weeds.

VELMURUGU, V. (1969). Determination of Critical Periods of Weed Competition in Rice and Chillies Under Rainfed Conditions in the Dry Zone. Cey. Asso. Adv. Sci. 25 Annual Sessions (1) 44.

One of the important criteria in weed control studies is the determination of critical periods of weed crop-competition.

Experiments were carried out with different times of weeding in rice and chillies under rainfed conditions during Maha 1968/69 at the Agricultural Research Station, Maha Illuppallama.

The results indicated that weed control in paddy for a period of 35 days is necessary from germination of the crop, while in chillies, the duration appear to be about 56 days Further, the experiment showed that presence of weeds causes negligible damage to the rice and chillies upto 7th and 14th day respectively, from germination of the crop.

WEERAKOON, W. L., KUSUMAWATHIE, P. H. D. and BANDARA, K. M. C. (1984). An Introduction to Conservation Farming. Krushi, 7 (3):1-6.

The per capita nutritional level in the developing countries borders on starvation for the greater mass of the population. Although expansion of area under cultivation is one

method for improving food production, this alone will not make an impact on the food requirement of the increasing population. Simultaneously a considerable extent of crop land is abandoned every year due to dessertification.

Continuous cultivation results in a dramatic change of the ecological environment and adversely affects crop growth. This degradative process should be overcome and lands should be restored. The objective can be achieved through development of suitable technology for sustained productivity.

The delicate equilibrium between soil-vegetation-climate should be maintained. Thus, the protective vegetation cover i.e. weeds etc. should be removed in such a way that this equilibrium is least affected. Hence, the conservation farming systems could be selected and adopted to overcome the constraints to agricultural productivity i.e. weeds, erosion, fertility and moisture stress, in order to promote the production to meet the needs of rapidly growing population.

WEERAKOON, W. L. and SENEVIRATNE, A. M. (1982). Managing a Sustainable Farming System in the Dry Zone of Sri Lanka. Trop. Agriculturist (Sri Lanka) 140, 41-41-50. Also see Proc. British Crop Protection Conf. - Weeds - 1982 BCPC Publishers, Lond. 689–696).

In this investigation which lasted three seasons, three aspects of weed control in Sri Lanka were studied. Firstly no-till techniques and crop residue mulches were examined. Results indicated that herbicides were more effective than conventional tillage practices in controlling weeds. Crop yields were often much higher in no-till plots than in tilled plots. Compared with the unmulched plots, those mulched with rice straw at 4 and 8 t/ha reduced the weed drymatter by 22.5% and 40.6% respectively. Crop yields showed linear responses to these mulching regimes.

Secondly, the use of live-mulch systems with creeping leguminous covers was studied. Suppression of weeds was high with legume covers and relatively high yields were obtained with *Phaseolus atropurpurens* live-mulch covers.

Thirdly, the use of leguminous shade trees was examined. Shade under *Leucaena leucocephala* in 2 m wide avenues reduced weed growth.

The significance of developing an integrated system based on these techniques for upland cropping in the Dry Zone of Sri Lanka is discussed.

YOGARATNAM, V., BALASUBRAMANIAM, E. M. and PERERA, W. G. S. (1982). Chemical Weed Control in Carrot in the Upcountry Wet Zone. Trop. Agriculturist. 138:81-92.

Nine weedicides were initially screened in Maha 1977/79 for weed control in vegetable crops in the up country wet zone at the Agricultural Research Station, Sita Eliya.

Three of the nine weedicides viz. Afalon (Linuron), 1.75 kg/ha (0.875 kg a.i.), Sencor (Metribuzin) 0.5 kg/ha (0.35 kg a.i.) and Planavin (Nitraline) 1.0 kg/ha (0.75 kg a.i.) which were found suitable for weed control in carrots were further tested in a replicated experiment in Yala 1979 season.

All weedicides gave good control of weeds when used as pre-emergent sprays, without significant reduction of yield of carrots, when compared with the hand weeded plots. Afalon was the only chemical found suitable for post-emergent control of weeds.

The use of these weedicides effected a reduction in the total cost of cultivation and an increase in the benefit/cost ratio as compared to hand weeding.

The effect of weeds on the plant population and yield of carrots and the feasibility of the use of chemical weed control are discussed.

YOGARATNAM, V. and PERERA, W. G. S. (1984). Chemical Weed Control in Wheat in the Up Country Wet Zone of Sri Lanka. Annual Res. Conf. (Cereals and Grain Legumes) 55.

Control of weeds is an integral part of the cultivation practices required for a successful crop. Observational studies and replicated experiments conducted at the Agricultural Research Station, Sita Eliya, to evaluate the effects of weedicides on the control of weeds in wheat indicated that Linuron and Tribunal applied as pre-emergent or post emergent sprays were effective in controlling weeds without causing phytotoxicity to the wheat crop.

While the yield differences between the treatments, were not statistically significant, high yields were obtained with Linuron and Tribunal pre-emergent applications.

Tiller number, number of spikes or 1000 grain weight were not appreciably affected by these weedicides, compared to the hand weeded control.

The cost involved in the use of these weedicides is much lower than hand weeding and hence the chemicals Linuron, Tribunal and Agroxone could be recommended for successful weed control in wheat.

WEED CONTROL IN TEA

ANON, (1967). Weed Control in Tea. Tea Res. Inst. Ceylon , 146-149.

Spermacoce latifolia and *Paspalum conjugatum* are the predominant weed species in many low country estates. *S. latifolia* is not adequately controlled by Gramoxone (Paraquat 20%), applied at 0.5 pints/ac every other month. 2,4–D Sodium (80% a.i.) at 2 lb in 100gl water/ac gave a complete kill of a dense stand of *S. latifolia;* a mixture with Paraquat was not successful. Gramoxone 0.5 pint+Diuron 1 lb in 50 gl water/ac gave satisfactory control up to 30 days of a dense stant of *P. conjugatum* in tea; Diuron at 1 lb incorporated+Gramoxone 0.5 pint/ac gave good control up to 60 days after a second spraying. In-tolerance trials in young tea herbicides were applied to the soil at transplanting and 3 weeks later. Gramoxone at 1 pint/ac, applied to the soil, did not affect the tea. Simazine at 2 # did not significantly reduce the total dry weight of tea 5 months after transplanting but produced marked interveinal chlorosis. Diruon at 1 # did not affect tea plants when applied immediately after transplanting but a rate of 2 # and later applications caused much damage. Dense stands of weeds (mainly *P. conjugatum)* which had been allowed to grow for 4 months were controlled in 2-3 months by monthly applications of Gramoxone at 1–1.5 pints / ac: plots were almost weed free by the 9th month. Weed control was satisfactory after 4 monthly applications of 0.5 pint/ac or after four 2 months applications of 1.5 pint/ac. Gramoxone had no adverse effect on the yield of tea over 9 months. Experiments in progress with new herbicides and on weed competition are described.

ANON (1980). Weed Control in Tea. Tech. Rept. (1969-78), Tea Res. Inst. of Sri Lanka.

Several weed control experiments done on tea over many years are reported.

Results of an experiment done in 1969 to study the systems of weeding on the growth of young tea showed that unweeded plots gave the lowest yield. The strip weeded plots gave lower yields than the completely weeded plots, however, the differences were not significant.

Effect of the frequency of weeding on yield of VP tea was studied in the same year. Results showed that, during the first cycle of weeding at two-monthly intervals gave a significantly greater yield than weeding at 4 or 6 monthly intervals. No difference was recorded in yields between two-monthly manual and Paraquat weeding.

Linuron, Lenacil, MCPA, Matabenzthiazuron, Bayer 6159 and VCS 438 at 1.12 lb/ac and 2.24 lb/ac were applied on the soil surface at two-monthly intervals on eight occasions in a crop tolerance trial. These treatment had no affect on the yield of tea, or caused any symptoms of toxicity.

In 1972 an experiment was carried out to study the levels and frequency of application of Glyphosate in young tea. Glyphosate at 0.56 kg/ha applied at four weekly intervals maintained satisfactory weed control (about 40%). At 6 weekly intervals the weed control was about 60%. Glyphosate at 1.12 kg/ha gave good weed control at both frequencies of application. The weed control was 80–90%. Glyphosate did not affect the growth of tea plants.

Another experiment was conducted in young tea in 1975 to study the feasibility of eliminating manual weeding in new clearings from the time the land is levelled and prepared for holings. Linuron at 1.12 kg/ha was applied to weed free ground in late March. Glyphosate was applied first in mid May at 0.56 kg/ha i.e. three weeks after the tea was planted and again in mid July at 1.12 kg/ha and early September at 0.84 kg/ha. The applications of Metribuzin was carried out at the rate of 1.12 kg/ha first in late October and again in early December. In March 1974, Metribuzine was applied at 1.68 kg/ha. Spot

spraying of Glyphosate (0.3 kg/ha) was carried out in early in April and in mid July 1974. Glyphosate was again applied at 1.12 kg/ha. Excellent weed control was achieved without any adverse affects on the tea.

In 1978 seasonal emergence and growth of weeds were studied in a series of plots, cleanly weeded at 4–weekly intervals. Data indicated that weeds are able to germinate and establish throughout the year. However, there is a reduction in the total number of weeds establishing during the dry months.

Effect of NPK on the growth of *Borreria latifolia* in association with the other weed studies. were tested. Fertilizer was applied twice, first at the time of land preparation and again ten weeks later. Rates of application were N at 0,40 and 80; P_2O_5 at 0,5 and 10, K_2O at 0,15 and 30 kg/ha. The applications of NPK had no effect on the number of *B. latifolia* established in a weed association. The growth of *B. latifolia* responded up to 40 kg N while the other species responded up to 20 kg N/ha. Application of phosphate or potash had no effect on the growth of either *B. latifolia* or other weeds.

Effect of light intensity and nitrogen on the establishment and growth of weeds were studied. Light intensities of 100, 60, 40, 30 and 10% of daylight as main treatments, along with N at 20 and 40 kg/ha as sub-treatments were compared. At a very low intensity (10%) the number of weeds established were significantly less than at intensities of 30% and above. The growth of weeds (over three months) was significantly reduced at light intensities of 30% and less.

ANANTHACUMARASWAMY, A., WATSON, M., AMARASEKERA, A. R. and PUNYASIRI, P. A. N. (1986). The Influence of Weed Management in Tea on the Surface Layer Soil Properties of an Ultisol. Sri Lanka J. Tea Sci. 55 (1): 28-35.

The effect of two methods of weed control namely (i) chemical and (ii) manual (with a weed scraper) on some soil physical and chemical properties were studied in a long term experiment. It was found that chemical weed control was superior to manual weed control with respect to changes in soil physical and chemical properties such as total pore space, percent aggregation, water retention, total available water, texture, organic carbon, CEC and percentage total nitrogen.

ATAPATTU, J. P. (1981). Herbicides for Weed Control in Tea Lands. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

Weed competition has been a problem on tea lands since their establishment many years ago and they continue to be so up to the present day. In the future too weeds will be a problem which could decrease both yield and quality of tea. Many methods have been used to control weeds, but good management is very essential as this involve a considerable amount of expenditure. The most modern is the use of herbicides which require knowledge and skill, sprayers and an efficient extension service. It is harmful to use herbicides as contamination could occur leading to environmental pollution. Therefore, there should be a thorough understanding when using herbicides in the tea plantations.

BROWN, G. C. (1931). Analysis No? Weeding Tea Quart. 4:117–118.

Soil conservation would be the most outstanding factor in weed control. When a weed is removed from any crop, it should be buried in the soil from where it came unless the weed contains poison noxious to the major crop. Even if the weed is noxious. the burnt ash should be returned to soil. The whole process would be ideal, provided there is no soil loss.

In this process, where the expenditure is concerned the enhanced cost of weeds should be overcome by a less cost control measure and the capital available i.e. the top soil, would be conserved.

DICKSON, G. T. (1945). Notes on the Effects of *Drymaria* on an Tea Estate in Uva. Tea Quart. 18:84-89.

The history of the weed *Drymaria* cordata is discussed briefly. An investigation done on an estate in Uva revealed that *Drymaria* has caused an annual average loss of tea by over 100 lb/ac. The weeding experiments carried out on St. Coombs estate by the Tea Research Institute, showed that weeds have caused a definite loss of crop during the first 6 years of the experiments. Heavy shade or sunless weather limited the growth of *Drymaria* to a reasonable extent and a good thick cover of tea in its third or fourth year from pruning, was an excellent control factor. During 1944, it became apparent that *Drymaria* could be weeded out and it was done from 1945 onwards.

EDEN, T. (1939). The Effects of Cultivation and Weeds on Tea. Tea Quart. 12:24-37.

In weed control experiments on tea,the fields were either clean weeded or selectively weeded and combination of manurial treatments were used. The degree of soil compaction was measured by using a Culpin soil probe. The cultivation practice had no effect on root distribution. There was a drop in yield due to the competition of weeds and intensive weeding also decreased yield by about 50%. The extra manuring increased yield in the selectively weeded plots for an extent at least as great as by the clean weeded plots. The conflicting views on selective weeding of tea is discussed.

EDEN, T. (1941). Studies on the Yield of Tea. IV. The Effect of Cultivation and Weeds on Crop Growth. Tea Quart. 14:47-60. (Reprinted from Emp. J. Expt. Agric. (1940). VIII, 269-279.

After an informative account on previcus work, results of a field experiment with tea is discussed. The main factors studied were cultivation, weeding and manuring. The effects of the various treatments were studied in relation to three characteristics, resistance of the soil to the penetration volume and depth distribution of feeding roots, and the yield of tea. Details of the techniques used are presented.

EDEN, T. (1947). Manurial Responses of Tea and Weeds. Tea Quart. 15:5-9.

Experiments on manurial responses of tea and weeds are reported. Results show that regulating the phosphate fertilizers has a prodigious effect on the weed flora. When plots were unweeded for $3\frac{1}{2}$ months, the weight of weeds removed from the phosphatic plots was $2\frac{1}{2}$ times more than those for which two cycles had been devoid of phosphate. Such weed growth causes an appreciable loss of nutrient in clean weeding methods. It is noted that phosphate loss is not severe since the phosphate content of weeds is small. But at a conservative estimate weeds remove $\frac{1}{2}$ as much as nitrogen removed by the tea crop at its most productive period; and equal amount of phosphate and twice as much as potash. The competitive effect of *Vigna* in exploiting manurial applications is discussed. The chief disadvantage of *Vigna* was its climbing habit, not its competition in absorption of nutrients. *Vigna* makes a positive contribution to the crop environment by fixing nitrogen. No clear distinction has been made between the various individual species of weeds. As a class, grasses are more avoid for nitrogen than broad–leaved weeds, and leave little available nitrogen in the soil for their competitors. This is unfavourable for tea. The

institute has been experimenting on a system of weed control based on leaving weeds for 3–6 months and then removing and burning them in pits. It is pointed out that forking deeply when incorporating manures is advantageous as weed root-systems are shallower than those of tea. Questions about general control of weeds using artificial methods are discussed. It is pointed out that in tea, the growth rate is much slower than that of weeds. Whether inorganic manures are less favourable to weed growth than organic, is discussed, although experiments have not shown any differences between the two but under suitable weather conditions, sulphate of ammonia might have a scorching effect on weeds.

HASSELO, H.N., and SANDANAM, S. (1965). Chemical Weed Control in Tea. Tea Quart. 36(1):22-31.

Ten different herbicides were assessed on their phytotoxicity to weeds and tea. All of them reduced the growth of weeds but also caused phytotoxic symptoms in tea.

It was shown that soil erosion could greatly reduce the efficiency of chemical weed control. On the other hand, herbicidal toxicity to tea might readily occur in places where sprayed soils accumulate after erosion or on soils with low organic matter contents. In view of the latter, lower rates of herbicidal applications might be effective and indeed be necessary, to reduce toxic effects on tea grown at lower elevations, where soils generally contain less organic matter.

The increase in efficiency of chemical weed control going down a slope was due to soil erosion rather than to leaching of herbicides. This efficiency gradient appeared to be of the same magnitude as that of the soil productivity gradients observed on sloping tea lands.

The results did not allow conclusions to be drawn on the long term herbicidal effects on tea nor on the economics of chemical versus other methods weed control.

JAYAKUMAR, M. (1981). Weed Control, Tea Bull. 1(1):19-22.

Weed control in tea for high yields is stressed. Management of the tea bush by infilling vacancies, correct pruning and proper slope of plucking etc., will prevent light reaching the ground and thereby control weeds. All exposed areas too could be grown to suitable grasses like Mana, *Eragrostis, Paspalum* and trees. The growth of covers such as *Oxalis* and *Desmodium heterocarpus* also control erosion. Scrape weeding is costly, remove nutrients,also cause soil erosion. Chemical weeding seem to be promising on tea lands should be undertaken when the weeds are in the active stage of growth.

KATHIRVETPILLAI, A. and PUNYASIRI, P.A.N. (1985). The Use of Oxyfluorfen as a Pre-Emergent Herbicide in Tea. Sri Lanka J. Tea Sci. 54 (1):42-45.

The effect of a new pre-emergent herbicide, Oxyfluorfen was studied by spraying clean weeded plots in young as well as in pruned tea at 0.12, 0.24 and 0.42 kg a.i. ha^{-1} and comparing it with Diuron at 0.90 kg a.i. ha^{-1} and an untreated control. In both young as well as pruned tea while Oxyfluorfen at 0.48 kg a.i. ha^{-1} gave complete control, satisfactory control was achieved at 0.24 kg a.i. ha^{-1} considering the wide spectrum of weeds controlled as well as the persistence of spray applications compared to the control obtained by Diuron. No adverse effects were noted on the tea due to the spray applications.

KULUGAMMANA, H. B. (1982). Case for Application of Weed - killers on Tea Plantations.(Comparison ofManual and Chemical Methods and Soil Erosion) J. Nat : Inst: Plantation Management 2(1) 89-93.

The advantages and disadvantages of manual weed control practice is discussed. It is pointed out that if manual weeding had been confined to pulling out of weeds, damage to the environment due to soil erosion could have been avoided. But the use of scrapers disturbes the top soil and causes losses of micro-nutrients and trace elements due to erosion. This is not only confined to the tea estates but also to the overall environment. Data on studies conducted over 6 year period on a tea estate to asses soil losses are reported. The advantages of chemical weeding due to minimised soil erosion are discussed.

LAMB, J. (1952). The Control of Pests, Diseases and Weeds. Tea Quart. (XXIII) III – 53–58.

The general aspects of control of pests, diseases and weeds on tea are discussed. The Tea Research Institute has conducted investigations on applications of the chemicals available for crop protection, and advises estates to wait for their precise recommendations as these chemicals could be highly toxic to tea. The poisonous effects of the weed killers require careful investigation. Hazards to the health of labourers employed in applying chemicals have been taken into account.

MARSH-SMITH, E. C. (1943). Tea Weeding. Tea Quart. 16:42-44.

An outbreak of Lime weed *Polygonum nepalense* occured in 1929 which suppressed *Oxalis* and all other weeds in a tea estate above 4000 ft. amsl. This weed is surface rooted. It also has a short growth cycle which allows *Oxalis* to grow in alternate cycles and provide continuous ground cover which prevented erosion. The other weeds that occured in this estate were the "White Weed" *Ageratum conyzoides*, "Spanish Needle Weed" *Bidens chinensis* and *Drymaria*. The procedures adopted in weeding tea estates such as hand pulling, scraping etc. and collection and composting of weeds are described in this report.

MEDLEY, V. F. (1961). Preventive Weed Control in Tea. World Crops XII (3) 103-105.

The work in Ceylon with Simazine shows that there is great potential benefit in a weed killer which by it's persistence will help to reduce the cultivations necessary and therefore decrease erosion: which will act as a seedling weed killer so that a dirty soil may be cleaned; which will have a wide spectrum of herbicide activity, but will also be selective so that some type of a permanent cover may be left in control or established where necesary, and which will have a low solubility in water so that it will be less subject to the leaching caused by the heavy rain of the tropics.

PHILLIPS, W. W. A. (1956). The Disposal of *Drymaria cordata* Seeds by Ground-Feeding Birds. *Tea Quart.* **27, 73.**

On the morning of 24th May, while in one of the top fields of Tonacombe Estate, adjoining extensive hill-patana (alt. 4,500 ft. approx.), I observed a common India pipit *(Anthus richardi malayensis)* feeding a full grown juvenile. The youngster was standing on a low stone in young tea and could be well observed, with the aid of field-glasses, from a distance of under 25 yards. The parent approached through the tea and, after feeding the youngester on a small grasshopper, turned its back so that the rump and tail could be well seen.

On the rump was a single small green seed and attached to the tips of the tail feathers were several more. Although there is very little *Drymaria* on this estate, there was no doubt that the seeds were those of *Drymaria cordata* clinging to the birds's feathers. Presumably they had been picked up as the pipit had run through or brushed against a *Drymaria* plant, during its search for insects.

Although it has always been well known that the seeds of *Drymaria cordata* are widely distributed, through adhering to the fur and hairs of animals which have brushed against the plant, it was not been observed that seeds being spread by a ground-feeding bird.

PORTSMOUTH, G. B. (1951). The Weed Problem on Tea Estates. Tea Quart. 22:101-104.

In this article attention has been given to the increasing weed problem on tea estates in many up-country districts. It has been suggested that developing a fairly good cover of tea over most of the fields can reduce this problem to some extent. However, it is necessary that efficient weed control measures should be carried out during the first year of the cycle. At present, experiments on a new weed killer known as Sodium Trichloroacetate are being conducted. This weed killer can be used in mature tea. Selective weeding is considered as another method of dealing with the weed problem.

PORTSMOUTH, G. B. (1953). The Principles of Pest Control III, Weedicides. Tea Quart. 24, 33-34.

Modern weedicides are divided into the following three classes: 1. Non-selective contact type. 2. Selective "Hormone" type, and 3. Selective "Grass" weedicides. All herbicides have been used for weed control in tea plantations, but the most recent has been the use of TCA and IPC, either alone or in combination with other weedicides to control couch *(Panicum repens)* and *illuk (Imperata cylindrica)*. Three applications of TCA at 50 lb/ac controlled both grasses however, the high cost of TCA make it uneconomic. Sodium chlorate at 20 lb/ac in 10 gl (100 gl/ac) was economic for controlling *Eupatorium riparium* in ravines. The complete elimination of all weeds appear impossible with weedicides as *Commelina* spp. were unaffected. As weedicides affect tea, their use should have proper scientific advice.

SANDANAM, S. MAPA R. B. and PREMARATNE A. D. (1980). Weed Control in Tea. Investigations with Glyphosate. Tech. Rept. Tea Res. Inst. of Sri Lanka, 18.

A glass house experiment was conducted to study the effectiveness of Glyphosate (2% solution) on cough grass grown in various soil moisture regimes, The death rate of the rhizomes was high when the soil remained either at field capacity throughout, dry throughout or at field capacity before and dry after Glyposate treament. Water logging the plants throughout the experimental period or maintaining a dry water regime before treatment resulted in a low rate of death of rhizomes after Glyphosate treatment. The production of new rhizomes was also affected by moisture regimes. In the untreated plants both the dry water regime and water logging resulted in a greater death of rhizomes. In Glyphosate treated plants the miximum supression of rhizome regeneration was in the plants which had adequate soil moisture at field capacity. Adequate soil moisture before and after spraying suppressed rhizome regeneration of the untreated control.

Treatment on Soil Erosion, Soil Moisture Status and Yield of Young Tea. Proc. Sri Lanka Asso. Adv. Sci. 36 Annual Session 31.

The effects were studied of ground cover treatments such as mulching, growing cover crops, selective weeding and leaving the soil bare on soil erosion, soil moisture status and yield of tea in the first two years of plucking. Soil loss from bare plots was estimated to be about 88 and 51 tonnes/ha in the first and second years respectively after planting tea. Soil loss in the first year was lower (5-7 tonnes/ha) from the mulched plots than from plots which were selectively weeded or under cover crops (11-31 tonnes/ha). In the second year soil loss from plots with *Crotolaria* as ground cover was higher (4.72 tonnes ha) than that from plots with other ground covers (1.2 to 2.5 tonnes/ha). In the third and fourth years soil loss ranged from 0.88 to 1.95 tonnes/ha in the various treatments. Mulching conserved more soil moisture than did cover crops. There was a trend to indicate that yield of tea from mulched plots was higher than that from plots under other ground covers.

SANDANAM, S. (1983). Effect of Glyphosate, Diuron and 2,4-D on Yield of Tea. Ann. Rept. Tea Res. Inst-Sri Lanka--18.

Highest weed dry weights were obtained in control plots and lowest in the plots treated with 2,4–D at 2 kg/ha. Diuron toxicity was seen in some plots and was attributed to excessive uptake of the chemical Karmex applied at 1 kg/ha.

SANDANAM, S. (1983). Weed Management in Tea. Annual Rept. 1983. Tea Res. Inst. Sri Lanka 18–19.

Control of *Crassocephalus crepidiodes.*

An experiment was carried out to study the efficacy of a new contact herbicide–Glufosinate (Basta) on *Crassocephalus crepidiodes.* Glufosinate at 2 5, 3.7, 5.0 1/ha, with Paraquat and 2,4–D were used as control treaments. The dry weight of the *Cressocephalus crepidiodes* showed that Glufosinate at given rates has reduced the growth compared to2,4–D.

SANDANAM, S., PUNYASIRI, N. and GAMAGE, A. K. (1985). Use of Oxyfluorfen as a Pre-Emergent Weedkiller in Young Tea ***(Camellia sinensis*** **(L) O. kuntze.) Sri Lanka J. Tea Sci. 54 (2): 73:77.**

An experiment was carried out at St. Coombs Estate, Tea Research Institute to test the suitability of Oxyfluorfen (Goal) at rates of 0.12, 0.24 and 0.36 kg active ingredient (a.i.)/ ha in 8000i water as a pre-emergent weedkiller in young tea of clone TRI 2025. Diuron at 0.90 kg (a i) ha^{-1} was included for purposes of comparison.

Visual assessment of weed control showed that 18 weeks after treatment Oxyfluorfen at 0.12, 0.24 and 0.36 kg (a.i)/ha^{-1} gave about 50%, 70% and 90% weed control respectively, compared to the untreated plot. Effect of Diuron was comparable to that of the lowest rate of Oxyfluorfen tested. In terms of total dry weight of weeds per plot, determined at the end of the experimental period, suppression of weeds grown by Oxyfluorfen amounted to 82%, 95% and 98% at 0.12, 0.24 and 0.36 kg (a.i.) ha^{-1} respectively whereas that Diuron at 0.90 kg/ha^{-1} was only 62%. Supression of broad leaf weeds was comparable with both herbicides used whereas supression of grasses was more efficient with Oxyfluorfen specially at the two higher rates used. Total number of broad leaf weeds were significantly reduced by all treatments and the control ranged from 85% to 97%. There was a strong

trend to indicate that Oxyfluorfen at 0.36 kg/ha supressed broad leaf weeds more effectively than the other treatments. There was no serious phytotoxic svmptoms seen in plants when foliage of young tea plants were drenched with a solution of Oxyfluorfen at the same concentrations as those tested in the field experiment or when sprayed only to the soil in pots containing tea plants.

SANDANAM, S. (1986). "Cultural Operations". Weed Control, *In* Hand Book on Tea. Ed. P. Sivapalan *et. al* Published by Tea Res. Ins. Sri Lanka. 48–55.

Weeds in tea besides competing for light, nutrients and water, harbour diseases and pests as well, and can sometimes be a nuisance to workers. The most common method of removing weeds from tea lands is scraping. Scraping breaks down the soil structure leaving a loose layer of top soil which is readily washed away by rain. The loss of soil nutrients is considerable. Use of herbicides is suggested as an alternative. The most critical stages at which weed growth is profuse are in young tea and in pruned tea; during other periods weed problem is relatively low.

Adequate weed control in young tea is necessary for successful establishment of young plants. Although scraper weeding is the most common method practiced at present it could cause injury to the collar or side branches of young tea and these wounds could aid invasion by pathogens such as *Phomopsis theae*. Use of contact herbicides could result in damage to young tea due to drift. Residual or pre-emergent herbicides such as Simazine at 1.1 kg/ha could safely be used at the early stages. Mulching the inter rows using Guatemala grass or Mana grass is the most desirable method of weed control in young tea. Growing a cover crop of low height is also recommend. Complete elimination of all weeds is not desirable. Soft weeds such as *Oxalis* and *Drymaria* could be retained as they do not compete with the tea plant, minimise soil erosion and offer no competition for water as they die during the dry weather.

A programme of weed control which combines chemical and manual methods is most desirable in mature tea, Simazine and Diuron could be used after pruning to prevent weed seeds from germination. Paraquat can be used if the sprayers are fitted with a spray guard, because the spray drift can damage the developing shoots. It is necessary to know the properties of herbicides for their efficient use. Some important points which should be taken into consideration in using herbicides are discussed.

SIVAPALAN, P. (1983). Minimizing Soil Erosion on Tea Estates in Respect of Manual Weed Control, Tea Quart. 52 (2): 81–23.

Soil erosion is a serious problem in tea estates besides silting of the water courses and rivers. The methods of weed control in tea contributes largely to this problem, as weed free estates is an accepted maxim, and is a yard stick for measuring managerial efficiency. However, top soil should be protected as it is a source of nutrients to the crop. If plants with a prostrate growth habit could be maintained erosion could be reduced. The use of the scraper, called "Sorodi" to control weeds has led to serious soil deterioration in tea lands. Thereafter weeding should be undertaken on a more scientific basis. It is necessary to evolve an integrated approach to control weeds in tea lands to reduce erosion. Such a program should induce the use of fast growing prostrate non aggressive ground covers and non climbing species (eg. *Stylosanthes, Desmodium* etc.) which could be slashed periodically. The use of ground covers on sloping tea lands will have numerous advantages.

SOMARATNE, A. (1987). The Use of Herbicides in Sri Lanka. Tea Bull. 7(1) 17

Four chemical sprayings were given at 3 to 4 monthly intervals, up to the end of the year. The control obtained with Dalapon (5 and 10 lb/ac) was very satisfactory. Although very high rates of Amitrole (2.5 and 5 lb/ac) were tried, the control obtained with this chemical was poor. Repeated applications of Dalapon are likely to check the rapid spread of this grass though complete eradication cannot be achieved.

SOMARATNE, A. (1968). Chemical Control of Weeds. Diuron, Simazine and Gramoxone on VP Tea. Tea. Res. Inst. Cey. Tech. Rept. 1970, 48.

Four sprayings of Diuron (1 and 3 lb/ac) Simazine (1 1/2 and 3 lb/ac) and Gramoxone (1 pint/ac) were given during the year. Control plots were hand weeded whenever necessary. Analysis of yield data for the 2nd year showed no significant differences between treatments.

SOMARATNE, A. (1987). The Use of Herbicides in Sri Lanka. Tea Bull 7(1) 10-17.

The use of herbicides in tea was seen first as a means of labour saving. The first reference to any herbicide trial appears in the Tea Research Institute (TRI) Annual Report 1949. During the later years trials had been carried out with 2-4 D, MCPA, 2.4,5-T Dalapon, Sodium Chlorate, Penta chlorophenol, Simazine and Casoron. From about mid 60's TRI commenced field trials with several herbicides at St. Coombs Estate, Talawakelle and St. Joachim Estate, Ratnapura. Paraquat, Diuron, Simazine, Dalapon, 2–4D and MCPA were first recommended followed by Glyphosate (Round Up) for the control of rhizomatous grasses in 1980 and Oxyfluorfen (Goal) for general weed control in 1985. Total consumption of herbicides, their cost and the harm of over-dependence on one herbicide in plantations are discussed. It is pointed out that herbicides recommended for tea at the current level of use would not cause any environmental damage.

SRINIVASAN, V, NEGI N. S., PERERA C. S. and ARCEO L. M., (1981). Development of the Isopropylamine, Salt of Glyphosate for Weed Control in Tea, Proc. 8th Asian-Pacific Weed Sci. Soc. Conf. 439–442.

The development program for the use of isopropylamine salt of Glyphosate in tea *(Camellia sinensis)* started with preliminary screening trials for weed control and continued systematically through to completion of crop residue analysis. Weed control evaluations concentrated primarily on the problem of perennial weed species *Imperata cylindrica* (L) Beauv. and *Panicum repens* (L) both of which were effictively controlled. Crop tolerance trials revealed that tea exhibits considerable tolerance to the herbicidal effects of the isopropylamine salt of Glyphosate from drift or accidental spray contact.

VISSER, T. (1961). Interplanting in Tea. 1. Effects of Shade Trees, Weeds and Bush Crops. Tea Quart. 32:69-87.

A review of the effects of shade trees, weeds, and bush crops, on soil moisture and nutrient relations and the performance of tea has led to the following observations, in regard to weeds.

The presence of weeds in mature tea can significantly reduce yield, but losses in crop may be small or negligible provided the tea covers the soil well and outstandingly

obnoxious weeds are kept out; under such conditions undue cultivation may do more harm than good. On steep slopes or in a poor stand of tea, weeds are to be preferred to prevent soil erosion.

WAIDYANATHA, U. P. de S. (1967). Chemical Control of Weeds in Tea in the Low Country of Ceylon, M.Sc. Thesis (Unpublished) University of Ceylon.

Effect of weeds on the yield of tea was studied. The yield of seedling tea receiving 100 lb nitrogen was not reduced when weeded only once every six months. At 200 lb nitrogen/ac weed competition appeared to reduce the response to nitrogen.

Paraquat, Diuron, Simazine, Aminotriazole, Dalapon, 2-4–D,2,4,5-T, MCPA and Shell HD.34 were evaluated for use as weed killers in tea. Primary evaluation was on the basis of their activity on the predominant weeds, when applied before and after the emergence of the weeds. Paraquat, Diuron and Simazine were more promising than the rest and were, therefore, selected for further evaluation.

Paraquat at 0.125 or 0.250 lb/ac, Diuron at 1 or 21/ac. and simazine at 1 or 2 lb per acre controlled weeds satisfactorily; the higher levels being more effective than the lower. Diuron and Simazine were far more effective when applied prior to the emergence of weeds than on standing weeds. Paraquat at 0.125 lb/ac. was not effective enough on grasses and certain dicotylednous creepers. However, 0.25 lb of Paraquat in 100 gallons volume/ac, followed by a repeat application when the grasses showed regeneration gave satisfactory control. Incorporation of 1/2 lb of Diuron in the Paraquat sprays delayed reinfestation of weeds.

Diuron and Simazine were phytotoxic to tea, especially at the higher levels. Paraquat too caused injury on contact but this could be minimised by careful spraying. At the rates used none of these herbicides had any effect on the yield of tea.

Simazine at 2 lb/ac. persisted in soil for only about 2 months while an equal quantity of Diuron appeared to persist for about 8 months. Paraquat when added to soil even at much higher rates than normally used for weed control had no effect on tea

WAIDYANATHA, U. P. de S. (1968). Investigations with Paraquat (Gramoxone) as a Herbicide for Weed Control in Low Grown Tea. Tea Quart. 39(2/2): 11-18.

Paraquat at 0.125 and 0.25 (half and one pint of Gramoxone), lb/acre controlled two months old weeds effectively, and less so at 0.063 lb/acre. The three-month-old stand of weeds was very profuse in growth, yet some control was obtained at 0.25 and 0.125 lb/acre. In weeds four months old, grasses and creepers were so dense that even 0.25 lb/acre was not effective and regeneration took place.

Paraquat at 0.125 and 0.25 lb/acre with 50 and 100 gallons water/acre were used on a dense stand of *Paspalum conjugatum;* 0.25 lb in 50 gallons of water appeared to be the optimum level. At rates of 0.125, 0.25 and 0.5/acre of Paraquat in 50 gallons of water, repeating the application after ten days was more effective than after 20 days. A significant decrease in the viability of seeds of *P. conjugatum* was observed at 0.25 lb Paraquat/acre when the spray volume was increased from 50 to 100. Seeds from the untreated plots were significantly more viable than those from the treated plots.

Ten ppm of Paraquat in the soil was not phytotoxic and growth of plants was normal. At 50 ppm and above, there was severe phytotoxicity and retardation of growth: phytotoxic residues were available for uptake by plants even six months after treatment. The conclusions were:

Bi-monthly applications of Paraquat at 0.125 lb/acre is necessary except perhaps during dry weather when the growth of weeds was less. Delaying the Paraquat spraying beyond 2 months may result in growth of weeds which may then be difficult to control even at a level higher than 0.125 lb/acre.

More than 0.125 lb Paraquat/acre and a repeat application before regeneration sets in may be necessary in the control of *P. conjugatum.*

There is no danger of Paraquat being available for root absorbtion at the level used in weed control in tea: the absorptive capacity of the soil used was found to be between 10 and 50 ppm Paraquat

WATSON, M. (1983). Weed Management in Poor Stands of Tea. Ann. Rept. Tea Res. Inst. 19.

The dominant weeds were *Borreria* spp. The experiment with five different weed control treatments were applied after clean weeding a poor stand of tea. The degree of weed control achieved with different treatments are described. The weed control at the lower rates of 2,4–D was only slightly less than that obtained at sub-lethal rates.

WATSON, M. (1984). Weeds and Weed Problems of Tea, Rubber and Coconut. 1 Weed Problems and Weed Control Recommendations for Tea. Proc. Symp. on Weeds and Weed Problems. Sri Lanka Asso. Adv. Sci. 15th Sept. 31–32.

The weeds in tea estates range from soft annual dicotyledonous weeds. (eg. *Drymaria cordata)* to perennial stoloniferous grass (eg. *Panicum repens)* which pose serious problems. The broad leaved and grassy weeds and sedges occuring in tea estates have been listed. The weed control parctices in use are: manual (with or without implements); cultural (cover crops) and chemicals (mainly Paraquat. Diuron, Simazine, Dalapon, 2,4 D and MCPA). The recommended practices have been listed with the caution that an integrated system of weed management should be adopted with a view to environmental conservation.

WETTASINGHE, D. T. (1968). The Use of Diuron for Weed Control in Mature Low-Grown Tea. Tea Quart. 39 (4):119-120.

The repeated use of Gramoxone monthly at $\frac{1}{2}$ pint/acre is common in some tea estates. However, *Paspalum conjugtum* (Sour Grass) and *Spermacoce latifolia* are not adequately controlled by the weedicide and these have become predominant. Higher rates together with manual weeding may control these weeds, but it will be costly. A number of other herbicides which may be useful in dealing with this problem have therefore, been evaluated. Promising results have been obtained with Diuron and its use in estates can now be suggested, but strictly on an experimental basis. The scheme suggested for mature tea fields where there is a dense weed growth includes following treatments: 1. applying of a pint Gramoxone plus 15 fl. oz Lissapol 'N' in 100 gls water per acre; 2. applying of 3/4 lb. Karmex plus 15 fl. oz. surfactant 'N' in 60 gls water per acre after 2–3 weeks; 3. removing the weeds which escaped the spray manually and; 4. repeating the treatment 2 when weed control breaks down

WETTASINGHE, D. T. and RAJENDRAN, N. S. (1969). Evaluation of Herbicides for Weed Control in Mature Tea. 1. Effects on the Weed Species. Tea Quart. 40 (4):160-163.

The importance of weed successions leading to the dominance of resistant species and, in this connection, the danger of depending on a single herbicide for weed control are emphasized.

Initial screening of herbicides in observation plots indicated that 12 materials were of relatively low activity and were therefore eliminated from further testing. Simazine, Diuron, Amitrole, Pentachlorophenol and 2,4-D were outstanding and selected for testing for crop tolerance.

Eleven other herbicides (with Diuron as a standard) were further evaluated for herbicidal activity in a field experiment. Lenacil, Linuron and Diuron displayed extreme herbicidal activity over a wide range of species including the Paraquat resistant *Paspalum conjugatum* and *Borreria* spp. Attratone, chloroxuron and prometryne gave good control of *Paspalum conjugatum*, but did not control *Borreria* spp. effectively. Propachlor was ineffective against both *Paspalum conjugatum* and *Borreria* spp., but gave good control of *Cyperus teanuiculmis*. All chemicals tested effectively controlled *Cleome burmanni*, *Ageratum conyzoides* and *Bulbostylis puberula*.

WETTASINGHE, D. T. (1972). Weed Control in Tea. Proc. Symp. "Towards Productivity of Tea Lands in Ceylon." Tea Res. Inst. Cey. No. 1, 30-31.

The over dependance on a single herbicide has become a major drawback of chemical weed control programme in tea lands. The repeated use of a single herbicide may cause serious damage. The weed control programmes based on more than one chemical will not only reduce the damages caused by a single herbicide, but also increase the spectrum of activity. In addition, the selection of a suitable chemical, time of application, the herbicide properties and the equipment used should be considered if effective weed control is to be achieved.

WETTASINGHE, D. T. (1980). Weed Management in Tea. Tea Res. Inst. Sri Lanka. Tech. Rept. 1980.

The main effort in this project was directed towards control of couch *(Panicum repens)* with Glyphosate. A provisional recommendation was made to use Glyphosate (at 2% concentration of Round Up) in ravines and road-sides. Studies were conducted to determine: (a) lowest dosage at which couch could be effectively controlled; (b) methods by which spray drift to tea can be prevented or minimized; (c) time of spraying in relation to the pruning cycle, at which phytotoxicity could be minimized. It was found that at dosages less than 4.4 kg/ha regrowth was fast. Since couch often grows through frame and appears above the plucking table spraying the couch foliage directly causes phytotoxicity to tea. A practical way to minimize this is to pull out the grass growing through the frame and lay it in the inter-row and then to undertake spraying. Any possible residue in made tea could be avoided by spraying a few weeks before tipping. Another alternative was to spray immediately after pruning. However, this could damage the buds which would cause leaf abnormalities.

Glasshouse experiments carried out with Glyphosate to study the effect of different treatment of plant parts, showed that treatments of either the main shoot or the tillers with a solution of Glyphosate (2.2 kg/a.i. in 227 litres of water) effectively killed the plant whereas treatment of either the stem or the two terminal leaves in the main shoot checked growth, suppressed rhizomes regeneration but did not kill the plant. Treatment of the stem in the main shoot suppressed rhizome regeneration more than did the treatment of the two terminal leaves in the main shoot. Glyphosate at 1% 2.2%, 3.3% and 4.4% sprayed on young tea plants checked the growth of leaf and root more than that of the stem. In general, treatment of the basal half of the tea plants was less injurious than treatment of the terminal leaf or the whole plant. This effect depended on the concentration of Glyphosate used.

Glyphosate used at 1.12 kg a.i. in 562 litres of water per ha in a pruned tea field resulted in a high degree of weed control which was comparable to that achieved with the use of 2.24, 4.48 or 8.96 kg/ha for three months after initial spraying. The higher level of Glyphosate tested produced abnormal symptoms such as inward marginal curling of leaves, production of long and narrow leaves devoid of serrations and multiple bud break from single nodes of pruned frames.

WILKINSON, C. H. (1933). Some Indigenous Weeds. Tea Quart. 6, 176.

The note describe the following weeds in tea cultivation: *Cardamine hirsuta (Mustard* weed) *Cardamine trichocarpa* (Mustard weed), *Artemisia vulgaris* (Chrysanthemum weed, *Oxalis corniculata, Oxalis latifolia, Oxalis corymbosa, Drymaria cordata, Ranunculus wallichianus, Justicia procumbens, Laurembergia wangerinii, Centella asiatica* (Violet weed), *Desmodium triflorum, Hydrocotyle javanica, Biophytum proliferum, Rungia elatior, Cassia leschenaultiana* and *Parochetus communis*. These weeds could be used as cover crops. The advantage and disadvantage of the spread of weeds are discussed.

WIMALADASA, G. D. and WICKREMASINGHE, K. N. (1986). Effect of Herbicides on Urea Hydrolysis in Tea Soils. Sri Lanka J. Tea Sci. 55(1):22-27.

Effect of Diuron (Karmex), Paraquat (Gramoxone) Glyphosate (Round Up) on urea hydrolysis in tea soils from different tea growing districts (St. Coombs, Passara and Hantane) with normally recommended and a ten-fold increase in concentration of the herbicide was studied under simulated field conditions. None of the herbicides had any inhibitory effect on urea hydrolysis in tea soils at both concentrations of the herbicides tested.

WEED CONTROL IN RUBBER

ANON (1967). Rubber Research Institute of Ceylon. (1967). Cover Crops Advisory Circular No. 77.

Advice on the establishment, maintenance and protection of cover crops, for *Heavea* plantations, with notes on desirable and undesirable species including weeds are presented.

CONSTABLE, D. H. (1954). Cover Crops or Weeds "Which is Which". 1st Quart: Circular Rubber Res. Inst. Cey. 30(1) 9-12.

Planting a leguminous cover crop in rubber lands has become necessity as this is being considered the best method to keep the undesirable weeds at a minimum. The leguminous plants are described as nitrogen fixing plants and the conditions for nitrogen fixation are summarised. Scientific advise should be sought after in the proper management of leguminous pastures. In our country the wrong attitude is being taken towards cover crops through a misunderstanding of the leguminous process and its agricultural application. The disadvantage in changing over of a successful creeper such as *Mikania scandens* for a creeper of less vigorous habit such as *Pueraria phaseoloides* is pointed out. Woody perennial weeds are usually considered undesirable due to competition effects, however soft herbaceous covers are considered better for decomposition and to keep in control. Grass has a slight adverse effect due to the formation of a very thick mat which restrict aeration and may render this soil. "sour". However this effect is less evident in older plantations. Writer suggests several other plants such as *Vigna hosei, Centrosema pubescens, Calopogonium mucunoides, Mimosa invisa* or *pudica, Eupatorium triplinerve, Salvia occidentalis* and *Indigofera endecaphylla* as alternatives. The desirable qualities of a cover crop is also given in the text.

CONSTABLE, D. H. (1957). A New Grass killing Mixture. Pest. Abstr. News Summary 3(4) 203-24.

A mixture containing 2-4 lb amino triazole + 2-4 gal 12% PCP+a small quantity of wetting agent is recommended for the control of mixed grasses at 40 gal/ac. Trials at varying unspecified rates have given complete control for 3 months of *Paspalam conjugatum, Briza minor, Ischaemum* spp and *Cyperus veginatus,* but *Mikania scandens* was resistant. The mixture has been superior to both PCP alone and amino triazole alone and Dalapon and Sovacide for weed control in rubber.

CONSTABLE, D. H. (1957). Weed Killing in Hevea, 3rd and 4th Quarterly Circular. Rubber Res. Inst. Cey. 33 (3/4) 57-62.

It is necessary to grow a creeping legume cover for weed control in young rubber. However, due to competition of grasses and composite, *Mikania scandens* have been used instead of a leguminous cover. Hand weeding and scraping lead to further soil deterioration on already eroded lands. Several mechanical methods of weeding and burning have been practiced, however chemicals appear promising due to their selectivity. Sodium arsenite has not been adopted due to its poisonous character. After several years of herbicidal screening Dowpon, Dipentox and Am/PCP have been recommended in eradicating grasses prior to replanting, using a boom sprayer. Strip spraying was found to be economic. Use of teepol and lissapol with the above herbicides help in spread of the chemicals on the leaf surface.

JEEVARATNAM, A. J. and KANTHASAMY, T. (1962). Use of Herbicides for Weed Control in Seedling Nurseries. Preliminary Rept. J. Rubber Res. Ins. Cey. 38 (1/2) 11-12.

Weed control of rubber seedling nurseries is a most expensive item and pre-emergence herbicides have shown great possibilities. Simazine 50W, Atrazine 50W, Ciba 1936 and 2059, Atratone, Prometrone and Prometryne were used in rubber replanting subsidy schemes nuseries at Hadigalla. Ciba 2059 at 5 lb/ac and Simazine 50W at 8 lb/ac have given satisfactory weed control. Some weeds were not controlled by these herbicides, hence combining with Paraquat at 1-2 lb/ac kept plots free of weeds for 3 months. Paraquat at 2 lb/ac is phytotoxic to rubber, hence lower concentration may have to be used.

KARUNARATHNA, T. (1987). Distribution of Weeds Under Rubber Plantations and Evaluation of Their Nutrient Status. 500 Series Res. Rept. Faculty of Agriculture, University of Peradeniya.

This study was carried out to investigate the weed distribution pattern under *Hevea brasiliensis* in Kegalle and Kurunegala districts. Nutrient contents of weeds and the soil were evaluated and their relationships were also investigated.

Six estates in the Kegalle district and two in the Kurunegala district were randomly selected. Five sample plots were taken using one m^2 quardrant in both mature and immature areas which were randomly selected in each estate.

Different weed species were identified and three prominant weed samples and soil samples from each plot were collected.

Soil and weed N and P contents were determined colorimetrically and weed K content was determined by photometry. Soil K, Ca,Mg and weed Ca,Mg contents were were determined by spectrophotometry. Soil organic carbon was determined using titration method.

Statistical analysis of data were carried to determine the coefficient of variation, frequency of occurrence and correlation between parameters.

In this study, a large number of weed species were observed under *Hevea*. Some weed species were fairly well distributed in each estate. Nutrient status of some weeds showed significant correlation with soil nutrient status. C: N ratio of the soil and nitrogen content of weeds was also significantly correlated in some weeds. But, there were no significant correlations between distribution of weeds and soil pH values.

MALLIKA, W. (1987). Influence of Soil Nutrient Content on Chemical Compositions of Weeds and their Distribution in Rubber Plantations. 500 Series Res. Rep. Faculty of Agriculture, University of Ruhuna.

In this study, attempt was made to identify weed species occurring under *Hevea brasiliensis* and their distribution in the Kalutara and Kurunegala Districts. The effect of soil nutrients on weed nutrient content were also investigated.

Eight estates in Kalutara and two in Kurunegala district were randomly selected and five survey plots of both immature and mature rubber areas were selected in each estate.

Different weed species were identified and three prominant weed species were collected. Soil samples were also collected from each plot. One m^2 a quadrant was used in each plot to assess the weed population and to collect samples.

Chemical analysis of soils and weeds were done. Roots and shoots of weeds were analyzed separately.

Soil and weed N,P and were determined by calorimetry. Ca, and Mg of both soils and weeds were determined by spectrophotometry. Soil organic C was determined using tritration method. Study showed that weed flora consists of grasses mainly and N, K, Ca and Mg in shoots of both grasses and broad leaf weeds were higher than in roots.

MATHEW, M., PUNNOOSE, K. I. and POTTY, S. N. (1977). Report on the Results of Chemical Weed Control Experiments in the Rubber Plantations in South India. J. Rubber. Res. Inst. Sri Lanka. Vol. 54, Part I (2):478-488.

Experiments were conducted by the Rubber Research Institute of India to study the possibility of chemical weed control in the seedling nurseries and immature rubber plantations. While in the seeding nursery, pre-emergence weedicides were found promising, a sequence of pre-and post emergence weedicides were proved to be advantageous in the planting strips of immature areas. Pre-emergence weedicide Diuron gave good control on the emergence of weeds in seedling nurseries. In the planting strips of immature areas no single weedicide, could effectively control all the weeds due to the diversify in the weed population. However, a cocktail application of weedicides were found to be effective, the ingredients of the cocktail being determined by the dominant type of weed population. Combinations of MSMA and Fernoxone were effective for weed population dominated by monocots and Paraquat and Fernoxone for populations dominated by dicots, especially *Eupatorium odoratum*. When the grass weeds *Imperata cylindrica* and *Pennisetum* sp. dominate, the chemical 2.4-Dichloro Propionic Acid and MSMA were found to be more effective.

PEIRIS, O. S. (1970). Weed control. *In* **Hand Book of Rubber Cultivation and Processing. 76-79.**

Chapter 12 of the above Hand Book is devoted to the control of weeds in rubber plantations. In new clearings a ground cover is essential but cultivation becomes necessary to control weeds and to establish the cover crops subsequently. This however, leads to erosion as the rubber lands are on steep terrain. The possible methods of weed control are hand cultivation (hoeing, scrapping, mammoty etc.) mechanical cultivation (ploughing, rotary hoeing) direct burning (firing, flame throwers and use of chemicals (soil sterilents, selective and non selective herbicides). The potential use of these methods on different locations are described and the nature of the weed problem is stated. Herbicides have the potential for use in all situations, although hand weeding may be advantageous when cover crops have been established. Sodium arsenate at 10 lb/ac, has been found to be useful and economical for use in rubber plantations. Paraquat used at $1\frac{1}{2}$–2 pints in 40-50 gls. of water is safer but more expensive than Sodium arsenate. Monosodium Methane Arsenate (MSMA) an organo arsenic post emergence herbicide has been found to be very effective when used in a mixture with Aminotriazole, 2,4,D–amine, Sodium chlorate and Dalapon depending on the main weeds present. Recommended mixtures of MSMA by the Rubber Research Institute of Malaysia are also given.

YOGARATNAM, N. (1971). Weed Control Under *Hevea* **in Ceylon with Herbicide Mixtures Based on MSMA, Quart. J. Rubber Res. Ins. Ceylon. 48, Parts. 3/4: 168-181.**

Results of seven experiments where the effects of MSMA when used singly and in mixtures with Amitrole, 2,4-D-amine, Sodium Chlorate and Dalapon on *Paspalum con-*

jugatum, Mikania scandens and a few other weeds under mature rubber in Ceylon is reported.

High rates of MSMA were required to obtain a good control of *P. conjugatum.* Under mature rubber, mixtures of 0.825 lb/ac. MSMA+0.188 to 0.375 lb/ac. Amitrole were found to effectively control *P. conjugatum,* Mixtures of 0.825 to 1.65 lb/ac. MSMA+ 0.6 to 0.9 lb 2,4-D-amine were very effective on a mixed growth of *P. conjugatum* and *M. scandens.* In areas with a mixed growth of *P. conjugatum, M. scandens, Axonopus affinis, Borreria hispida, Borreria ocymoides* and *Hedyotis auricularia,* mixtures of 8.825 to 1.65 lb/ac. MSMA+0.6 to 0.9 lb/ac. 2, 4-D-amine+4 to 5 lb/ac. Sodium Chlorate or 1 to 2 lb/ac. Dalapon were found to control the weeds effectively.

YOGARATNAM, N. (1984). Weeds and Weed Problems on Tea, Rubber and Coconut. 2. Weed and Weed Control Under *Hevea.* Proc. Symp. on Weeds. Sri Lanka Assoc. Adv. Sci. 15th Sept. 33-34.

The methods of weed control in rubber include hand cultivation (Hoeing, scraping, mammoty) mechanical cultivation (Ploughing, rotary hoeing), direct burning and chemicals, either of selective or non-selective types. An extensive list of weeds occuring in rubber plantations have been listed and recommendations for different stages of the crop are reported. The herbicidal recommendation is the use of Monosodium Methane Arsenate (MSMA) based mixtures depending on the main weed present and local soil conditions. Glyphosate (Round Up) has been found to be effective in controlling couch and illuk. Gramoxone is also used to control weeds in rubber plantations.

WIJESINGHE, K. G. G. (1986). Effect of Herbicides on Soil Characteristics and Weed Control Under *Heavea* 500 Series Res. Rept. Faculty of Agriculture, University of Ruhuna.

This study was carried out to investigate the effect of herbicides on soil characteristics and weed control under *Hevea.*

The experiment was carried out using a randomised block design with eight treatments and four replicates. This trial was sited in medium shade rubber plantation, plot size being 0.005 ac arranged between the rows of rubber trees. The soil belonged to Agalawatta series, and the site was at Vogan State Plantation, Matugama.

Different weeds species were identified and soil samples were collected from each plot, before treatment and six weeks after treatment. Only commercial formulations of the herbicides were sprayed using a knapsack sprayer. New growth and regrowth of plants were observed in each plot weekly. Six weeks after treatment fresh and dry weigh of weeds were measured in each plot

Soil N and P was determined colorimetrically using Technicon Auto Analyzer. Soil Na, K, Ca and Mg were determined by spectrophotometry using Atomic Absorption Spectrophotometer. Soil organic carbon and cation exchange capacity were determined using titration methods.

This study clearly indicated the following. The weedicides tested did not change the nutrient status of the soil to any observable extent except for the potassium content, which was slightly higher than in the control and in the manual weeded plots.

It was evident from the types of herbicides used that the mixtures of certain formulations was better than the use of a single herbicide. These herbicides are economically suitable than the manual weeding.

WEED CONTROL IN COCONUT

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GUNATHILAKE, H. A. J. (1981). Weed Control in Coconut Lands. Coconut Bull 1(2) 43.

Weeds compete with the coconut plant for nutrients and moisture. Weeds like *Mikania* creep over coconut sedlings and compete for sunlight. *Mimosa* and Illuk obstruct cultural practices such as manuring and picking. However, the weeds have some beneficial effects as well. They prevent soil erosion, reduce damages to soil due to direct exposure to sunlight, they are also a source of organic manure and cattle feed. Complete eradication of weeds in coconut lands is inadvisable however, checking the growth of the very noxious weeds is essential. Weed control methods that could be adopted are: mechanical, cultural, chemical and biological. The most suited methods of weed control in coconut lands are mechanical and cultural while biological means of weed control are still in the experimental stage. Although chemical weed control is effective it is more costly, and applied only against very noxious weeds such as Illuk, in coconut nurseries, intercropping lands with pineapple and in large estates.

Slashing and mammoty weeding ideally suit the small holders, while usage of machinery and tillage implement suits large estate owners. Complete uprooting of tall plants are considered unwise. Total eradication of *Mimosa* results in the exposure of soil which helps spreading of noxious weeds like *"Podisingho maran"*, Foxtail grass and their establishment in these lands. Tilling and harrowing cause the same. Slashing is considered the most suitable method of keeping such weeds as "Podisingho maran" and "Getakola" under control, by reducing their growth and eventual disappearance and encourage beneficial types of grasses, Undupiyaliya and Aswenna.

The cultural methods can be applied in both small and large coconut plantations. Some examples of cultural methods are the use of cover crops, intercropping, grazing, mulching and prevention of invading weeds from external sources. *Calapogonium Centrocema* and *Pueraria* are recommended as cover crops. Intercropping with selected crops like coffee and cocoa is recommended. A few major weeds well distributed in all coconut growing areas of Sri Lanka, are listed. They are: Podisingho maran *(Chromolaena odorata,* Nidikumba *(Mimosa pudica),* Keselpaluvel/Wathupalu *(Mikania scandens),* Bibila *(Sida rombafolia, Sida acuta, Sida cordifolia)* and Apala *(Urena lobata).*

GUNATHILAKE, H. A. J.(1984). Weed Control in Coconut - Pol Puwath 7 (8) 128-132 (In Sinhala).

The report details the losses caused by weeds together with their advantages in relation to coconut plantations. The weed species also differ depending on the location of the coconut plantations. Most common practices of weed control in coconut plantations are mechanical and cultural, however, biological methods too have been used. A weed **podisingho maran,** has been controlled partially using an insect *Ammalo insulata,* Chemicals are expensive and should only be used to control specific weeds such as Illuk or when intercropping coconut with pineapple. The following methods have been found economic for both large and small coconut plantations, filling of vacancies, cover cropping, intercropping, grazing, mulching, prevention of weed introduction from other neighbouring estates. The report list 21 weeds that are commonly found in coconut growing areas and their control methods.

GUNATHILAKE, H. A. J. (1985). Weed Control in Coconut Lands. Coconut Planter's Rev. 61 (716)-531-537.

Weed control in coconut plantations is discussed in relation to crop husbandry practices, and cultural and biological control. Satisfactory control of *Chromolaena* spp has

been achieved using *Parechaetes pseudoinsulata.* Management practices including cover crops *(Calopogonium, Centrosema* or *Pueraria* spp.), intercropping with shade producing crops e.g. coffee and cocoa, cattle grazing, or mulching with e.g. coconut fronds or husks or slashed weeds around palms are recommended. A table is presented on the main monocotyledonous and dictyledonous weeds associated with coconut plantation in Sri Lanka, with details of distribution, propagation, dispersal and control methods.

GUNATHILAKE, H. A. J. and COSTA, M. J. I. (1983). Effect of Six Cover Crops with Three Different Establishing Times on the Growth and Yield of Manioc Grown under Coconut at Bandirippuwa (Weed Control of Manioc) Coconut Res. Ins. Sri Lanka, Rept. Agron. Div. 34-35.

Cassava was planted simultaneously with the establishment of the cover crops. *Calapogonium muconoides, Centrocema pubescens, Pueraria phaseoloides, Psophocarpus palustris* and *Psophocarpus tetragonolobus* were better than that planted one and two months after the establishment of cover crops. All treatments with cover crops except *P. tetragonolobus* (var TPT-1) reduced tuber yield compared in the unweeded plots. This could be attributed to the competition from cover crops rather than from weeds. Cassava planted with the establishment of *P. tetragonolobus* (Var TPT-1) was the best and gave an additional income by producing winged bean vegetable pods.

GOONASEKERA, G. C. M. (1953). Pastures Under Coconut. The Incidence of Weeds.Cey. Coco. Quart 4(1) 9-12.

The significance of weeds in agriculture has been emphasised. Some weeds having a large surface areas such as *Mikania scandens* consume twice as much as water and heavily complete for light in pasture lands. Another common weed *Amaranthus viridis* (S. Kura Thampala) absorb nitrogen in large quantities. *Mimosa pudica* and *Sida acuta* (S. Gasbablila) cause heavy infestation under coconut and increase cost of production. *Ipomea cymosa* (S. Madu), *Asystacia gangetica* (S. Puruk) and *Comalina bengalensis* (S. Diyameneri) are palatable to cattle but they deteriorate pastures. Therefore, pastures should be better managed to decrease incidence of weeds. One of the reasons for weed infestation in pastures is over grazing. Weeds such as *Sida acuta, Mimosa pudica, Vernonia javanica, Hydiotis auricularia* have shown rapid growth when pastures are intensively grazed. Soil fertility is also a vital factor in keeping pastures free of weeds. Low soil fertility is indicated by the presence of plants like "Botia" and Kakilla, *Gleichenia linearis* which could be remedied by the use of fertilizers and organic manures. The popular saying that "one years seeding means seven years weeding" has been quoted.

LIYANAGE, L. V. K. (1977). Weeds of Coconut Lands. Pol Puwath 6 (3) 79-95. (In Sinhala).

Some of the most troublesome weeds of coconut lands and their control methods are discussed. *Eupatorium odoratum* (S. Podisingho maran) has become widespread and cause trouble particularly in coconut estates. It complete with the coconut plam for nutrients, moisture and sunlight. Besides it harbours certain pests. This weed has spread and well established in coconut lands in Kuliyapitiya, Kurunegala, Gampaha, Veyangoda and Puttalam districts. In the areas where *Eupatorium* growth is dense, the other weed species become suppressed. This weed can grow satisfactorily even on poor soils. It has been found that *Eupatorium* prefer sandy soils better than clay-loams. This weed grows quickly and forms bushes within about 6 months. It produces a large number of seeds (nearly 93,000 seeds/plant). Seeds are widespread. *Eupatorium* can be controlled by

uprooting to some extent and should done before flowering. Application of weedicides and mechanical methods are effective, but are costly.

Another weed which has spread into coconut lands at an alarming rate is Illuk *(Imperata cylindrica)*. It can grow on any soil but prefers light sand. Illuk propagates by seeds. Once established its control and eradication become both difficult and expensive. By frequent ploughing and harrowing it's growth can be checked. Growing Ipil-Ipil which provides shade is another satisfactory method of control. Burning is not recommended.

Pennisetum polystachyon (Mana) and *Mimosa pudica* (Nidikumba) are the otner two dominant weeds in coconut lands.

LIYANAGE, L. V. K. (1984). Weeds and Weed Problems of Tea, Rubber and Coconut. 3. Major Weeds and Their Control in Coconut Lands. Proc. Sri Lanka Assoc. Adv. Sci. 15th Sept. 35-38.

The major weeds occuring in coconut estates are: *Imperata cylindrica* (Illuk), *Pennisetum polystachyon* (Rila thana), *Panicum repens* (Atora) *Cyperus rotundus* (Kalanduru) *Cynodon dactylon* (Bermuda grass), *Aristida setacea* (Ath-thuththiri), *Chromolaena odorata* (Podisingho maran), *Lantana camera* (Gandapana), *Mimosa pudica* (Nidikumba) and *Mikania scandens,* (Watupalu).Weeds are controlled by several methods, mechanical (manual weeding, harrowing ploughing, slashing/mowing) cultural (cover cropping, intercropping, grazing, mulching) and chemicals. Herbicides have been found to be effective, but costly. Some herbicides eg. 2,4 D, 2,4 5T and MCPA are toxic to young seedlings. Biological weed control of *Chromolaena odorata* has been attempted with the leaf eating Arctiid insect *Ammalo insulata* in 1973 with partial success. Effeciency of this insect has been reduced due to natural enemies such as *Apanteles creatonotivier* (Braconidae) and *Exorista* spp. (Tachinidae) and predators *Sycanus* spp. (Reduviidae).

MARTIN, M. P. L. D. and MUDALIAR, T. (1983). Response of Coconut to Fertilizer Application and Weed Control. Fiji Agric. J. 45(2) 51–53.

A fertilizer application and weed control trial on coconut was conducted at Kubuna and Navonu in Cakaudrove province on the island of Vanua Levu in Fiji. The mean yield of copra over an 8 year period showed that fertilizer application and weed control increased it by 7.3 times over the control (i.e. no fertilizer application and no weed control), and by 2.6 times over weed control only. The practical application of these results are discussed.

PETHIYAGODA, U. (1980).Weed Control. *In* Hand Book on Coconut Cultivation. CH. 11. 68–70.

Common weeds found in coconut lands in Sri Lanka are *Chromolaena odarata* (earlier *Eupatorium odoratum S.* Podisingho maran), *Imperata cylindrica* (Illuk) and *Pennisetum polystachyon* (Mana), *Mimosa pudica* (Nidikumba). Less Common weeds are *Cenchrus echinatus* (Kuweni), *Sida acuta* (Gasbebila) *Hediyotis auricularia* (Getakola), *Vernonia cinera* (Monarakudumbiya) and *Hibiscus.* Important methods such as cultivation, mowing and slashing, use of cover crops, grazing and herbicides which are used in control and suppression of weeds are discussed *Tephrosia candida* (Bogamedilla), *Tephrosia purpurea* (Pila), cowpea or green gram can be grown in coconut lands as cover crops.

REGINOLD, C. (1984). Coconut Cultivation and Maintenances of Adult Plantations. 1. Control of Weeds. CH 10. 157–161.

In coconut plantations, cultivations are primarily aimed at control of weed vegetation which compete with the main crop for water and nutrients. However, when regular harrowing is carried out ploughing may be superfluous specially on sandy soils on which coconuts are grown. Weeds can also be controlled by herbicides such as MSMA based mixtures as reported in Malaya to control Illuk *(Imperata cylindrica)* and *Ischaemum* spp. The worst weeds in coconut plantations are Illuk and nut grass *(Cyperus rotundus)*. Of the shrubs *Lantans camera* L, *Eupatorium* has been declared as pests under the Plant Protection Ordinance of Sri Lanka.

REMISON, S. U. and MGBEZE, G. (1987). Competitive Effects of Weeds and Beneficial Effects of Mulching on Coconut Seedlings. Cocos 5, 19–28.

Dwarf coconut seedlings were raised in polybags under four mulching treatments (no mulch, coconut husk, oil palm bunch refuse and grass) and two weeding regimes (designated W0 and W1) in the nursery. Weeding was done once every month in W1 plots whilst W0 plots were left unweeded.

Weed competition reduced the growth of coconut seedlings a great deal and the unweeded and unmulched plants were not vigorous enough for transplanting. Weeds reduced yield of leaves, stem and roots in unmulched plots by 61, 46 and 44% respectively. Mulching was beneficial and reduced competitive effects of weeds. Mulching increased plant height, girth and drymatter yield. At harvest, leaves formed the greatest proportion of the drymatter; the mean being 171.6 g compared with 20.8 and 43.2 g for stem and roots respectively. Soil temperatures were only moderately reduced by mulching. Coconut husk suppressed weeds the most but oil palm bunch refuse increased K content of soil more than any other mulch material.

ROMNEY, D. H. (1971). The Danger Using Phenoxyalkyl Herbicides on Coconut Palms. Ceylon Coconut Quart. 22 (3/4), 104–106.

Hormone weed killers such as, 2,4–D and 2,4,5–T are extreamly dangerous and often lethal to young coconut palms and should not be used for weed control around young palms. Palms are killed by concentrations of herbicides much less than those used in weed-killing.

Serious and costly damage to the bunches and fruits of bearing coconut palms can be caused by hormone weed-killers. Only non volatile formulations should be used, and spraying performed only in still weather to ensure that no herbicide reaches the coconut crowns. Brush control is most safely and most effectively done by painting freshly cut stumps, with 2,4–D and 2,4,5–T in oil.

The coconut palm, being a monocotyledonous plant like sugarcane and grass, was expected to show resistance to phenoxyalkyl (or "hormone)) herbicides such as 2,4-D; 2,4,5-T; MCPA etc. Such materials had been used in Fiji for many years, apparently without ill effects. 2,4-D in particular, is a cheap and therefore an attractive herbicide. It was also hoped that one of the phenoxyalkyl herbicides, such as 2,45-T; or possibly a material such as Fenac (2,3,6-trichlorophenyl acetic acid) might prove useful in controlling creeping and climbing dicotyledons (broad-leaved plants) such as hog meat *(Ipomoea liliacea)*'

SALGADO, M. L. M. (1961). Weeds on Coconut Lands and Their Control. Cey. Coconut Planter's Rev. 1 (3) 16-27.

On a perennial crop like coconut, complete eradication of weeds is not an absolute necessity as the weeds have only a temporary effect. However, studying the biology of weeds is important. Weeds in coconut lands such as *Cyperus rotundus* (Nut grass-Kalanduru), *Panicum repens,* couch grass, (Etora) and *Imperata cylindrica* (Illuk) propagate vegetatively. Other weeds *Vernonia cinera* (Monara Kudumbiya), *Careya arborea* (Kahata), *Ficus religiosa* (Sacred bo) and *Cenchrus echinatus* (Queens grass) propagate by seed. Growth of weeds in relation to their environment is considered. *Salicornia brachiarta* and the shrub Lunu-warana *(Cratacva roxberghii)* are dominant on saline soils while the weedy shrub-*Calotropis gigantea* (Wara) on sandy soils. The perennial and ubiquitous *Mimosa pudica* grows particularly on over grazed gravelly soils. Illuk is adopted to almost any soil. Most weeds do not tolerate shade, while some do. *Eupatorium odoratum* is the most dominant weed in coconut lands on all environments and on almost all soil types and climatic ranges.

Seeds of *Hyptis suaveolens* (Madurutala), *Euphorbia geniculata* and *Croton glandulosus* buried in the ground can remain viable for long periods.

Weed control where weed dispersal and propagation is by seed is carried out by adoption of mechanical or chemical methods, so as to prevent flowering and seed setting. Grazing by cattle is common and one of the most important techniques of weed control on coconut estates.

In this article the common noxious weed Illuk *(Imperata cylindrica)* is discussed and suitable methods of control are recommended. Mechanical methods include ploughing or digging, disc harrowing, grazing, cover crops, thatching, mulching, and burning. Among chemical methods of control applying weedicide Dowpon has been claimed to be effective, but it is costly.

SALGADO, M. L. M. (1960-61). Weeds on Coconut Lands and Their Control. Cey. Coconut Quart (1 & 2) 16-19).

Eupatorium odoratum has established itself in all environments, on almost all soil types and climatic ranges. It is a woody shrub which belongs to the family Compositae. Large numbers of tiny seeds are produced and spread by wind.

Control could be achieved by the systematic uprooting of the plants before seeding. It is easy to uproot in the early stages. Once established this becomes difficult and expensive as the tap root goes deep and numerous branches reappear.

Euphorbia geniculata made its appearance on coconut estates about ten years ago and has now firmly established itself.

This weed belongs to the natural order Euphorbiaceae and is quick growing. The plant produces seeds in barely three months, and seed profusely. The seed remain viable for a long time.

Disc harrowing is the only economical control method and should be done before flowering

BIOLOGICAL WEED CONTROL

ANON, (1978). Biological Control of the Weed *Cordia curassavica* and *Salvinia molesta*. FAO PLant Prot. Comm. S.E. Asia Pacific. Quart. News!. 21 (4) 4.

The Department of Agriculture, Sri Lanka, was able to obtain nuclear stocks of some beneficial insects, through the Commonwealth Fund for Technical Cooperation (CFTC). These insects imported into Sri Lanka between April and July this year were recognized as parasites of some pests of local importance. Their ability to control these pests has been proven in other parts of the world. If found effective in Sri Lanka, they will augment and strengthen the biological control of pernicious pests.

1. *Telenomus remus* – Egg parasite of *Spodoptera* species
2. *Eurytoma attiva* – Hymenopteran pest of the weed *Cordia*.
3. *Schematize cordiae* – Coleopteran pest of the weed *Cordia*.
4. *Paulinia acuminata* – Orthopteran pest of the weed *Salvinia*.
5. *Samea multiplicalis* – Lepidopteran pest of the weed *Salvinia*.

E. attiva and *S. cordiae* were obtained from the Dept. of Agriculture, Kuala Lumpur, Malaysia, for the control of the weed *C. curassavica*. The former is a tiny, jet-black wasp which destroy the tender green berries of this weed; the latter is a dull grey beatle with light yellow edging of forewing. These two phytophagus insects, indigenous to Trinidad were used successfully in Mauritius and Malaysia.

P. acuminata is an aquatic grasshopper and *S. multiplicalis* is a Lepidopteran, the caterpillar of which is a leaf feeder; these two enemies of the water fern, *Salvinia molesta* (*S. auriculata)* were imported from Fiji.

DHARMADHIKARI, P. R. PERERA, P. A. C. R. and HASSAN, T. M. F. (1977). Introduction of *Ammalo insulata* for the Control of *Eupatorium odoratum* in Sri Lanka. Commonwealth Inst. of Biol. Control. Tech. Bull. No. 18, 129-135.

Although very encouraging results have been observed in the control of *Eupatorium odoratum* using *Ammalo insulata* it is yet premature to state categorically whether this insect itself would be able to suppreses the weed. Even after severe defoliation new flushes comes up soon after the rains and then the *Ammalo* larvae are not immediately available in large numbers to attack the fresh growth. Very soon the insect population increase and *Eupatorium* is once again defoliated as before.

In the laboratory it has been noticed that during the months of April/May possibly correlated with the wet season there has been each year a period when eggs laid have proved infertile. The mating occurs apparently successfully although a percentage of the moths die in coitus, but eggs laid shows a high percentage of sterility. This obviously influences the effectiveness of *Ammalo* and its cause is so far completely unknown.

JAYAWARDENA, A.P.B. RAJASINGHAM C.C. and DE SILVA, R.L. (1979). Studies on the Biological Control of *Panicum repens* by Means of Fodder Legumes. 1st Year Results. Proc. Sri Lanka Asso. Adv. Sci. 35 Annual Session (1) 18.

Panicum repens (L) Beauv. Couch grass (English) Etora (Sinhala) Injspul (Tamil) is a pernicious rhizomatous weed, which is either controlled by spraying herbicides or manually. Both methods are expensive. The advantage of successfully eradicating *P. repens* is that the land could be used for more profitable purposes.

The smother crop principle was tested as a cheaper alternative method in a water logged ravine in the up-country wet zone.

A field with *P. repens* as the dominant species was manually defoliated, divided into 30 plots and basal fertilizer mixture minus nitrogen was evenly applied. Five fodder legumes was used in randomized block design with six replicates. The legume seeds were sown at the rate of 5 kg/ha in the field without cultivation (zero tillage) in July, 1978. The legume seeds germinated satisfactorily and seedlings were well nodulated except in two blocks that were badly waterlogged.

After six months *Desmodium uncinatum* grew to a height of one meter, completely suppressing the growth of *P. repens*. The other four legumes did not cover *P. repens* completely.

The legumes in all the plots were harvested regularly leaving a stubble of about 20cm. At the end of the first year rhizomes of *P. repens* still persisted and more time had to be allowed for complete eradication through depletion of its carbohydrate reserves.

Besides being able to smother a pernicious weed like *P. repens, D. uncinatum* had the added advantage of providing good quality fodder.

KANAGARATNAM, P. (1973). Biologival Control of the Weed *Eupatorium odoratum* (Podisingho Maran). Rept. Crop Protection Div. Ceylon Coconut Quart. 25, 75.

Work on the biological control of this weed was started in December 1973. *Ammalo insulata (Order, Lepidoptera),* a beneficial insect for the control of *E. odoratum* was obtained through the Commonwealth Institute of Biological Control. The leaf eating caterpillars of this insect are expected to control the weed by destroying the green leaves of the plant. The first consignment of about 2,500 larvae and eggs was received on 15th December 1973. A laboratory culture was maintained for breeding and subsequent release in various parts of the country. The balance was released in the field at three different locations.

KANAGARATNAM, P. (1974). Biological Control of *Eupatorium odoratum*. Rept. Crop. Protection Div. Ceylon Coconut Quart. 26, 55-56.

The exotic beneficial leaf eating insect *Ammalo insulata* which was introduced into Sri Lanka in December 1973 for the control of *Eupatorium odoratum* was mass bred at Lunuwila and Colombo and released in the estates where this weed was found. This insect has multiplied in several thousands in an estate at Bandirippuwa. Its larvae have completely defoliated the bushes leaving only the hard stem. Even the tender vegetative buds were eaten by the larvae. From this estate several thousands of larvae were collected and released in estates where large extents of this weed were found. Before the end of the year intensive defoliation of the bushes was observed in four other estates close to the institute. In one estate at Haldanduwana it took only two months for intensive defoliation to occur after the first release was made. At Bandirippuwa where first intensive defoliation occured in July, the bushes in about five acres were found dead at the end of the year due to repeated defoliation. In an adjoining land the bushes died a few months after intensive defoliation as this was followed by severe drought.

All the plants except *Ageratum conyzoides* found in association with *E. odoratum* were left unattacked by this insect even where complete defoliation of the latter weed occured. From there the larvae were moving far in search of *E. odoratum* leaving the other plants unattacked. *A. conyzoides* was found severally defoliated in the field by the larvae of this insect. Preliminary studies in the laboratory revealed that *A. insulata* can complete its life cycle when fed alone with the leaves of *A. conyzoides*.

Large scale multiplication of this insect was found to occur mostly in the fields where the weeds were succulent. In dry areas the results were not as promising.

Tetrastichus israeli and *Trichospilus pupivora* were found to parasitise the papae of *A. insulata* in the laboratory. These parasites were released in the past in estates for the control of the coconut caterpillar pest. *T. pupivora* is an indigenous parasite and is recoverable from the field. In addition a second instar larva of *A. insulata* with the grubs of a Braconid parasite was collected from the field at Bandirippuwa. In the long run these parasites may be harmful for the large scale multiplication of *A. insulata* in the field. A flower eating weewil from Commonwealth Institute of Biological Control, Trinidad in February, 1974 and released on the *E. odoratum* in the flowering stage at Kallady in the Puttalam District. They have not established in the field. These insects control the weed by the destruction of its flowers.

KANAGARATNAM, P. (1975). Biological Control of *Eupatorium odoratum*. Rept. Crop Protection Div. Ceylon Coconut Quart. 27 40-41.

Ammalo insulata (Arctiidae), a leaf eating caterpillar was mass bred in the laboratory and releases were made in various parts of the country. Caterpillars were also hand collected in several thousands from fields where they were found and released in new areas. A total of 185,825 caterpillars were released, at 47 sites where a thick, luxuriant growth was present extensively.

This beneficial insect has become established in the country. Hundreds of acres of the weed have been completely defoliated by it. All the leaves and buds with tender stems have been eaten by the larvae, leaving only the hard stem at several release points. However, it has not become established at every release point. In most of the defoliated areas, populations of this insect did not persist, to cause repeated defoliations and bring the weed under control. As a result, the defoliated plants produced new shoots with the onset of rains. In a few localities there have been resurgence of the larvae at former release points a few months after the initial defoliation.

The efficiency of *A. insulata* is partly reduced by the following newly recorded natural enemies:

A. Parasites

1. *Apanteles creatonoti Vier* (Braconidae) 2. *Exortista* sp. (Tachinidae)

B. Predators

3. *Sycanus* sp., *(Reduviidae)*

A few consignments of adults of the flower-eating weevil, *Apion brunneonigrum* (Curulionidae) were imported from Commonwealth Institute of Biological Control and released on flowers of *E. odoratum* directly in the field. Two months after release they were seen on flower heads at the same release points. However, whether these will establish and control the weed is yet unknown.

KANAGARATNAM, P. (1976). New Development in the Control of Pests and Weeds of Coconuts in Sri Lanka. Coconut Research and Development. Proc. Int. Symp. on Coconut Res. and Dev. Kerala, December. 27-31 :376-384.

The management and control of pests and weeds of coconut in Sri Lanka have sought to exploit a variety of methods. These include field sanitation, trapping, use of parasites, predators, bacterial, and viral pathogens, and conventional chemical methods. The nature of pest has determined the particular methods of choice.

Outstanding success has been achieved in the control of *Promecotheca cumingi*, while at the other extreme, two decades of sustained mass releases of parasites have failed to bring *Nephantis serinopa* under effective control. While the indigenous predator *Chilochorus nigritus* appears to be an effective agent for the control of *Aspidotus destructor*, several exotic predators have failed to establish. The paper examines some of the special factors that may have determined the success or failure of attempted control measures.

The more recent approaches and the results of preliminary investigations on the use of bacterial and viral pathogens and systemic insecticides for the control of selected pests and of the leaf eating caterpillar *Ammalo insulata* for the management of *Eupatorium odoratum* are presented and discussed.

MAHINDAPALA, R. (1976). Weed Control of *Eupatorium odoratum*. Rept. Crop. Protection Div. Ceylon, Coconut Quart. 28:46.

Mass breeding of an exotic defoliator of *Eupatorium odoratum, Ammalo insulata* was continued during the year under review. Field releases were carried out under supervision as these caterpillars are required to be liberated on fresh and succulant *Eupatorium*. During the course of the year, tctal of 38,000 *Ammalo larvae* were released in 18 sites.

It was possible to collect *Ammalo larvae* from the fields in certain estates at Galmuruwa and Dummalasuriya. It was also observed that in Kuliyapitiya and Kurunegala areas, *Ammalo* defoliations occured in places other than release points. The indications are that after the initial defoliation, *Euparotium* re-establishes itself, through new foliage and further defoliation is seldom seen, indicating the emigration of *Ammalo* to fresh grounds.

During the later part of the year two consignments of the weevil, *Apion brunneonigrum*, which attacks the *flowers of Eupatorium* were received from the Commonwealth Instutite of Biological Control, West Indian Station, Trinidad. As laboratory, breeding was not possible these insects were directly released in the fields. No recoveries have yet been made of this insect.

MAHINDAPALA, R. (1978). Biological Control of *Eupatorim*. Ceylon Coconut Quart. XXIX. January-June 1978.

Ammalo insulata was found to cause heavy damage to *Eupatorium* in certain areas. As very large number of this insect had been released in areas infested with *Eupatorium* more emphasis was directed towards field collection. Larvae were collected from heavily infested localities and redistributed at localities in Puttalam, Malwana, Nattandiya and Attanagalla. However, the inability of the insect to establish itself poses problems with its use. Observations indicate that *Ammalo* rapidly defoliate *Eupatorium* in the vicinity of its release point, but, as *Eupatorium* rejuvenates through intact roots, *Ammalo* disappears from the localities.

MAHINDAPALA, R. (1979). Biological Control of *Eupatorium odoratum*. Rept. Crop. Protection Div. Ceylon Coconut Quart. 30:49.

During the year under review, a large number of the defoliator insect, *Ammalo insulata* was collected from the field and redistributed in lands where profuse growth of *Eupatorium* was observed.

The insect was able to cause heavy defoliation in lands at Katunayake, Malwana, Nattandiya and Vanathavillu. The performance of the insect at Malwana had been extreamely satisfactory and the insect had defoliated the weed about 10 miles away from

the point of release. The public awareness of the insect is considerable and the insect has been collected and distributed by the public too.

Although the insect caused heavy defoliation it was unable to establish itself in the coconut plantations.This caused problems and necessitated periodic releases at the same point. Field experiments were started to investigate this aspect and results indicate that the life cycle of the insect is interrupted by heavy pupal mortality. No recoveries of the flower attacking weevil *Apion brunneonigrum,* first released in 1976, were made.

MAHINDAPALA, R. (1981). Biological Control of *Chromolaena odorata*. Rept. Crop Protection Div. Ceylon Coconut Quart. 32;40.

The defoliator insect, *Ammalo insulata* was found to be established in almost the all areas of Sri Lanka.

A field study at Malwana was continued during the year. The results indicate the importance of larval mortality in the field.

The Institute entered into a research contract with the IAEA to study some of the field problems of this biological control programme using radio isotopes. However, no significant progress has been made.

MAHINDAPALA, R. (1983). Biological Control of Weeds. Economic Review Coconut Res. Institute. (In Sinhala), 8 (10) 12–13.

Initial studies on biological control has begun in Sri Lanka in the latter part of 1930's. These studies were mainly concentrated on weed control in coconut plantations. Recently a leaf-eating insect was introduced into Sri Lanka for the control of the weed *Eupatorium odoratum.* All the necessary investigations have been done on this insect before it's mass breeding and release in the estates. This insect has proven itself by keeping the weed *Eupatorium odoratum* well under control in coconut lands.

MAHINDAPALA, R. KIRTHISINGHE, J. K. E. and PINTO J. L. J. G. (1980). Some Studies on the Biological Control of *Chromolaena odarata (Eupatorium)* Coconut Quart. 31 (3/4) 98-104.

Laboratory studies on the biology and life cycle of the defoliator insect *Ammalo insulata* Walk. (*Lep. Arctiidae*) introduced to Sri Lanka to control the pernicious *weed. Cromolaena odorata* Robinson, indicated that the insect could complete the life cycle on the two known hosts, *C. odorata* and *Ageratum conyzoides* but preferred *C. odorata.*

Fluctuation of the defoliator insect population in a locality were monitored while periodic increases of the insect coinciding with new generation were noted. Larval and pupal mortality appears to be a major constraint in the successful establishment of the insect

Some changes in the insect population in relation to host and climatic factors have been noted.

PERERA, P. A. C. R. (1981). Predation Studies on *Parenchaetes pseudoinsulata* (Lep: Arctiidae) Using 32P Labelled Immatures. Ceylon Coconut Quart. 32, 105–110.

A defoliating insect *Parenchaetes pseudoinsulata (Ammolo insulata)* is used for the control of *Chromolaena odorata (Eupatorium odoratum)* (Compositae), a pernicious weed growing on coconut estates in Sri Lanka. The rate of consumption of *C. odorata* leaves by *P. pseudoinsulata* has been estimated and based on these results the requirement of *P. pseudoinsulata* per ha of weed for complete defoliation is discussed.

The sudden disappearance of large field populations of *P. pseudoinsulata* however limits the usefulness of this method for *C. odorata* control.

Field placement of ^{32}P labelled *P. pseudoinsulata* larvae and pupae with a view to studying parasitism and predation were undertaken.

Four methods of labelling *P. pseudoinsulata* with ^{32}P were tested and an appropriate method for uniform labelling was selected.

The results of initial studies on field placement of ^{32}P labelled *P. pseudoinsulata* are presented and discussed.

PERERA, P. A. C. R. (1983). Biological Control of the Weed. ***Chromolaena odorata (Eupatorium odoratum).*** **Rept. Crop. Protection Division. Coconut Research Institute of Sri Lanka. 120.**

On the advice of the International Atomic Energy Agency's Research Coordination Committee meeting held at Jakarta, Indonesia in February 1982, studies on the stage of dispersal of the defoliator insect *Parenchaetus pseudoinsulata* were made on a natural field population of the insect on an estate at Malwana in the Western province. The experiment was terminated in 1983. An examination of the data indicates no distinct pattern of dispersal and considerable overlap of germination was often observed.

ROHITHA, B. H. (1982). Weed Control Rept. Crop Protection Division. Cey. Coconut Quart. 33: 59.

The pernicious weed in coconut estates, *Chromolaena odorata* (formerly – *Eupatorium odoratum)* was satisfactorily kept under control by the defoliator insect *Parenchaetes pseudoinsulata* (formerly : *Ammalo insulata)* but restricted to certain areas in the Western province. The factors governing the spread and the migration of the insect were under study using 32p labelled pupae and lavae. This work was carried out under a research contract with IAEA. A culture of *P. pseudonisulata* was maintained for experimental purposes.

SALGADO, M. L. M. (1972). ***Tephrosia purpurea*** **(Pila) for the Control of** ***Eupatorium*** **and as a Green Manure on Coconut Estates. Cey. Coconut planter's Review. 6 (4) 160-173.**

The weed *Eupatorium odoratum* has established itself, on coconut estates in most districts and it's control and eradication has become both expensive and interfering with the effective utilization of labour on estates. The usual method of control such as slashing, mowing and mamoty weeding are discussed. Methods are recommended based on the biology and ecology of the plant and it's method of propagation.

A biological method of using an indigenous, legume usually present on coconut estates *Tephrosia purpurea* (S. pila, T. kolinchi) which has been successfully developed on a coconut estate as adivsed by the author is described The method is inexpensive compared to other methods, some of which are prohibitive costly and yet ineffective.

Methods of utilizing *T. purpurea* as a green manure are also discussed.

Further problems associated with the growth, and development of *T. purpurea* both as a method of controlling and eradicating *Eupatorium* (and perhaps other weeds such as illuk) are discussed.

SENEVIRATNE, S. N. de S., SIVAKADACHAM, B. and JAYANANDARAJAH, P. (1984). Seeds, Soils and Weeds as Determinants of the Health Status of Cultivated Crops. Annual Res. Conf. (Cereals and Grain Legumes) Res. Div. Dept. Agric. 1-3.

The health status of a crop is influenced by the pathogen content of the propagules used, those in the soil and the weed population in the vicinity. Among weeds are those which serve as alternate hosts for pathogens attaking crops; also others which serve as hosts for virus vectors. Much information is available about pathogens transmitted in seeds harboured in soil and dispersed from weeds.

The important role of weeds as determinants of the health status of cultivated crops is not often realised. Yet, they influence to a great extent the incidence and severity of many diseases affecting crop plants. *P. solanacearum* the bacterial pathogen attacking many cultivated crop lands also infects general weeds which serve as alternate hosts. *Hyptis suaveolens. H. capitata* and *Croton hirtus* are hosts of *P. solanacearum* recently recorded in the low-country, intermediate and wet zones and the mid country wet zone. *Passiflora foetida* and *Cassia occidentalis* are weed hosts of the passion mottle virus influencing the prevalence of this virus disease on passion fruit. *Acanthospermum hispidum* is a common weed in the mid country wet zone influencing the incidence of tomato leaf curl, a component of which is Virus induced. It is a host favoured by the insect vector *Bemisia tabaci*. Another weed, *Phaseolus, lathyroides,* which is colonised by *B. tabaci* and which is a host for the many yellow mosaic virus has adversely affected the cultivation of green gram in traditional dry zone areas.

WEERAKKODY, S. C., ARIYARATNE J. K. P. BALASURIYA. I. and WIDANAPATHIRANA G. S. (1975). Some Preliminary Observations of a Pathogenic Fungus Isolated from *Salvinia molesta* D. S. Mitchel (*(S. Auriculata Auct)* Proc. Sri Lanka Assoc. Adv. Sci. 31 Annual Session (1) 43.

A fungus which is pathogenic to *Salvinia molesta,* D. S. Mitchel (*S. auriculata* Auct) has been isolated from senescent leaves of the same plant. This fungus was later identified as *Rhizoctonia solani* state of *Thanatephorus cucumeris* (Frank) Donk. by the Commonwealth Mycological Institute.

Pathogenicity of *Thanatephorus cucumeris* (Frank) Donk. to fresh Salvinia plants has been confirmed. In the field the lethal effect of the fungus on Salvinia plants was not so pronounced as observed under laboratory conditions due to the slow spread of the fungus.

Morphology, culture characteristics of the fungus and the preliminary observations on its physiology, host range and toxicity of its metabolites are discussed.

SPECIAL WEED PROBLEMS

AMARATUNGA, K. L. D. (1972). ***Aeschynomene americana,*** **L. A. New Record for Sri Lanka. Trop. Agriculturist. CXVII.**

Two species of the genus *Aeschynomene* have been recorded for Sri Lanka. *Aeschynomene aspera* L. a stout marsh herb common in wet rice fields and *Aeschynomene indica* L, a very slender much branched annual, often a bad weed in both wet and dry rice fields.

Aeschynomene americana a weed in rice fields was first recorded for Sri Lanka in 1967. The species is distributed in the warmer parts of the world, chiefly in the Carribean, Central America and Tropical South America. The botany of this plant is throughly discussed.

AMARATUNGE, K. L. D. (1977). A Provisional List of Weeds (Phanerogams) Found in Arable Soils in Sri Lanka with Special Reference to the Three Noteworthy Weed Records. Cey. J. Sci. (Bio. Sci.) 12 (2) 182-193.

The list of weeds have been drawn from the personal collection made over a period by the author. The weeds listed have shown rapid growth both on wet and dry lands and could cause crop losses which will be great concern to agriculture.

The weeds enumerated are distributed over 42 families. Besides those three new weeds are also reported.

These weeds are:

1. *Pennisetum polystachyon (L) Schult.*
   A weed occurring in a wide range of habitats, which was first recorded at Melsiripura in 1986. It could be a troublesome weed in the west zone coconut plantations as well as in the dry zone lands where chena is practiced.

2. *Spermacoce latifolia* Aublet.
   First recorded in Sri Lanka in 1963 at Ranmutugala in Colombo district A quick growing weed found along the coast of the Western province.

3. *Aeschynomene americana* L.
   Occuring in rice fields, this weed was first recorded in Narammala in the Kurunegala district in 1967. It may have been intoduced with the seeds of some cover crops.

ANON (1940). The Eradication of Wel-marukku from Paddy Fields. Trop. Agriculturist (Cey.) XCV, 294.

Wel-marukku is a very serious weed of paddy fields. It multiplies rapidly from mature stems and from seed, resulting in a great decrease in the yield of paddy.

All the weed stools should be removed at once from the field and thrown into compost heaps elsewhere, or the field should be ploughed with a mould board plough so as to bury and destroy these plants. After about 10 days the field should be harrowed with a Burmese harrow or ploughed with a village plough to destroy the seedlings which germinate from fallen seed. This operation should be continued as often as possible at intervals of 10 days until the fields are to be sown or transplanted.

Seed paddy from Marukku infested fields should be cleaned so that no pest weed seeds are introduced. This can be easily done by immersing the paddy in water, and after stirring it by hand in the water for about half a minute and allowing it to settle, the marukku seeds and the empty paddy grains will rise to the surface of the water which can then be poured off This operation should be done once more to remove any weed seed adhering to the sides of the vessel when the water is poured off on the first occasion. The paddy will then be completely free from any Marukku seed. It can then be germinated or dried and sown later when required.

ANON (1959). Admin. Rept. Director of Agriculture, Dept. Agric. 127-130, 137, 151.

Salvinia auriculata. – PCP oil-based formulations were the best of the contact herbicides tried and caused rapid sinking of the Salvinia plants. with negligible regrowth. Atrazine at 4 and 8 H has proved even more effective than PCP, and Monoxone (Sodium monochloroacetate 90%(w/w) at 30 H as effective as PCP. (P. 127–130).

Rice. – In irrigated paddy, weeding with a rotary weeder has proved more effective than the use of chemicals. The optimum time for applying MCPA in broadcast paddy was found to be 4 weeks after sowing. (P. 137).

Potato haulm killers. – PCP is recommended, DNOC gave a better kill, but is not recommended because of it's toxicity. (P. 151).

ANON (1962). Killer Weed *Salvinia auriculata.* World Crops 14 (5) 143.

Lake Kariba's "killer weed" has thrown the Central African Federation Authorities into a quandary. They do not know whether to embark on an expensive chemicals spraying campaign, probably by a South African Weed killing Firm, or to gamble on nature keeping the pest in control by wind wave. A chemical was being tried out in experimental ponds. This chemical disrupts cells of the spongy leaves of the weed causing waterlogging. The plant is killed when it's foliage sinks.

A similar form of plant poison has been used in Ceylon, where 22,000 ac of paddy fields have become infested with this weed in 10 years. In some quarters the opinion is expressed that the nature is finding a way to cope with the weed, which has now covered 15% of the lake's present 1600 sq. miles a month, but lately expansion seems to have stopped. Some of the experts who have been investigating this swamp like growth think that all the areas likely to be affected are already infested–the quiet waters of bays, estuaries, river mouths and around and among submerged trees.

ANON, (1966). Coconut Research Institute of Ceylon. Control of Illuk. Coconut Res. Inst. Leaflet 29.

The growing of catch and cover crops such as cowpea *(Vigna unguiculata)* and green gram *(Vigna sp.)* in young plantations will prevent the establishment of Illuk *(Imperata sp)*. In other plantations soil cultivations and grazing with buffalo are recommended No recommendation for herbicidal control at present is available.

ANON, (1976). Control of Illuk, Coconut Research Board. Leaflet. No. 28. Revised Ed.

The first colonizer of any cleared or abandoned land is Illuk which propagates both by seeds and vegetative methods. Illuk can be controlled by several methods. Burning only controls aerial growth, but reappears later. Most effective means is by digging but it is costly Ploughing and harrowing too are effective, but all the roots should be exposed to the sun for drying. Illuk does not like shade and quick growing covers such as *Tephrosia candida* (S. Bogamadilla) and catch crops such as cowpea, or green gram are also useful. The other methods of control are slashing and grazing with buffaloes. Herbicides can be useful but no research data is available to make recommendations.

BALASOORIYA, I., GUNASEKARA S. A., HETTIARACHCHI S. and GUNASEKARA, I. J. (1984). Biology of Water Hyacinth; Fungi Associated with Water Hyacinth Sri Lanka. Proc. Int. Conf. on Water Hyacinth. Nairobi, Kenya. 304-317.

On the fungi found to be associated with *Eichhornia crassipes* in the NW and W provinces of Sri Lanka, *Penicillium oxalicum, Currularia lunata, Insarium* sp., *Helminthosporium* sp., *Myrothecium roridum* and a sterile fungus were the main colonizers of leaf surface. Leaf spots were often colonized both by pathogenic fungi (including *M. roridum)* and non pathogenic spp. An endotrophic mycorrhizal association was also identified on semi-rooted or rooted *E. cressipes.*

BALASOORIYA, I., PAULRAJ, P. J., ABEYGUNAWARDENA, S. I. and NANAYAKKARA C. (1984). Biology of Water Hyacinth: Physico Chemical Properties of the Water Supporting *Eichhonia crassipes* (Mart) solms. Proc. Int: Conf: on Water Hyacinth, Nairobi, Kenya. 318-333.

In a survey of waters at several sites in Sri Lanka infested with *E. crassipes;* those containing 0.41–6.4 mg PO_4–P, 0.03–1.6 mg NO_3–N and 0.21–7.94 mg NH_4–N/l favoured growth, though lower concentration of nutrients proved adequate at one site where rainfall was heavy. A temperature of 26-35°C and pH 6–7 were optimum for growth. The water quality deteriorated as *E. crassipes* became established, with steady increases in biological oxygen demand, dissolved CO_2, turbidity and suspended solids.

BALASOORIYA, I., PAULRAJ, P. I., ABEYGUNAWARDENA, S. I. and NANAYAKKARA, C. (1984). Biology of Water Hyacinth; Influence of Nutrient on Shoot/Root Ratio of *Eichhornia crassipes* (Mart) solms. Proc. Int. Conf. on Water Hyacinth, Nairobi, Kenya. 334-347.

In a laboratory study time required for *E. crassipes* plants to double their growth increased from 7.4 to 9 and decreased form 9.6 to 8.1 days respectively when PO_4–P and NO_3–N conc. in the medium were reduced from 6 to 3 mg/l. Reductions in P and N conc. were accompanied by associated increases in root: shoot ratios. Decreases in N conc. also retarded leaf and shoot formation. The colour of the roots changed from

light pink to purple when the P and N conc. were < 0.76 mg and < 1.5 mg/l respectively.

BASNAYAKE, V. S. (1966). Eradication of Sporadic Lalang. Planter's Bull, Rubber Res. Inst. Malaysia. 78, 197-198

The problem of tacking sporadic Lalang under legume cover is discussed. The author stated that he attended to such Lalang only when it grew to a height of 18" over the cover and emphasised that Lalang in the open must be tackled immediately.

CHANDRASENA, J. P. N. R. (1987). *Ludwigia* species - Most Prevalent Broad-Leafed Weeds in Wet Zone Rice Fields of Sri Lanka. Int. Rice Res. News Letter 12 (6) :32.

The paper reports of a survey on weeds conducted in four maior rice growing districts in the Wet Zone during 1984–85. Both narrow-leafed and broad-leafed species were counted in each field and frequency of occurrence determined for all major weed species. *Isachne globosa* (Thunb.), *Kuntze, Frimbristylis miliacea* (L), Vahl, *Cyperus iria* L, *Ischaemum rugosum* Salsib, *Echinochloa crusgalli (L)* Beauv., and *Echinochloa colona* (L) Link were the dominant narrow-leaved weeds at all four sites. Two species of Lugwigia appeared to be the most prevalent broad-leafed weeds, *Ludwigia hyssopifolia* (G.Don) was the most frequent broad-leafed species. *Ludwigia decurrens.* Walt was recorded for the first time in Sri Lanka.

CHANDRASENA, J. P. N. R. and AMARASINGHE V. (1985). A Study of the Genus *Ludwigia* in Sri Lanka. Sri Lanka Asso. Adv. Sci. 41 Annual Session (1) 68.

Several species of the genus *Ludwigia* are major rice field weeds and some other species are extensively established in wet marshy lands in the low country wet-zone, particularly around Colombo. Since the early works by Trimen (1993–1900) and Alston (1930) the genus has not been studied by local researchers. The family *Onagraceae* and the *genus Ludwigia* have been examined in other parts of the world.

Extensive collections of the species of *Ludwigia* were made during 1983–1985. Careful studies of the collected species and examination of herbarium specimens indicated the occurrence of seven species of *Ludwigia* in Sri Lanka. These are *Ludwigia adscendens* (L) Hara, *L. uruguayensis* (camb) Hara; *L. octovalvis* (Jacq.) Raven; *L. peruviana* (L) (Hara; *L. hyssopifolia* G. Don. Excell.; *L. perennis* L. and *L. decurrens* walt. In addition, there is a species described by Trimen as *L. prostrata* which has not been subsequently collected. *Ludwigia decurrens,* a major rice-weed, in the Low Country is a new record for Sri Lanka. It appears to be a relatively new introduction to the Island and spreading very rapidly.

The distribution of the species the high degree of morphological variability and other characteristics have been noted. The identification of species based mainly on floral and fruit characteristics is presented.

DASSANAYAKE, M. D. (1973). 5. Noxious Aquatic Vegetation Control in Sri Lanka. *In* Aquatic Weeds In South East Asia. Proc. Regional Seminar on Noxious Aquatic Vegetation, New Delhi 12-17 Dec. 59-61.

Eichhornia crassipes, Salvinia auriculata and *Limnocharis flava* are the most important aquatic weeds. These weeds reduce flow of water in irrigation and drainage channels, block gates of power generating stations, harbour larvae of mosquitos and

reduce yields in paddy. Some of these weeds are also used by local people for various purposes eg. *Salvinia* as packing material for fish, *Eichhornia* flowers as offerings in Buddhist temples. Mechanical methods of control of *Salvinia, Eichhornia* and *Pistia* has proven to be slow on large scale, but on small scale it is effective. Paraquat has been used to control *Salvinia* at 2.1 kg ai/l at 1125 l/ha. However, this too have been less effective and expensive.

DE SOYZA, D. J. (1937). *Coix gigantea* (Linn) – Wild Adlay. A Pernicious Paddy Field Weed. Trop. Agriculturist (Cey.) LXXXVIII, 208-214.

A thorough description of the weed–*Coix gigantea* and its characteristics is reported. The effect of this weed on paddy yield is greater than the combined damage done by all other paddy field weeds. *Coix*, being a cereal, demands the same kind of nutrients as required by paddy and in the competition for nutrient absorption, the paddy crop is adversely affected, owing to its poorer root-system. This weed is found in paddy fields in the North-Western and South Western divisions. Its spread is becoming general and its effect in the reduction of crop yields is considerable. Field observations and pot experiments revealed that when fully submerged wild adlay seeds do not germinate and this behaviour of the seed should be taken into consideration. Control and eradication measures and the difficulties which may be encountered are discussed.

DIAS, G. R. W. (1965). Control of *Salvinia* - Methods and Progress. Proc. Symp. on Research and Production of Rice in Ceylon. 139-152.

Salvinia, a free floating weed was introduced to Ceylon in 1939 by a Botanist in Colombo for study. It has spread to water ways along the coastal belt due to its rapid growth. *Salvinia* can be controlled by the use of herbicides such as Paraquat, but follow up sprayings will be necessary to control them completely. When *Salvinia* grows in marshy lands spraying should be combined with drainage or excess water should be pumped out and spraying also be carried out in open at higher concentrations of Paraquat. An amendment to the Plant Protection Ordinance is recommended for strict control of *Salvinia* and chemical control has been slowly encouraged.

DIAS, G. R. W. (1967). Eradication of Water Weed in Ceylon. World Crops 19(1) 64-68.

Salvinia auriculata is a free floating water weed which was introduced into Ceylon from tropical America by mistake in 1939. Since then it has clogged the water ways and marshes of the Island.

In 1952 the Ministry of Agriculture started a scheme to collect and destroy the weed. This was ineffective and even assisted in it 's spread. In 1956 it was declared a weed, and the transfer of it from any locality was prohibited. If the law had been fully enforced, control could have been obtained prior to 1960.

A campaign of eradication was started in 1957, using PCP. It was unsuccessful. Recommendations of an American expert were adopted for the re-organization of the campaign on a more efficient basis. Under this District Agricultural Officers reported on the degree of infestation in these areas, and a district-by-district spraying programme was undertaken using Paraquat. Officers were made responsible for preventing re-infestation. Considerable control was achieved until 1964 when foreign currency shortages stopped the import of herbicides. Since then there has been an increase in infestation. One of the effects of infestation has been in bad drainage which in turn has resulted in the loss of farming land which has to be reclaimed on eradication of the weeds.

JEPSEN, F. P. (1933). The Water Hyacinth Problem in Ceylon. Tropical Agriculturist LXXXI 6, 1-17.

Water hyacinth, a South American plant introduced to Ceylon in 1905 as an ornamental has become a weed. It has covered many tanks, water ways etc. due to its rapid growth. It propagates by seed and vegetatively, the latter method being the chief means of propagation. The spread is mainly through water. The report provide a comprehensive account on the history of this weed in Ceylon and the attempts which have been made to control it. The most economic method for control is the removal of the weed by hand. The most satisfactory chemical method is the use of common salt and sulphuric acid. Sodium Chlorate could be used only in the dry weather. The chemicals usually kill the foliage but the submerged vegetative portion remain uneffected. The most pressing need appears to be broadcasting suitable knowledge to the public, to keep this weed under control.

KEHL, F. H. and RAJIAH E. S. (1954). ***Eupatorium riparium*** **Benth (Compositae). A common up-country weed. Tea Quart. 25 :3-4.**

Eupatorium riparium a native of Mexico was introduced to Ceylon around 1918 spread very rapidly in the Dimbula district between 1940-41 and is now very common on tea estates in the Uva Province. The plant is shrubby with a loosely spreading habit and grows to height of 2-3ft. The stems which are usually reddish are minutely covered with short hairs; they are woody at the base but tender at the apex. The leaves, which are opposite, are long lance shaped, tapering into a petiole, and 3-ribbed. The closely compacted white flower heads are born in clusters on long stalks. Complete eradication of this weed cannot be attempted as it has became far too widespread. The application of Sodium Chlorate gives a complete control of this weed. Minimum effective concentration is 2% in water (2lbs of Sodium Chlorate in 10 gls water) The amount of Chlorate solution required, varies from about 100 to 200 gls/ac, depending on the growth of the plant. The spray must completely cover and wet all the leaves. The most efficient and economic method is by means of a knapsack sprayer. This weedkiller is harmful to tea and should not be used in standing tea, but can be safely used to control *Eupatorium riparium* growing along roadsides and in ravines. It is considered that there will be no danger of polluting water supplies if it is used as recommended. As the principal aim is the prevention of spread by seed, this weedkiller should be applied before flowering.

Another method of control is the use of smother crops, and quick growing types such as Gautemala grass *(Tripsacum laxum)* will not only smother this weed and others, but will also supply thatching materials for tea fields.

It has been discovered that *Eupatorium riparium* is an alternative host of the capsid bug *Lygus viridianus* which causes "corroded flush" symptoms on tea in plucking.

KOTALAWELA, J. (1973). 4. Noxious Water Vegetation in Sri Lanka. The Extent and Impact of Existing Infeststions. ***In*** **Aquatic Weeds in South East Asia. Proc. Regional Seminar on Noxious Aquatic Vegetation, New Delhi 12-17 Dec. 51-58.**

The potential danger of noxious aquatic vegetation was realised in Sri Lanka as early as 1907 when Dr. Wills, Director, of Royal Botanical Gardens, Peradeniya, persuaded the Government to enact Water Hyacinth Ordinance. In spite of this recognition and the efforts made for clearing Water Hyacinth its further spread has not been controlled.

These exotic weed plants such as Water Hyacinth, Salvinia, Limnocharis and Pistia were initially introduced into the country for their potential as commercial crops, orna-

mental value or for the purposes of scientific investigations. They, however, escaped and established as noxious aquatic weeds. *Typha,* which is a native of Sri Lanka, has also become a serious weed in the dry zones as a result of changed ecological conditions brought about by the new irrigation system.

The loci of infestations of these weeds have been very small in extent but their capacity to multiply rapidly is mainly responsible for their rapid spread. The exotic weed plants upset the natural equilibrium and upset the biological balance as their new habitats are free from natural enemies and other controls.

Water hyacinth, *Salvinia* and *Limnocharis* species occupied small areas in the beginning but due to undesirable delay in recognizing their weed potential and failure to control them, has helped their spread to a very large area. Water hyacinth and Salvinia cover the coastal districts of North Western, Western and Southern Provinces. Typha has spread widely in the dry zone. These weeds choke irrigation and drainage channels, promote silting, reduce water discharge capacity and render fertilie paddy fields unproductive. A vigorous drainage drive to clear the weeds from the paddy fields is likely to be very helpful in controlling these weeds.

LESTER SMTH, W. C. (1926). The Water Hyacinth Pest. Trop. Agriculturist. LXVII. 327-329.

Water Hyacinth *(Eichhornia crassipes Solms)* was introduced into Ceylon about 1905 and a menacing weed. Botany of the plant is discussed. Strenuous efforts should be made to eradicate this weed to increase both the yield and the acreage under paddy. The following control methods are suggested. All Water Hyacinth plants must be pulled out and piled up on some high ground for proper disposal. These plants must be dried in heaps and all burnt; or rotted in pits dug in the ground, and covered with a layer of earth of sand. However, the eradication of this weed cannot be effected in one season.

LESTER-SMTH W. C. (1927). Water Hyacinth Eradication. Trop. Agriculturist LXVIII 336-338.

The water hyacinth is a native of Brazil in South America and is a serious weed in many countries. No method has yet been found in any of these countries by which the plant can be completely eradicated at a reasonable cost. Chemical sprayers were tried but it has been found that poisonous sprays were quite incapable of killing out the entire plant. Killing out the plants by forcing hot steam into the water under them had been attempted but this method somehow is not being adopted. In Florida the attention was diverted to the possibilities of mechanical piling. Piling by means of an elevator was first tried and some time later a simpler contrivance called the "grappler" was tried. These machines lift the plant out of water, convey, it to the bank of the river and there pile it in heaps to rot. Another method is surrounding masses of the plant with nets and towing them down to sea. This method is practicable only for a very short distance, or where there was a strong current. However, none of these methods can compete with thorough eradication by hand labour.

In Ceylon the only practicable method is dragging the plants out of water to places above flood level where these cannot be forced back to the water. In these places they are piled up in heaps to dry and subsequently burnt or buried in pits. Rakes have been used in the removal of plants.

The rapid spread or propagation of the plant by vegetative means and the delayed germination of the seeds are the two main reasons why the plant is such a serious pest. The utmost precautions must be taken to ensure that not a single stray plant is left behind. All

seedlings must be collected periodically and before any of them have reached the flowering stage. The clearing of all infested areas should be commenced at the top, and the work proceeded with a down stream direction.

On streams and channels subject to flow back due to tidal or other causes, booms have to be erected above and below the places where the work is in progress. The successful eradication of this weed from the infested areas in Ceylon depends on the following factors, the supply of a sufficiently large labour force to enable the bulk of the clearing work to be done in the shortest possible time, absolute continuity throughout the work, constant reinspection and clearing where necessary.

LIYANAGE, L. V. K. and ABEYSOMA, H. A. (1983). Effects of Cultural, Mechanical and Chemical Methods of the Control of the Weed Illuk *(Imperata cylindrica)* **Under Coconut at Ambakelle in 1981. Coconut Res. Ins. Rept. Agron. Div. 1983 – 41–42.**

The growing of *Calopogonium mucunoiaes* as a cover crop is superior to rest of the treatments tested in controlling illuk. Sweet potato also appear to control illuk to some extent. But it's less vigorous growth compared to *Calopogonium* and its inability to cover the land completely make it less effective. Slashing was less effective compared to ground covers. Harrowing at the beginning of the second rainy season controlled illuk effectively but was inferior to the use of cover crops. Application of husk was effective only only at the early stages. Application of black polythene was very effective in controlling illuk at later stages and was similar to that of *Calopogonium*. Chemical treatments, although effective were inferior to cover crops and black polythene.

Data suggest that growing of a creeping cover such as *Calopogonium* is very effective in controlling illuk in young and mature coconut plantations.

MANIPURA, W. B. and SOMARATNE, A. (1974). Some Effects of Manual and Chemical Defoliation on the Growth and Carbohydrate Reserves of *Panicum repens* **(L). BEAUV. Tea Quart. 44 (4): 154–160.**

In pot experiments on *Panicum repens* manual and chemical defoliation at intervals of 2-6 weeks decreased the growth of shoots, roots and new rhizomes and reduced the carbodydrate reserves. The most frequent manual defoliation did not completely suppress growth even when continued for 9 months. The plants were killed, however, by application of Paraquat at doses of 0.14 – 0.56 kg/ha every 2 weeks for a period of 3 months. It is suggested that repeated mechanical defoliation may help to reduce plant vigour and limit the rate of spread in the field and that it may be possible to develop a method of more permanent control based on repeated application of Paraquat.

PERERA, K. L. S. D. (1982). Chemical Control of Illuk grass. 500 Series Res. Rep. Faculty of Agriculture, University of Ruhuna.

An experiment was conducted in the glasshouse with three-year old Illuk plants *(Imperata cylindrica)* to study the effectiveness of control with Glyphosate when compared with that by Dalapon and Dalapon-Paraquat sequential spray. Glyphosate was tested at 0.5%, 1%, 2% v/v concentration and Dalapon at the rate of 22.4 kg/ha. The Dalapon-Paraquat sequential spray was tested with Dalapon at the rate of 5.6 kg/ha and Paraquat at 0.568 lt/ha. Assessments were made by visual scoring, The degree of kill of tops of plant parts indicated that Glyphosate at 1% and 2% concetration gave almost 90% control.

Assessments made by dry weight analysis of shoots, roots and rhizomes, showed that the highest dry weight production was in roots and that rhizome growth was reduced by Glyphosate at 2% spray. The highest reduction in dry weight of rhizomes was brought about by Glyphosate at 8% concentration. There was a significant difference in the dry weight of rhizomes between Dalapon and Dalapon-Paraquat sequential spray when surfactant was not added. This difference was not significant when surfactant was added. Addition of surfactant did not alter the degree of control achieved with Glyphosate treatments.

PETCH, T. (1923). Weeds. Trop. Agriculturist LX, 125-126.

Several weed species are discussed in this paper.

Drymaria cordata occurs on open waste ground in the wet zone above 1,000 ft, and is known as a weed in gardens and has recently began to give trouble on estates. The plant belongs to the natural Order *Caryophyllaceae*. Ripe fruits adhere to clothes or tools and seeds get distributed that way. It dries down in dry weather but if one leaf is left lying on the ground in wet weather at once it takes roots.

Eleutheranthera ruderalis (Sw) Shultz- an American weed which is becoming distributed round the tropics This weed is now established in Henaratgoda.

The following weeds occur on estates; *Polygonum punctatum*, a common weed in upcountry, *Sehizaea digitata* (L) SW, a grass-like fern, frequent on damp clayey soil in the lowcountry; *Typhonium roxburgii* Schott a weed in tea at medium elevations. *Pilea muscosa* usually florishes best on a damp gravelly soil. *Desmodium triflorum* can be used in preventing wash.

The following are representatives of the weed flora of unweeded rubber. *Vernonia cinera* Less, Monara-kudumbiya, *Blumea flexuosa* Clarke, *Erigeron sumatrense* Retz, Alavanga-pillu, *Mikania scandens* Willd, Loku-padu, *Pogostemon rupestris* Benth, *Desmodium heterocarpum*, DC, Etundu-piyali, *Hedyotis auricularia* L. Geta Kola, *Hydrocotyle asiatica* L, Hin-gotukola, *Passiflora foetida*. Grasses - *Pogonatherum crinitum* Kunth, *Paspalum conjugatum* Berg, *Paspalum scrobiculatum* L, Amu, *Paspalum sanguinale* Lam, *Panicum trigonum* Retz, *Imperata arundinaces* Cyrill, Illuk and ferns *Cyclophorus Gardneri* (Kze), C Chr. *Asplenium adiantoides* (L).

RAJAPAKSE, G. (1950). Death to Illuk. The Ceylon Coconut Quart. 1(4) 7-9.

Prompt action must be taken to eradicate Illuk before it gets established, as it can do great harm particularly to young coconut estates.

Its wind-blown seeds spread rapidly to adjoining properties from a neglected piece of land where it has been allowed to establish itself. The easier is to eradicate the first plants as they appear before they have time to seed. The following control methods are suggested: burning, cultivation, use of creeping and erect cover crops, application of weedicides, heavy grazing by cattle, moving or slashing and mulching.

The commonest and most disastrous method of all is burning. It exposes the bare soil to sheet erosion. The roots left in the ground following burning can reproduce and the new plants grow vigorously because of the ash left after burning. Therefore, burning a field of Illuk is not recommended.

Digging out with mammoties and removing the underground stems is the most effective method of controlling Illuk, although it is a very laborious process.

Planting of quick and vigorously growing cover crops to provide shade can check the growth of Illuk as it does not like shade. *Thephrosia candida* as a cover crop has given successful results.

Herbicides plays a great part in suppressing weeds in economic crop production. Experiments were carried out in Malaya with Sodium Arsenite, Sulphuric acid and also Sodium Chlorate to check the growth of Illuk. But these are advocated on coconut estates where cattle are not allowed to graze as it is poisonous.

Grazing by cattle and buffaloes is another effective method but is not possible in young coconut plantations.

Repeated slashing and mowing is also considered effective. Mulching with Illuk leaves prevents the re-growth of Illuk.

RAJAPAKSE, G. (1950). Illuk, The Destroyer, Ceylon Cocon. Quart. 1 (3). 7-10.

A grass "Illuk" can penetrate the roots of rubber and coconut and grow along them for 1–2 ft. before emerging. As coconut roots do not resist wounded tissue, a single penetration may result in several feet of the roots being killed.

SALGADO, M. L. M. (1963). New Menance on Coconut Estates. *Eupatorium odoratum* Spreads into the Coconut Estates. Cey. Coconut Planters' Rev. 3(3) : 69–70.

The weed *Eupatorium odoratum* L. has spread on to the coconut estates at an alarming rate in past two years. It was found that the weed is establishing in areas where it was not seen before.

Although uprooting is recommended as the best method of control, this will be expensive once the weed has established and the roots become bulbous. The gall fly *Procecidochares utilis* in India. was found to be a parasite of a single *Eupatorium* spp. but not against *E. odoratum*. However a search in this country may reveal a parasite specific to *E. odoratum*. The weedicides could be used but will be costly. Hence unless this menace in controlled by a systematic drive, many coconut estates will soon become *Eupatoria* jungles.

SANDANAM, S., and JAYASINGHE, H. D. (1977). Manual and Chemical Control of *Imperata cylindrica* on Tea Lands in Sri Lanka. PANS 23 (4) 421-426.

In an experiment conducted on an almost pure stand of *I. cylindrica* to compare manual and chemical methods of control; forking out of rhizomes upto a depth of 45 cm gave long-lasting control. Slashing the grass to ground level at intervals of 4-6 weeks resulted in a low degree of control in terms of visual assessment of top growth and a high degree of control in terms of suppression of rhizome development which was comparable to the most effective chemical method; Dalapon (22.2 kg/ha) and Dalapon+Paraquat sequential spray. The results suggest that the effectiveness of control measures can be improved by timing the Dalapon spray to coincide with adequate soil moisture reserve and by regulating frequency of slashing with regard to soil moisture status and the number of previous slashings imposed. The chemical treatments and the slashings suppressed the development of the rhizome, but did not cause increased rhizome mortality. The stage of growth at which Dalapon was sprayed in Dalapon–Paraquat sequential spray treatments did not influence the degree of control achieved as assessed visually.

SANDANAM, S. MAPA R. B. and YATAWATTE S. T. (1980). Control of Illuk. *(Imperata cylindrica)*. Tea Res. Inst. of Sri Lanka. Tech. Rept. 1980.

Imperata cylindrica is not considered a serious weed in tea plantations. However, neglect of weed control leads to invasions of the land by this grass. An experiment was conducted to devise a method of control using herbicides. Treatments included use of Dalapon at 5.6, 11.2 and 22.4 kg ai/ha. Paraquat at 0.28kg ai/ha and sequential spraying programme using Dalapon at 5.6 kg ai/ha followed by Paraquat at 0.28 kg ai/ha three weeks later. These treatments were compared with slashing the grass to ground level at 4-6 weeks intervals and forking out all rhizomes to a depth of 45 cm.

The results showed that forking out of rhizomes up to a depth of 45cm gave a lasting control. Slashing the grass was less effective in suppressing rhizome development, so was Dalapon at – 22.2 kg ai/ha and Dalapon–Paraquat sequential spray. The effectiveness of control measures can be improved by timing the Dapalon spray to coincide with adequate soil moisture reserve and regulating frequency of slashing with regard to soil moisture status and the number of previous slashing imposed. The chemical treatment and slashing suppressed rhizome development, but did not cause increased rhizome mortality. The stage of growth at which Dalapon was sprayed in Dalapon-Paraquat sequential spray treatment, did not influence the degree of control achieved

SANDANAM, S., PUNYASIRI, N., PERERA, K. L. S. D. and GAMAGE, A. K. (1982). Chemical Control of Illuk *(Imperata cylindrica)* (L.) BEAUV. Tea Quart. 51 (4): 180-184.

An experiment carried out with 3-year old Illuk *(Imperata cylindrica)* grown in pots in a glass house showed that a single application of Glyphosate, as 1% or 2% solution, gave an almost 100% control as assessed visually by scoring. A high degree of control of rhizomes, by way of kill and suppression of rhizome regeneration, was achieved with Glyposate at these concentrations. A single application of Dalapon at 22.4 kg/ha in 667 litres of water and Dalapon-Paraquat sequential spray (Dalapon 5.6 kg/ha and Paraquat 0.568 litres/ha) gave about 50% control up to 6th week followed by a decline, the degree of control reaching about 30% by the twelfth week, as assessed visually. Determination of dry weight of plant parts at the end of twelve weeks after spraying showed that Dalapon and Dalapon-Paraquat sequential spray did not reduce rhizome weight significantly. Addition of a surfactant to the spray solutions did not materially alter the degree of control achieved with any of the treatments.

SENARATNA, J. E. (1940). Hambu, *Typha javanica* Schnizlein. A Weed of Irrigation Channels in Ceylon. Recently Proclaimed a Declared Weed Under The Plant Protection Ordinance. Trop. Agriculturist (Cey.), XCV, July–Dec. 218–224.

Hambu *(Typha javanica Schnizl)*—an indigenous plant occurring in tanks and lagoons, in riverine estuaries and marshy places is one of the most undersirable weeds of irrigation. In appearance Hambu resembles Illuk grass *(Imperata cylindrica)*, with erect, aerial stems and leaves, and a system of underground rhizomes with 3 kinds of fibrous roots. Rhizomes are of two kinds at the base of aerial stems, short, stout, erect rhizomes with crowded nodes and arising from these, narrow cylindrcal, horizontal stolons. This weed propagates both by seed and vegetatively. A single plant may produce in a year up to 30 inflorescences each yielding 400,000 to 1,000,000 fruits. The fruits are very light and have a ring of hairs at the base, helping in dispersal by wind and water. The vegetative means of distribution are pieces of rhizome and stolon.

Hambu spreads very rapidly in irrigation channels and cause silting up of the channels. When the channel beds rises the plant spreads inward into the channel and this process goes on continuously and in due course the plant completely covers the channel and chokes it.

Leaves of Hambu can be used in mat weaving and paper manufacturing. However, these uses are insignificant comparing to the potential danger it causes to irrigation.

The weed may appear in paddy fields but there it can be easily killed out by proper drainage or by annual average cultivation of the fields.

The most satisfactory control method is to cut and burn all flowers and seed spikes, remove the plant with its entire system of underground rhizomes and leave on high land to dry. Where the infestation is severe and a large area is involved, the aerial stems and leaves should be cut off at ground level under water at intervals of about 4 weeks, which prevents the underground rhizomes from obtaining sufficient oxygen, and this causes the rhizomes to ferment and rot. Chemical treatment is found to be inffective and uneconomic. Another control measure suggested is to prevent the bare area from becoming infested. This could be achieved by growing cover plants like Kikuyu grass *(Pennisetum clandestinum* Hochst.) and *Paspalum dilatatum* on the channel bunds and banks.

SENARATNA, J. E. (1940). *Gomphrena decumbens* Jaqc., A Weed New to Ceylon. Trop. Agriculturist XCIV, 293-297.

Gomphrena decumbens Jacq., a weed native of Central America, was first noticed at Colombo in March 1940. This weed is still confined to a small area in Ceylon and it is advisable to eradicate before it becomes a menace, in cultivated lands. *Gamphrena decumbens* belongs to the family Amaranthaceae. The botany of the plant is described. Results of some tests conducted on the viability of the seeds are reported.

SENARATNA, J. E. (1940). *Cyperus procerus* Rottboell, An Indigenous Plant Liable To be a Troublesome Weed of Paddy Lands. Trop. Agriculturist (Cey.) XCIX, 212-213.

Cyperus Procerus Rottb. (Cyperaceae) is an indigenous plant liable to be a troublesome weed of paddy lands. A description of the plant, its distribution, economic significance, methods of reproduction and dispersal, and means of control are given.

SENARATNA, J. E. (1940). *Limnocharis flava* (L) Buchenau, A Weed of Rice Fields Recently Naturalized in Ceylon. Trop. Agriculturist. 94 (6) : 362-364.

Limnocharis flava (L) Buchenau is a perennial weed with a short, stout, erect rhizome and with numerous fibrous roots. Aerial stems are erect, with leaves rising above the water. The plant flowers and fruits throughout the year. Its spread is of grave concern as it may become a serious menace to paddy cultivation. This weed spreads mainly by seed as seed production is prolific. A single fruit may produce over 1000 seeds and a single plant over 1m seeds per year. It also has a vegetative method of multiplying and is widely distributed in swampy lands and rice fields in Tropical America, Brazil, Siam and Java. It was first introduced to Ceylon in 1898, and has spread by natural or human agency thereafter. On soft mud this plant grows better than a hard soil. The only effective way of eradication is pulling out the entire plant, burning the seeds and fruits, drying the rhizomes, burning them too. This process has to be repeated at intervals for complete eradication.

SENARATNA, J. E. (1943). *Salvinia auriculata* Aublet. A Recently Introduced Free Floating Weed. Trop. Agriculturist XCIX, 146-149.

After an introduction in which are briefly mentioned how and where the Central American water weed *Salvinia auriculata* Aubl. was found in a naturalized state in Ceylon, and which has now assumed pest proportions in Colombo. A description of the plant and its methods of reproduction and dispersal are given. Its possible danger in silting up water-courses and in obstructing machinery is pointed out and methods of control are indicted.

SENARATNA, J. E. (1946). Some Weeds New to Ceylon. Proc. Ceylon Assos. Adv. Sci. 1 Annual session (III) 57.

Recently on account of increased communications between Ceylon and other countries and the greatly increased volume of transport consequent on the war, there have been introduced to Ceylon some foreign plants which are now naturalised and are likely to become weeds. Six of these are described.

Alternanthera pungens HBK of Tropical America, naturalised in India is a very recent introduction to Ceylon. It was first recorded by the writer at Ridiyagama on 6-2-1945, where it is quite naturalised and spreading fast.

Evolvulus nummulariaus L. of Tropical America naturalised in India was recorded by the writer at Negombo, on a roadside at Kurana on 1-1-1945.

Eupatorium conyzoides Vahl. of North and Tropical America has spread widely and become a serious weed over a large tracts in the Ratnapura, Balangoda area. *Spigelia anthelmia* L. of Tropical America is naturalised in Barigoda near Dandagamuwa.

Croton sparsiflorus Morong, of Tropical America naturalised in India was recorded by the writer on 6-2-1954 as a roadside weed Matara.

SENARATNA, J. E. (1952). The Preliminary Trials for the Control of the Water Fern (Salvinia) Trop: Agriculturist (Cey.) CVIII (i) 49–50.

Observations are given below from preliminary trials for the control of Salvinia on plots of 1/500 ac to 1/75 ac at Negombo and Katunayake with spraying two hormone weedicides, 2,4, Dinitrobutyl ester and 2,4,5 Trinitrobutyl ester, at strengths of $\frac{1}{2}$, 1 and 2 gls of the weedicide per 100 gls of water/acre.

Spraying at a strength of $\frac{1}{2}$ gl followed by a second spraying 10 days later at the same strength was ineffective.

At a strength of 1 gl followed 10 days later by a 2nd spraying at the same strength, most of the aerial parts were killed after 5 days but at the joints of the stem new young plants were being produced. On the 18th day after the 2nd spraying a 3rd spraying was done at the same strength. Ten days later the original plants were dead, but most of the new young plants were growing and a 4th spraying was done at 2 gallons strength 20 days later most of the young plants were dead and 5th spraying was given at the same strength. Nine days later practically all the plants were dead.

At a strength of 2 gls followed 10 days later by a 2nd spraying at the same strength almost all the aerial parts were killed after 5 days but from the joints of the stem there were new young plants. 18th days after the 2nd spraying a 3rd spraying was done at the same strength. 12 days later all the original plants were dead and also most of the new young plants and a 4th spraying was done at a strength of 4 gls. 10 days later practically all the plants were dead.

These are therefore indications that these weedicides offer some promise for the control of this weed, but much more work is needed before any conclusions could be drawn.

SOMARATNE, A. and MANIPURA, W. B. (1974). The Control of *Panicum repens* (L) BEAUV. with Glyphosate. Tea Quart. 44 (2/3). 86–94.

Established stands of *Panicum repens* (L) Beauv were treated with Glyphosate (B-Phosphonomethyl Glycine) at 4.48, 2.24, 1.12, 0.56 kg/ha and Dalapon (2,2, Dichloro-propionic acid) at 11.2 kg/ha. Both herbicides suppressed shoot growth and development of new rhizomes significantly at each rate of application. Glyphosate at 4.48 and 2.24 kg/ha completely suppressed shoot growth $4\frac{1}{2}$ months after the first application. Two applications of Glyphosate at 4.48 kg/ha reduced the dry weigh of new rhizomes to 0.1% nine months after the first application, while the reduction in weight of new rhizomes due to Dapalon at 11.2 kg/ha was 53% during the same period.

TEMPANY H. (1950). The Scourage of *"Imperata"*. Ceylon Coconut Quart. 1 (4) October-December, 1950.

Illuk *(Imperata cylindrica)* is the most important of the undesirable grasses which invade abandoned chena lands. It demands a high rainfall, and seeds are wind-dispersed. Illuk grows rapidly and forms a dense mass of roots. With the advent of drier weather it becomes dry and highly inflammable and causes fierce conflagrations in which vegetation may be destroyed. The constantly recurring burning destroys soil organic matter and these lands are usually regarded as irrevesibly lost.

The suppression of *Imperata* is a difficult prohlem. In Malaya some success was achived in suppressing the growth of *Imperata* by the use of *Centrosema pubescence* as a cover crop. *Leucaena glauca* has also given satisfactory results.

Spraying with chemicals is also being practiced in suppressing *Imperata* but the cost and the risk of poisoning are limiting factors.

Rehabilitation of lands regarded as lost and the prevention of their extension are considered pressing problems.

WATSON, M. (1986). Note on the Control of Foxtail Grass *(Pennisetum polystachyon)* (L) Schult.) Tea Bull. 6 (2):10-11.

A brief account on the spread and the propagation methods of the species *Pennisetum polystachyon* (L) (Foxtail grass) and the chemical methods of control are discussed. The main means of propagation is by seed. As suggested for effective control plants should be sprayed prior to flowering with Diuron, at a dilution 20 g of trade product (80% a.i.) in 10:1 (0.6 oz. in 2 gal.) water. The spray will not kill mature plants in flower. Spraying of tall mature plants is not recommended. They should be cut back and the re-growth sprayed. Foxtail grass could also be controlled by Glyphosate. Paraquat and Dalapon have been found to be ineffective. The main strategy of control should be to prevent the grass from flowering.

WEERAKOON, W. L. (1972). The Control of *Eupatorium odoratum*, a Pernicious Weed of Coconut Plantations in the Low Country of Ceylon. M.Sc. Thesis, Univ. of Sri Lanka, Vidyodaya Campus.

E. odoratum which is one of the most important weeds in the wet low country areas offers serious competition to coconut palms. Its characteristics have been studied in

relation to its importance as a weed. The change in the population density of the weed under coconut cultivation, the reproductive capacity of the plant and viability of the seed under various environmental conditions have been studied, as they form the principal medium of distribution.

The cardinal temperatures for germination of *E. odoratum* seed in the presence of light, air and 70%–80% MHC are 18°C minimum, 28°C ±2° optimum and 36°C maximum.

The weed can be controlled by uprooting at intervals of 5 months. The nutrient content and C/N ratio at the time of flowering and its importance as a green manure have also been discussed. Attempts to develop a method of biological control of the weed with the aid of pests or fungal diseases proved unsuccessful.

Contact, pre-emergence and systemic herbicides were tested for control of *E. odoratum* and it was found that effective control could be achieved by spraying a mixutre of 2,4–D and 2,4,5–T to the regenerated growth after slashing, at the rate of 2 pints in 40–60 gallons of water per acre. The cost of this treatment has been compared with that of manual weeding. It should be noted however that the mixture at this concentration is harmful to coconut seedlings and young nuts if the spray comes into direct contact with the palm.

The weeds that grow in succession, when *E. odoratum* is controlled has also been studied, and their significance discussed.

HERBICIDES

ANANTHACUMARASWAMY, A., LAKSHMIE, M. S. D., ANANDAVIJAYAN, S. and KUDAGAMAGE, S. N. (1987). Effect of Pre-Emergent Herbicides on N-Mineralization and Microbial Population. Sri Lanka J. Tea Sci. 56 (1) : 41-47.

Effect of pre-emergent herbicides Diuron and Oxyfluorfen on an Ultisol was investigated by measuring ammonification, nitrification, microbial population and pH. It was found that soils treated with both herbicides had either the same or higher rates of N-mineralisation and microbial activity as the control soil over the total period although a temporary depressive effect was seen soon after application.

BANDARA, J. M. R. S., KEARNEY, P. C., VINCENT P. G. and GENTNER, W. A. (1985). Paraquat. A Model for Measuring Exposure. In Dermal Exposure Related to Pesticide Use, Ame. Che. Soc. Symp. Series ISSN 0097–6156: 273, 279–285,

Residues on gloves and plastic boots were used as surrogates to measure herbicide transfer from treated plants. No human exposure occurred since harvesters wore protective clothing. The model was Paraquat (1,1–dimethyl–4,4' – bipyridinium ion) residues on *Cannabis sativa* (marihuana). The use of paraquat on *Cannabis* to reduce marihuana production presents a unique model situation when the grower attempts to salvage the treated plant. Marihuana plants were grown in a greenhouse, moved to a field and ground-sprayed with a solution of Paraquat (0.6 kg/ha) plus 100 uCi (methyl ^{14}C) Paraquat. Leaves of sprayed plants were harvested at 0, 1, 2, 4, 8 and 29 h after spraying. Time 0 was 10 min after spraying. Leather gloves, worn over rubber gloves, and boots were analyzed for residues. The highest residues were measured at time 0 (0.95 mg right glove, 0.50 mg left glove) and declined rapidly during the first 4 h after spraying. Residues on boot covers were lower than glove residues and also exhibited a rapid decline with time of picking. The mean plant Paraquat residue, measured by combustion analysis, based on leaves harvested at time 0, was 4.65 mg per 10.41 g drymatter per plant and remained fairly constant during the first 8 h, but showed a loss of 64% (based on ^{14}C) at 29 h.

CHANDRALATHA, M. and JAYAKODY, A. N. (1986). Effect of Machete (Butachlor) and Goal (Oxyfluorfen) on Nitrogen Mineralization of an Alfisol and an Oxisol. Sri Lanka Asso. Adv. Sci. Proc. 42*nd* Annual Session, 58.

Soil samples drawn from plough layers of an Alfisol and an Oxisol were treated with pre-emergent herbicides Machete and Goal at rates of 400 ml and 500 ml per hectare respectively to examine their effect on nitrogen mineralization. Soils treated with herbicides and non treated soils serving as controls were incubated at 25°C maintaining the soil moisture at 60% of the water holding capacity. Sampling was carriedout after 1, 2, 4, 8 and 12 weeks of incubation and the nitrate and exchangeable ammonium were determined in IN KCl extracts. Results indicated that Machete and Goal inhibited nitrification process in both soils significantly during the first week of incubation. During this period, Machete and Goal treated Alfisol showed 60% (21 ppm NO_3-N) and 70% (25 NO_3-N) lower NO_3–N contents respectively than the controls. Nitrification was inhibited upto 60% 41 ppm NO_3-N) by Machete and 45% (30 ppm NO_3–N) by Goal in the Oxisol. From the first week onwards, an increase of NO_3–N contents in herbicide treated soils was observed similar to controls. However, these values were considerably lower than the controls upto 6 weeks. The difference in controls fluctuated between 9 and 21 ppm NO_3–N.

A slight decrease of exchangeable NH_4-N (2 ppm) was observed in herbicide treated Alfisol during the first week of incubation, whereas in the Oxisol an increase amounted to 4 ppm by Machete and 2 ppm by Goal.

The net effect of Machete and Goal was a reduction of available nitrogen in soils for a considerable period. This might clearly influence the plant growth at early stages.

CHANDRASENA, N. R. (1979). Some Observations on the Effects of Herbicides of the Microflora of Paddy Fields. Proc. Sri Lanka Assoc. Adv. Sci. 35–(1) 40.

Many previous workers have reported general differences between herbicides in fungitoxicity and also between the fungi in their ability to tolerate these compounds.

Three locally formulated herbicides, used extensively, on paddy fields (MCPA, Propanil and Gramoxone) were studied for their fungitoxicity. Effect of concentrations equivalent to normal fields rates and far in excess of these chemicals on 5 different fungial genera, were investigated. Fungal growth was measured as linear extensions on artificial media incorporated with the herbicides, to give 0, 10, 100,500, 1000 and 2000 ppm. w/w the concentrations equivalent to recommended fields applications, for all 3 herbicides were in the range of 0.5-5.0 ppm.

Results indicated that there are distinct differences in terms of degree to which these herbicides are fungitoxic between the 3 chemicals that have been tested. All three herbicides do not seem to cause significant growth reduction at a concentration less than 100 ppm. Beyond 100 ppm, herbicide concentration appear to be significantly harmful to most of the fungi. Propanil appears to be highly fungitoxic than the other two. The Gramoxone preparations even at 200 ppm allowed fungal growth to some extent.

Herbicides applied at normal field rates of slightly above may not cause marked changes in the total number of soil micro-organisms or in the level of microbial activities, as pointed out by previous workers. But differences in herbicides tolerances of the fungi can result in certain qualitative changes in the soil microflora which could lead to important ecological consequences.

EKANAYAKE, A., WICKRAMASINGHE, R, L. and LIYANAGE, H, D. S. (1979). Studies on the Mechanism of Herbicidal Action on N – (Phosphonomethyl Glycine).Weed Res. 19 (1) 39-43.

Application of Glyphosate to couch grass *(Panicum repens)* resulted in an initial increase of the total amino acid content in the plant, which reached a maximum on the 8th day following treatment. This was most marked in the rhizomes where the value was about three times that of the control plants. The initial increase fell off rapidly with time and on the 15th day after application the total amino acid content of the treated leaf and rhizome samples was less than in the controls. Resurgence of rhizome activity was noticeable on about the 48th day.

GUNAPALA, W. O. and WIDANAPATHIRANA, G. S. (1981). Microbial Oxidation and Release of Cloride Ions from Halogenated Herbicides. Proc. Sri Lanka Asso. Adv. Sci. 37th Annual Session (1) 38.

Six strains of bacteria capable of utilizing six commonly used cholrinated herbicides MCPA, 2,4–D, 3,4 D.P.A., T.C.A., Saturn 50 (Benthiocarb) and Lorox were isolated from paddy soil by enrichment culture technique. These methods (a) growth test, (b) halide release, and (c) Oxygen uptake, were employed to study the degredation of the above chlorinated herbicides by these isolates. All organisms isolated were able to grow in 3,4 D.P.A, and dehalogenate the herbicide and also showed an appreciable oxygen uptake, probably, indicating that 3,4 D.P.A. is universally degraded by these bacterial species.

2,4–D and M.C.P.A. were degraded by bacterial species tested. Only 3 bacterial species showed any growth on T.C.A. and this compound was neither dehalogenated nor oxidized by any bacterial species. T.C.A. probably is the most recalcitrant chlorinated herbicide and does not serve as a growth stubstrate for many of these bacteria.

Pseudomonas aeruginosa and *Micrococcus* species appear to be the most efficient organisms in the process of degradation of these herbicides, when the ability to grow in and dehalogenate the herbicides were considered. Where as *Pseudomonas* showed an appreciable oxygen uptake, utilizing all the six herbicides as a growth substrate, the *Micrococcus* species showed oxygen uptake only in 2,4–D and 3,4 D.P.A.

The evidence indicated that, generally, an organism capable of utilizing any of the above chlorinated herbicides; dehalogenates the same and also shows an appreciable oxygen uptake. But there are exceptions.

It's also apparent that dehalogenation of aromatic chlorinated herbicides is more efficiently carried out by bacteria than the aliphatic derivatives.

PARANAGAMA D. M. (1986). Recent Experiments on the Production of Insecticides and Herbicides from Plant Sources, Govikam Sangarawa (in Sinhala) 30 (1/4) 31-34.

The articles describes the natural mechanisms of plants to overcome pest attacks. The instances quoted are mostly relating to insects, but a few cases of allelopathic effects of plants are presented citing Sorghum, Sunflower, Walnut from abroad and Pyrethrum spp from Sri Lanka.

PEMADASA, M. A. and JAYASEELAN, K. S. (1976). Some Effect of Three Herbicidal Auxins on Stomatal Movements. New Pathologist 77(3) 569-573.

The efects of 2,4–D, 2,4,5–T and MCPA on stomatal opening on illumination of excised, turgid leaves of *Stachytarpheta ihdica* were studied by microscopic examination of epidermal strips fixed in absolute ethenol. All 3 herbicides prevented wide opening of stomata and accumulation of K in the guard cells. Hydrolysis of stomata starch was hindered by 2,4,5-T and MCPA and hastened by 2,4–D. CO_2 free air was effective in compensating substantially the effects of 2,4,5–T and MCPA but not of 2,4,–D. It is concluded that 2,4,5–T and MCPA arrest light induced stomatal opening partly by disturbing the CO_2 balance in the leaf and partly by hindering starch hydrolysis and K accumulation in the guard cells; whereas 2,4,–D appears to exert a more direct effect, probably by affecting the membrane permeability, on guard cells although inhibition of K accumulation may also be partly involved in it's action.

PEMADASA, M. A. and KORALAGE, S. (1977). Some Effects of Three Herbicides on *Bidens chinesis* Wild and *Tridax procumbens* L. Cey. J. Sci. (Bio. Sci.) 12 (2) 139-146.

The effects of a range of concentration of 2,4 Dichlorophenoxyacetic acid (2,4–D), 2,4, 5-Trichlorophenoxyacetic acid (2,4, 5 - T) and Methyl-4-chloro phenoxyacetic acid (MCPA) on *Bidens chinensis* and *Tridax procumbens,* at various stages of the life-cycle, were investigated experimentally. All three herbicides inhibited germination and caused mortality of seedlings of both species, and the degree of toxicity increased with increase in herbicide concentration and decreasing age of plants. The herbicides were more effective

when applied to the foliage than to the root system. In general 2,4–D and MCPA were more detrimental than 2,4,5–T. The results are discussed in relation to the control of natural populations of the two weeds.

SIVASITHTHAMPARAM, K. (1969). Some Effects of an Insecticide (Dursban) and a Weedicide (Linuron) on the Microflora of a Submerged Soil, Proc. Cey. Asso, Adv. Sci. 25 Annual Session (1) 48.

The widespread use of selective chemicals for the control and elimination of agricultural pests has created a variety of new agronomic, biological and public health problems. In as much soil micro-organisms play a key role in soil fertility, the residual effects of such chemicals are of considerable importance.

An investigation was carried out to ascertain the effect of the insecticide Diuron, (0,0 diethyl)–0-3-5,6 trichloro 2-Pyridyl phospherothioate) and the weedicide Linuron, (3-4 dichlorophenyl) 1, methoxy:1–methylurea) on the microflora of a submerged soil.

Details of their effects on the number of fungi, bacteria and actinomycetes and also on the ammonifiers; nitrifiers, oxidizing ammonia to nitrate; denitrifiers; aerobic nitrogen fixers, anaerobic nitrogen fixers; phosphate dissolvers, cellulose decomposers, sulphate reducers and iron precipitators are presented.

TAMBIAH, M. S. and KRISHNAPILLAI, S. (1963). A Study on the Effect of Indole–3–Acetic Acid and Gibberellic Acid on the Movements of the leaves of *Mimosa pudica*. Proc. Cey. Asso. Adv. Sci. 19 Annual Session (1) 29.

Stems with the main petioles only of *Mimosa pudica* were held submerged in solutions of Indole–3–Acetic Acid (IAA) at varying strengths ranging from 1.25 mg/1 to 20 mg/l and in solutions of Gibberllic Acid (GA) ranging from 1 mg/l to 100 mg/l. The main petiole in each case was stimulated by touch and the angle of movement and the time taken for recovery of the main petiole was recorded The results indicated that in weaker strengths of IAA and GA the sensitivity and response was increased, but at higher concentrations in both cases there was a decrease in sensitivity and response. The values obtained are compared with standard experiments conducted in distilled water and in buffer solutions ranging from pH 4.8.

Mixtures of GA and IAA of strengths showing maximum sensitivity individually caused a complete loss of sensitivity and response to touch while other properties of mixtures showed only very slight sensitivity and response.

THIEVENDIRARAJAH, K. and JAYASEELAN K. (1975). The Effect of Weedicide on Blue Green Algae. Proc. Sri Lanka Asso. Adv. Sci. 31 Annual Session (1) :39.

Effects of weedicides such as Saturn, Machete, Avirosan (C-288), Linuron and 2,4, DIPE that are commonly used in paddy soils on the nitrogen fixing blue green algae *Anbaenopsis* sp, *Nostoc* sp., *Nostoc carneum, Wollea bharadwajae, Aulosira fertilissima, Mastigocladus laminosus, Tolypothrix tennis, Calothrix* sp. and *Anabaena* sp. were observed. All these algae were found to be unaffected by 2,4–DIPE up 100 g.a.i./ml. However, different levels of tolerance were observed with regard to the other weedicides; Avirosan was found to retard the growth of most of these algae at very low concentrations. *Mastigocladus laminosus* was the most tolerant to all the weedicides. Tolerance of weedicides was almost similar in nitrogen free and nitrate containing medium. The rate of growth of *Anabaena* sp. and *Nostoc carneum* was found to be similar to that of the control

up to 50 g/ml concentrations of 2,4-DIPE. In the case of *Anabaena* sp. an increase in the frequency of heterocysts was observed with higher concentrations of 2,4,–DIPE.

THEIVENDIRARAJH, K. and JAYASEELAN, K. (1981). Effect of the Herbicide Isopropyl Ester of 2,4-Dichlorophenoxyacetic Acid (2,4-D IPE), on Blue Green Algae. Ceylon J. Sci. (Bio: Sci:) 14 (1/2) 10-14.

The effect of the hormonal herbicide Isopropyl ester of 2,4-Dichlorophenoxyacetic acid (2,4-D IPE) on the growth of two nitrogen-fixing blue-green algae *Nostoc carneum* and *Anabaena* sp. and the non-nitrogen-fixing blue-green alga Anacystis *nidulans* was studied. The rate of growth and the final cell number of these algae were not affected by this weedicide even at a concentration that is approximately 15 times more than the concentration used in paddy soils.

WEERARATNA C. S. (1976). Effect of 2-Chloro 4,6-Bis-(Ethylamino) S - Triazine (Simazine) on Soil Microbial Activity and Nitrification in an Alluvial Soil. Proc. Sri Lanka Asso. Adv. Sci. 32 Annual Session (1) 51-52.

2–chloro-4,6–bis–(ethylamino)–S triazine (Simazine) is a biologically active compcompound in that it is known to inhibit photosynthesis. Simazine is commonly used as a selective herbicide in crops such as citrus, coffee, maize.

Investigations reported in this paper were carried out to examine the influence of Simazine (10 ppm) on soil microbial activity and nitrification of added ammonium ions in an alluvial soil of pH 6.5 over a period of 12 weeks.

Result indicated that Simazine increased soil microbial activity (shown by increased CO_2 production) from the initiation of the experiment. This effect was observed over a period of 8 weeks. Nitrification was found to be inhibited by Simazine over a period of 6 weeks.

WEERARATNA, C. S. (1976). Studies on Residual Effects of Some Agrochemicals. Paper Presented at the Agricultural Research Seminar Series. Faculty of Agriculture, University of Peradeniya, 1-20.

Studies were carried out to examine the residual toxicity of 2,4–Dichlorophenoxy acetic acid. (2,4–D) Methyl, 4, Chlorophenoxy acetic acid (MCPA), Sodium 2,2 dichloropropionate (Dalapon), 3,4- Dichlorophenyl -1 dimethyl urea (Karmex), Pentacholorophenol (P20) and Sodium trichloroacetate (TCA). These were tested on different soil groups. Under varying conditions an initial drop in the concentration of herbicides was due to the adsorption by the soil. The herbicides incorporated into low humic gley (LHG) soils have decomposed relatively faster except P. 20. Faster decomposition in the LHG was related to its higher microbial activity. In reddish brown latasolic (RBL) soils, herbicide decomposition was slow due to low pH. Dalapon decomposed at a slow rate. P20 was resistant to decomposition. Karmex too shows a similar tendency except in LHG. Under flooded conditions drop in the concentration of herbicides was also due to adsorption, it is relatively less in other herbicides except in TCA, which decomposed faster, and formed a toxic compound. However, TCA is less toxic in sterile soils under flooded conditions. Karmex and P 20 were not decomposed during the 13 weeks of incubation.

Residual concentration of herbicides incubated in sterile soils show that almost no decomposition has taken place during the incubation period. The decomposition of certain herbicides is rapid in soils previously treated with them.

In another experiment the residual effect of 2,4-D, MCPA and Dalapon decreased beyond toxic levels by the end of the 12th week. At Kundasale TCA decomposed within 8 weeks of application. However, Karmex and P 20 had not decomposed completely. All the compounds tested get absorbed mostly in the first 1-3 in of the soil and LHG soils in the first inch of the soil.

Dazomet was also tested on some soil biological processes in tropical reddish brown earths (alfisol). In Dazomet treated soils CO_2 production decreased in the intial period of incubation in both acidic and alkaline. soils. This effect lasted for a lesser duration in the alkaline soil. The decrease in microbial activity was due to the toxic effect Dazomet had on the micro-organisms. Thereafter the CO_2 production increased after 19 and 9 days in acid and alkaline soils respectively

WEERARATNA, C. S. (1977). Residual Toxicity of Some Herbicides (1) 2,4-D, MCPA and TCA. J. Nat. Sci: Coun: Sri Lanka 5 (2)147-155.

Residual toxicity studies of 3 herbicides viz. 2,4-Dichlorophenoxy acetic acid, 2-methyl 4-Chlorophenoxy acetic acid and Trichloroacetic acid in four common soil groups: Reddish Brown Earths. Reddish Brown Latasolic, Immature Brown Loam and Low-Humic Gley (LHG) indicated that the herbicidal effect of the compounds examined decreased during incubation, more rapidly in LHG soils than in others. 2,4-D and MCPA decomposed faster than TCA. The residual toxicity of herbicides examined except TCA decreased at a slower rate under flooded conditions than under unflooded conditions. Studies carried out with autoclaved soils show that microbial activity is responsible for the decrease in toxicity except in TCA. Residual toxicity decreased more rapidly in soils previously incubated with these herbicides. Leaching tests indicated that the three herbicides tend to get adsorbed mostly in the first 3 in. of the soil except in LHG where accumulations were more in the 1 to 2 in. soil layer.

WEERARATNA, C. S. (1979). Effect of 2-Chloro-4,6, bis (ethylamine)-s-Triazine (Simazine) on Some Microbial Processes, Zentralblatt, fur Bakteriologie, Parasitenkunde, Infektionskrankheiten and Hygeine. II Abeilung 134 (2), 115-118.

A soil consisting of coarse sand 20.3%, fine sand 15.8%, silt 28.6% and clay 35.3% and with pH 6.5. was treated under controlled conditions with Simazine at a conc. of 10ppm and incubated at room temperature. The herbicide accelerated microbiological activity over a period of 8 weeks; nitrification was inhibited for 5 weeks.

WEERARATNA, C. S. (1980). Residual Toxicity of Dalapon in Four Soil Groups in Sri Lanka. Proc. Sri Lanka Asso. Adv. Sci. 36 Annual Session 24.

A large number of synthetic, biologically active compounds are applied to the environment to control weeds in cultivated crops. These chemicals undergo physical, chemical and biological changes resulting in the formation of compounds which have toxicities different from the original.

Toxicity of Dalapon (a weedicide) in four soils, viz. Reddish Brown Earth, Reddish Brown Latasolic, Immature Brown Loam and Low-Humic Gley, over a period of 13 weeks was studied by bio-assay tests under flooded and unflooded conditions.

Results indicated that phytotoxicity of Dalapon decreased rapidly in all four soils under unfloooded conditions but slowly under flooded conditions and in sterile soils. Toxicity decreased more rapidly in soils previously treated with Dalapon. Leaching tests indicated that this herbicide tends to leach down to 5-7 cm in soil.

WEERARATNA, C. S. (1980). Effect of Dalapon-Sodium on Nitrification and Denitrification in Tropical Loam Soil. Weed Res. 20(5), 291–293.

A loamy soil treated with Dalapon-Sodium (10 ppm) was incubated under aerobic or anaerobic conditions with added ammonium or nitrate nitrogen respectively. Results indicated that the herbicide retarded nitrification and denitrification upto 8 and 12 weeks respectively.

WEERARATNA, C. S. (1983). Residual Toxicity of Some Herbicides. Proc. 10th, Int. Congr. Plant Protection.British Crop Protection Coun. 736.

Bioassays of four types of soil treated with Dalapon, Diuron and PCP showed that the concentration of herbicides declined rapidly during the 1st week, probably owing to absorbtion. After 12 weeks residues were still detectable, though decomposition was more rapid in soil kept at 50% field capacity than in flooded soil.

WIJEKOON, R. ARIYARATNE, J. K. P., DHARMAWARDENA, K. G. and SIRIWARDENA, P. P. G. L. (1973). Translocation of Some Small Organic Molecules in *Salvinia*. Proc. Cey. Asso. Adv. Sci. 29 (1) 135.

A preliminary survey was done to study the translocation of small molecules such as Acetic acid, Chloroacetic acid, Trichloroacetic acid, Acetaldehyde and Formaldehyde applied on the surface of the salvinia leaf. Of these compounds chloro-acetic acid was found to be the most efficiently translocated compound. The behaviour of this compound was studied in greater detail using chloroacetic acid labelled with C^{14}. It was found that a small quantity of 5% chloroacetic acid applied on the surface of one leaf can get translocated throughout the plant within a few hours and kill the whole plant. If a very small quantity insufficient to kill the plant is applied, then the chloroacetic acid slowly passes through the roots into the water. Chloroacetic acid behaved in a similar way when applied on Eiconia leaf.

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BOCION, P. E., DE SILVA, W. H. HUPPI, G. A. and SZKRYBALO, W. (1975). Group of New Chemicals with Plant Growth Regulatory Activity. Nature 258 (5331) 142–144.

Dikegulac-sodium is formed as an intermediate compound in the commercial synthesis of ascorbic acid. in glasshouse tests, 11 derivatives of dikegulac were applied at concentrations of 3000 and 6000 ppm in 1000 1/ha to Kentucky bluegrass *(Poa pratensis)* Cv. Norma. Salts of dikegulac were highly active in reducing growth while except for the pentyl and methyl esters which were also highly active. Further tests were carried out on 10 species including cereals, herbage and weed grasses and woody plants. Growth retardation of *Digitaria sanguinalis* was sufficient for dikegulac-sodium to be considered a herbicide.

CAMPBELL, R. T., PERERA, L. A. and HARTWIG N. L. (1981). Competitive Control of Giant Foxtail by Early and Late Planted Corn. Proc. Northeastern Weed Sci. Soc. 35; 23-26.

In a trial in 1980 on silt loam soil, the competitive control of giant foxtail *(Setaria faberii)* with early and late sown maize, with varying rates of Alachlor applied pre-emergence did not differ significantly. Average control due to maize competition was 24% at the mid September foxtail harvest with Alachlor at 1.33 lb/ac, giant foxtail control was improved to 53% for July and September weed harvest.

CHANDRASENA, J. P. N. R. and SAGAR, G. R. (1986). Uptake and Translocation ^{14}C–Fluazifop by Quack Grass *(Agropyron repens)*. Weed Sci. 34 (5) 676-684.

Detached leaves and whole plants of quack grass *(Agropyron repens)* were used to study uptake and translocation of butyl esters of ^{14}C-Fluazifop–butyl, with or without additional adjuvants. In the absence of adjuvants 3.2% of applied radioactivity entered detached *A. repens* leaves by 6 hours and at the end of 24 hours, 6% had penetrated. The presence of additives increased uptake by leaves significantly. In the presence of the non-ionic surfactant agral (nonyl phenol ethoxylate) at 0.2% (V/V) or the oil-additive Actipron (self emulsifying ajduvant oil) at 2% (V/V), 17.2 and 12.9% of applied radioactivity respectively entered the leaves by 24 hours. Evidence of the dependance of phloem translocation of the radioactivity of source-relationship of the plant was obtained in studies with whole plant. Translocation measured up to 7 days after treatment showed that radioactivity was concentrated in areas such as young developed leaves, young stems and rhizome species. Rhizomes appeared to be major sinks for the accumulation of radioactivity at 7 days; 0.5% of applied radioactivity was found there. In whole plant experiments the 2 adjuvants either individually or in a mixture increased the uptake of ^{14}C-Fluazifop significantly. However, a corresponding increase in basipetal translocation was found only in one experiment. Much of the increased activity that had entered the leaves in the presence of adjuvants was found to have moved to areas distant to the treated zone or remained within the treated zones. In all experiments applied ^{14}C was not fully recovered in any of the experiments. Significant losses from treated surface were thought to be the main reason for the inability to recover all of the applied activity.

CHANDRASENA, J. P, N. R. and SAGAR, G. R. (1986). Some Factors Affecting the Performance of Fluazifop–butyl Against *Elymus repens* (L) Gould *Agropyron repens* (L) Beauv). Weed Res. (U.K.) 26 (2) 139-148.

In green house experiments, factors influencing the foliar activity of Fluazifop–butyl against *E. repens* were investigated. The growth stage of the weed up to 16 weeks of age

was not a major factor affecting herbicide performance, if 1 kg/ha was used. The activity of Fluazifop–butyl was reduced to varying extents by low temperature, low humidity and water stress. High post treatment temperature or humidity favoured the activity of the herbicide measured by the regrowth ability of treated plants. Moderate water stress did not affect the activity significantly, but severe stress led the plants becoming more tolerant of the herbicide. The effect of light/shade on foliar activity was not clear, but tended to decrease with increasing shade. The performance of fluazifop–butyl was reduced by rain within 6 hours of spraying, probably due to wash-off of the retained spray droplets.

CHANDRASENA, J. P. N. R. and SAGAR, G. R. (1987). Effect of Fluazifop-butyl on the Chlorophyll Content, Fluorescense and Chloroplast Ultrastructure of *Elymus repens* (L) Gould, Leaves, Weed Res. U. K. 27 (2) 103-112.

Over a period of 0–12 days after spraying with 0.25 or 1 kg Fluazifop –butyl/ha, chlorophyll–a and –b contents of *E. repens* decreased, progressing from the youngest to the more mature leaves. Newly formed tillers and the youngest expanding leaves exhibited more severe chlorosis and were often devoid of chlorophyll. A similar progressive decline of the chlorophyll content was observed when leaf segments were floated in Fluazifop-butyl solutions. A rapid and significant alteration of the normal chlorophyll fluorescence of *A. repens* leaves treated with Fluazifop–butyl was evident, with 0.25–1μg fluazifop butyl/ μ l causing a significant loss of the fast fluorencence yield and, after 24 hours a total abolition of fluorescence decay (PS decay). Ultrastructural damage to chloroplasts was seen within 24 hours after treatment with fluazifop–butyl. This damage ranged from partial to total disruption of the outer chloroplast envelope and disorganization of the internal thylakoid system. Such ultrastructural effects on chlorplast intensified up to about 6–7 days after spraying, by which time nealy all chlorplasts in tissue sections were affected to some degree.

CHANDRASENA, J. P. N. R. and SAGAR, G. R. (1987). The Effect of Site of Application of 14C–Fluazifop its Uptake and Translocation by Quack Grass *(Agropyron repens)* Weed Sci. 34 (4) 457-462.

Uptake and distribution of (^{14}C)–Fluazifop by *Elymus repens* were significantly greater from the abaxial than from the adaxial surface of leaves. The addition of the non-ionic surfactant nonyl phenol ethoxylate (agral) increased the uptake significantly, but only through the adaxial surface. Uptake of ^{14}C by the apical, middle and basal regions of the treated leaf lamina did not differ significantly. However, movement of labelled ^{14}C to stem areas and leaves both above below treated leaves was greater from lamina base applications than from treatments to the lamina apex and middle. The older leaves absorbed more herbicides than younger leaves, but the pattern of translocation did not differ. Considerably greater translocation occured from treatments to the outisde of the leaf sheaths in the lower regions of the stem than from applications to the upper leaf sheaths. Uptake from applications to the outside of the upper leaf sheaths also resulted in improved translocation mainly within the stem areas and into upper leaves.

DENNING, G. L., JAYASURIYA, S. K., and HUEY B. A., (1983). Constraints to the Adoption of New Weed Control Technology in Rice. Weed Control in Rice IRRI. Int. Weed Sci. Soc. 345-361.

New weed control technology involving herbicides has emerged for use in developing and developed countries. Adoption has varied among countries and rice growing environments. This report examines the factors affecting adoption, with particular emphasis

on institutional factors. In some developing countries inadequate labelling of herbicide containers, complexity of chemical weed control technology and poor research–extension linkages constraint farmer in adopting the new weed control methods. The need to train extension personnel is emphasized and the responsibility of chemical companies to asist is argued. In developing countries; practical training of extension workers on weed identification and recognition of field situations affecting herbicide effectiveness is also required.

As labour becomes relatively higher priced, shifts from labour–intensive weed control techniques are likely occur in tropical Asia. However, if the real price declines and costs continue to rise, the shift could be towards lower levels of weed control. Government policies have been and will continue to influence the adoption of new weed control practices in both developed and developing countries.

FIELD, R. J. and JAYAWEERA, C. S. (1985). The Influence of Clopyralid and Glyphosate on Yarrow Rhizome Regeneration. Proc. New Zealand. Weed and Pest control Soc. 106-109.

Seasonal application of 0.5kg Clopyralid/ha and 2.16kg Glyphosate/ha to *Achillea millefolium* in the field did not result in a total kill of rhizome buds. Autumn application resulted in most effective control, following rhizome fragmentation; with Glyphosate and Clopyralid controlling > 85% and 70% of rhizome buds respectively. Simulation of cultivation by fragmentation of rhizomes suggested that shorter fragments (40 mm) were more effective in improving the efficiency of Glyphosate while longer fragments (160 mm) assisted the performance of Clopyralid.

HETTIARACHCHI, P. L. and TRIEST, L. (1986). Isozyme polymorphism of *Potamogeton pectinatas* L. Proc: 7th Int. Symp. on Aquatic weeds. 163-168.

Isozyme patterns in leaves, seeds and turions (winter buds) of different populations of *P. pectinatas* collected from both fresh and brackish water in N. W., Central and S. Europe, were studied using PAGE. While some enzymes were constant within individual species, the isozyme patterns of peroxidase in leaves, alcohol dehydrogenase in seeds and both shilcimate dehydrogenase and glutomate-oxaloacetate transaminase in turions displayed remarkable intraspecific variation. Consistent isoenzyme banding patterns of malic enzyme and speroxide dismutase were observed in leaves, seeds and turions. In addition, isoenzyme phenotype of xanthine dehydrogenase in turions was constant among the populations studied.

JEYANAYAGAM, S. S. and COLLINS E. R. (1984). Weed Seed Survival in Dairy Manure Anaerobic Digester. Transactions of the ASAE 27 (5) 1518-1523.

Dairy waste containing Johnson grass and fall panicum seed was subjected to batch and continuously–fed anaerobic fermentation processes in laboratory scale digester. The effect on influent solids concentration (4% and 6%) and retention time (15 days and 20 days) on seed viability was observed in the nespphilic temperature range (35° ± 1° C). Fall panicum seeds were found to lose resistance to anaerobic digestion than Johnson-grass seeds. Greater seed destruction was achieved in 20 days than in 15 days digester. Anaerobic fermentation was more effective in destroying non-dormant than dormant seeds. Influent solids concentration did not have a significant effect on seed viability.

KANNANGARA, H. W. and FIELD, R. J. (1983). The Effect of Shade and Crop Interference on Reproduction and Growth of Seedling Yarrow, *Achillea millefolium* L.) Aspects of Appl. Biol. 4, 147-155.

Artificial shading reduced seed and rhizome production by *Achillea millefolium*. There was no seed production at 6.4% full daylight although a similar portion of dry weight was allocated to rhizome development as was recorded at full daylight. Crop interference by barley or peas successfully eliminated seed production and allowed only a small development of rhizomes. The particularly effective intereference by barley suggests that it could be used to control Yarrow populations by preventing the formation of new propagules.

KANNANGARA, H. W. and FIELD R. J. (1985). Environmental and Physiological Factors Affecting the Fate of Seeds of Yarrow *(Achillea millefolium* L) in Arable Land in New Zealand. Weed Res. (UK) 25 (2) 87-92.

A. millefolium has risen as a problem weed in arable lands in New Zealand. A spring sown population of 50 plants/m^2 produced about 245,000 seeds. These were capable of immediate germination in the autumn, but virtually no germination occurred in the winter and up to 80–100% at other times of the year. Seeds are positively photoblastic, but 30% of seeds may germinate in the dark after chilling, coat pricking, exposure to high nitrate concentration or to alternating temperature. Seed buried at 32cm in undisturbed soil lost viability almost completely within 2 years.

KANNANGARA, H. W. and FIELD, R. J. (1985). Growth of Seedling *Achillea millefolium* L. (Yarrow) in Association with Pea. *(Pisum sativum) L)* Weed Res. (U.K.) 25 (5) 355-361.

When *A. millefolium* seedlings were grown in the field in association with a pea crop, vegetative growth of *A. millefolium* was significantly reduced by 6 weeks after emergence. Flowering of *A. millefolium* in mixed stands was totally suppressed while the pure stand of *A. millefolium* developed flower clusters at 13 weeks after seedling emergence. Rhizome development occured at 8 weeks after seedling emergence in the pure stand, but not until 15 weeks when grown with peas. The early suppressing of seedling *A. millefolium* in a green house. experiment was associated with root interference, although by 5 weeks shoot interference by pea plants was important in reducing *A. millefolium* growth. The greatest suppression of *A. millefolium* occured when both roots and shoots of the two spp. were allowed to interfere. Low aggressivity of the weeds was shown against peas in a replacement series experiment.

LOVETTE, J. V. and WEERAKOON, W. L. (1983). Weed Characteristics of the *Labiatae* with Special Reference to Allelopathy, Biol. Agric. and Hort. New Zealand 1, 145-158.

The *Labiatae* is a large family of diverse morphology and habit. Almost all members contain phytochemicals, volatile oils which contribute variously to commercial value, problems of toxicity and allelopathic activity. Weed status on the *Labiatae* depends primarily on competition for environmental resources and on characteristics dependent on the phyto-chemical content. In a number of genera, notably Salvia, *allelopathic* activity has been documented.

PERERA, L. A. and HARTWIG, N. L. (1980). Competitive Control of Fall Panicum and Foxtail by Field Corn. Proc. Northeastern Weed Sci. Soc. 34, 38-42.

Control of the annual grasses *Panicum dichotomiflorum* and *Setaria faberii* and of Johnson grass *(Sorghum halepense)* seedlings by maize competition was 75%. With increasing rates of Alachlor, the grass control was increased to 92%; Alachlor did not provide more than 17% of the grass control. These results were obtained with a well adapted maize variety sown at 24,400 plants/ac with adequate soil fertility and moisture.

SIRIWARDANA, T. G. D., BLAIR A. M. and BARTLETT B. C. (1981). The Leaching of Chlorfoluron, Isoproturon and Metoxuron as Determined by Bioassay of Soil Columns. Proc. E. W. R. S. Symp: on Theory and Practice of the Use of Applied Herbicides, Versailles 309-317.

The leaching behaviour of chlorfoluron, isoproturon and metoxuron was assessed using a test species grown *in situ* on the vertically cut-open faces of leaching columns. Plant fresh weights from this bioassay were plotted against distance down the column to produce curves. Estimates of the load of herbicide damage within the column as assessed phytotoxicity to perennial ryegrass and the average herbicide movement were derived from these curves and the results analyzed. Increasing the amount of leaching water for the same dose of herbicide and incressing the dose of herbicide for the same amount of water through the column resulted in detection of chlorofoluron and isoproturon further down the profile. Prevention of surface evaporation had the same effect but increasing the time interval over which the water was added decreased isoproturon movement down the profile. A wheat seedling grown in the column did not affect isoproturon movement.

SIRIWARDANA, G. and NISHIMOTO, R. K. (1987). Propagules of Purple Nut-Sedge *(Cyperus rotundus)* in Soil. Weed Technology 1 (3):217:220.

The upper 30 cm of soil in a field infested with *C. rotundus* contained 4900–5100 corms and tubers/m^2 6 weeks after soil rotavation and irrigation. The upper 4, 8, 12 and 16 cm of soil had 45, 79, 95 and 99% respectively of the corms and tubers. Lower depths of soil contained larger tubers with higher percentage of drymatter than the shallow depths. Of the total of corms and tubers, 51% were from the parent population. At 6 weeks only 15% of the total tuber and corm population were not connected to aerial parts. Tubers from the parent population had a higher fresh weight than those from the new population. Parent tubers occured singly or in chains of up to 8 tubers.

SMITH, M. S. and WEERARATNA, C. S. (1974). A Study of the Effect of Simazine on Soil Microbial Activity and Available Nitrogen. In Transaction of 10th Int. Cong. Soil Science, Moscow 3, 173-178.

Air dried and ground brick earth of particle size of 2 mm and of pH 4.9 was used incorporated at 10 ppm in soil at 33% of maximum water holding capacity to determine CO_2 production. Simazine stimulate net microbial activity. The higher nitrate content in treated soil was confirmed by perfusing soil with 50 ml. of $(NH_4)\ SO_4$ solution containing 100 ppm ammonium N and 250 ppm Simazine and analyzing the perfusates for ammonium and nitrate contents. When these contents attained steady stage, a nitrification inhibitor suppressing the activity of Nitrosomonas spp. was applied and perfusates were analyzed for 2 more weeks. The availability of ammonium N and Nitrate N tended to increase in treated soil. Simazine stimulated heterotrophic nitrification.

SMITH, M. S. and WEERARATNA, C. S. (1974). The Influence of Some Biologically Active Compounds on Microbial Activity and on the Availability of Plant Nutrients in Soils. I. Simazine, Ixoynil and 2, 3,6–T B. A. Pesticide Sci. 5 (6) 721-729.

The effect of simazine, loxynil and 2,3,6-TBA on an acid and an alkaline soil during an incubation period of 6 weeks under aerobic conditions has been studied in comparison with the soils at normal application rates. At intervals, determinations were made of CO_2 liberated and the content of ammonium and Nitrate N and of available mineral plant nutrient elements. These quantities were not significantly influenced by the presence of 2,3,6 TBA; Simazine stimulated microbial acvitivity and loxynil retarded nitrification in the alkaline soil but increased it in the acid soil, a fact attributed in part to stimulation of heterotrophic organisms. Biological oxidation of Mn was retarded by loxynil but stimulated by Simazine. Changes in the availability of some other plant nutrient elements were also found.

SMITH, M. S. and WEERARATNA C. S. (1975). Influence of Some Biologically Active Compounds on Microbial Activity and on the Availablity of Plant Nutrients in Soils II. Nitrapyrin, Dazomet, 2 Chlorobenamids and Trybutyl-3–Chlorobenzylammonium Bromide. Pesticide Sci. 6 (6) 605–615.

The effect of the nitrification inhibitor Nitrapyrin, Dazomet, the growth retardant Tributyl 3–Chlorobenzylammonium Bromide, and the pre emergence herbicide 2 Chlorobenzamide on acid and an alkaline soil during an incubation period of 6 weeks under aerobic conditions was compared with untreated soils. The compounds were incorporated into the soils at normal application rates At intervals determinations were made of CO_2 liberated the content of ammonium and nitrate N and some available plant nutrient mineral elements. All 4 compounds were found to influence these quantities. Nitrapyrin increased CO_2 production throughout and Dazomet did so after an initial depression. 2 Chlorobenzamide and the growth retardant reduced CO_2 liberation specially in the early stages of incubation. All the compounds retarded nirification in both soils; an increase in ammonium N resulted in treated soils except in the alkaline soil containing the growth retardant, where ammonification was also reduced. A reduction in the content of available mineral nutrient elements was usually found suggesting inferference with the biological oxidation of these elements to less available forms. However, available Mn was increased by Dazomet, where as available Iron and Mn was reduced by the growth retardant and 2 Chlorobenzamide.

WAIDYANATHA, U. P. de S., STAUSS, R. and HURLE, K, (1983). Determination of Atrazine and Alachlor in Soil Using Indirect Bioassay Technique Ber. Fachg. Herbologie Heft. 24, 163-172.

The amount of Atrazine and Alachlor received by the soil following separate applications of the herbicides onto mulch-covered and bare soil, and later, simulated rain, was estimated.

The direct bioassay technique gave variable estimates of herbicide quantities in the soil at different dilutions of the test. Usually the estimated amounts increased with increasing dilution of the test soil.

The data were, therefore, examined using the parallel line assay technique. It was found possible to adopt it after appropriate tranformation of the data for the Atrazine assay, but not for the Alachlor. Fiducial limits in the Atrazine assay were estimated using the FIELLER's theorem.

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The results from this indirect bioassay suggest that under the experimental conditions, used, the soil with mulch cover received only 1/3 of the herbicide compared to bare soil.

WEERAKOON, W. L. (1981). Studies on the Autecology of *Salvia reflexa* Hornem (mintweed) with Special Reference to Weed Management. MS Thesis, University of New England, Australia.

Seeds of *S. reflexa* germinated between 4 and 39°C and the optimum temperature for both total germination and germination rate was 27-32°C. Interaction between temperature and osmotic potentials indicated that germination increased when temperature fluctuated from 28/27°C and there was high tolerance to low osmotic potentials at this temperature. Dormancy was broken by chilling and emergence was greater in spring than in autumn. Moisture stress reduced leaf area/plant, LAI, mean dry weight of above and below ground parts and root volume and the plant was very sensitive to water potential reduction. Phosphorus and nitrogen produced a positive growth response. *S. reflexa* competed with Phalaris *(Phalaris aquatica)* and *Digitaria* sp. Density and total cover of *S reflexa* was greater than wheat; increased tiller production in wheat suppressed *S. reflexa.*

WEERAKOON, W. L., and LOVETT, J. V. (1986) Studies of *Salvia reflexa* Hornem. III.Factors Controlling Germination. Weed Res. 26, 269-276.

Some germination of *Salvia reflexa* Hornem. could occur from 4 to 39°C, with good germination between 12 and 32°C and the best germination at 28-32°C. Rate of germination and total germination were decreased as osmotic potential of the germination medium increased from – 0.4 to – 1.4 MPa. Germination thus occured at a higher osmotic potential than in most species previously reported. This wide tolerance of environmental factors affecting germination should enable *S. reflexa* to be competitive over a wide range of field conditions. In field studies on emergence, when new seed formation was prevented, germination occurred in spring as soils warmed up and rainfall became adequate and continued to mid-summer when drought occurred. When seed fall was allowed from these spring emerging plants there was a further period of autumn germination, but this was not evident in disturbed plots with no seed return. These patterns conformed with expections based on laboratory germination studies.

WEERAKOON, W. L., and LOVETT, J. V. (1986). Studies of *Salvia reflexa* Hornem. IV. Effects of watering Frequency, Drought and Nutrient Supply on Growth and Development. Weed Res. 26.277-282.

Plants of *Salvia reflexa* Hornem. grown in pots were subjected to drought treatments in glasshouse conditions. Quite short durations of water stress significantly decreased leaf area, top and root dry weight and the plants rapidly adjusted their water loss below potential evaporation rates. The plants survived and recovered from periods of drought up to 30 days but plants dehydrated, even after short droughts, did not attain the growth rates of undroughted plants. In an infertile soil, *S. reflexa* plants demonstrated a large requirement for applications of phosphorus. With phosphorus applied the species was also very responsive to nitrogen, and where both nitrogen and phosphorus were applied there were smaller responses to sulphur and potassium.

WEERAKOON, W. L., and LOVETT, J. V. (1986). Studies of *Salvia reflexa* Hornem V.Competition from Crop and Pasture Species. Weed Res. 26,283-290.

The growth and productivity of *Salvia reflexa* Hornem was greater in the field where it competed with a summer crop of sorghum, than in a winter crop of wheat. In a glasshouse experiment, the growth of *S. reflexa* with *Digitaria smutzii* Stent and *Phalaris aquatica* L. cv. 'Sirocco' was much modified by nutrient and defoliation treatments. *Digitaria smutzii* was a strong competitor in warm growing conditions, even in drought, and with frequent defoliation. With application of phosphrous and nitrogen *D. smutzii* gained a competitive advantage over *S. reflexa*. When *S. reflexa* was grown with *P. aquatica* under these conditions *S. reflexa* was more competitive than *P. aquatica*, especially at high nutrient levels, Stress (defoliation or drought) adversely affected *P. aquatica* growth and competitive ability. *Salvia reflexa* has a modest invasive capacity in pastures which, coupled with its tolerance to adverse environmental conditions, could cause significant weed problems in poorly managed pastures.

WEERASINGHE, B. (1975). Effects of Herbicides on Soil Cynophyceae. PhD Thesis University College of N. Bangor, U.K.

Short terms effects of herbicides on the blue green algae *Phormidium molle* and *Oscillatoria tenuis* in soil are reported. Simazine and Aminotriazole were the most highly toxic. Low concentrations of PCP, Paraquat and EPTC stimulated growth. Other treatments selectively inhibited the growth of *P. molle* with accompanied stimulation of *O. tenuis* Long term effects of repeated application of MCPA; Paraquat, and Simazine on *P. foreolarum* and *O. laete* – virens in soil were investigated. Paraquat increased population levels of algae; MCPA reduced *P. foreolarum*. No algae survived Simazine treatments. In viro studies showed the toxicity of Aminotriazole, Simazine, and Paraquat. PCP at 11 ppm selectively inhibited *O. tenuis*. Higher concentrations were toxic. TEA at 175 ppm selectively inhibited *P. molle*. Algae were unaffected by Dalapon at 325 ppm and MCPA at 300 ppm. Chemistry of halogenated aliphatic acids revealed no relationship between structural confirguration and toxicity, Dalapon proved more toxic as the acid equivalent than as the sodium salt. Low doses of MCPA, PCP and Simazine enhanced the growth of *O. tenius*, but had no effect on *P. molle*. Algae did not respond to growth regulatory compounds in general but exhibit high tolerance to MCPA, Mecoprop and MCPB; chemicals differed in activity. *O. tenuis* proved more susceptible. Simazine affected photosynthesis and pigmentation in both species. The effects were reversible at low levels of exposure. The effects of extracelluar material produced by the two species on the uptake of labelled TCA were investigated. In both species TCA absorbtion was enhanced by the more acidic extracellular products of *P. molle*. Decreases in pH of the culture medium by buffering resulted in a similar increased absorption of labelled TCA by *O. tenuis*. In mixed culture, *P. molle* appeared to be dominant species in competition with *O. tenuis*. Attempts were made to correlate the results obtained in soil. with those in liquid culture and to understand the behaviour of algae treated with herbicides in soil.

WETTASINGHE, D. T. (1968). A Preliminary Investigation of the Effect of Two Plant Factors on Simazine Toxicity. Proc. 9th Brit. Weed Control Conf. 645-649.

Seeds of swede (cultivar Bangholus), Marrow stemkale; White mustard (cultivar English White), Wheat (cultivar July 1) and Pea (cultivar Big Ben) were graded according to weight into two or three categories. They were sown in soil containing a series of Simazine concentrations. In all species, the seedlings arising from the heavier seeds tolerated higher concentrations of Simazine than those from the lighter seeds.

Seedlings of wheat, white mustard and *Polygonum lapathifolium* (Pale persicaris) at different stages of development were exposed to a series of Simazine concentrations in solution culture. Four leaf stage of white mustard and 5 leaf stages of Pale persicaris were more tolerant to Simazine than the cotyledon stage. However, in wheat the 1 leaf stage was more tolerant than 5 leaf stage. These results are discussed.

YOGARATNAM, P. (1969). Use of Chemicals in Lieu of Land Preparation in in Flooded Rice. M.Sc. Thesis (Agronomy) University of the Philippines.

Field experiments were conducted in the wet and dry seasons to evaluate the effetiveness of chemicals substituting for land preparation under transplanted and broadcast methods of planting, and to substitute chemicals for land preparation between successive rice crops using rice variety IR8.

Herbicides substituting for land preparation were applied at different rates and in various combinations onto randomly distributed weedy plots before, regular seedlings were transplanted or pregerminated seeds were broadcast sown.

Among the herbicide substituting for land preparation in transplanted rice, chemical combinations such as MCPA at 0.8 kg/ha a.i.+Dalapon at 3 kg/ha a. i. followed by Paraquat at 1 kg/ha a.i., or Dalapon at 3 kg/ha a.i. followed by Paraquat at 1 kg/ha a.i. or Dalapon /2,4 D amine at 3 kg, 1 kg/ha a.i. followed by paraquat at 1 kg/ha a.i. of Pyriclor at 2 kg/ha a.i. gave grain yields similar to the transplanted standard (control).

Among the herbicides substituting for land preparation in broadcasted rice conducted in the dry seasons, chemical combinations such as MCPA at 0.8 kg/ha a.i. followed by Pyriclor at 1 kg/ha a.i. followed by Paraquat at 1 kg/ha a.i. or Dalapon at 3 kg/ha a.i. followed by Paraquat at 1 kg/ha a.i. or Dalapon at 3 kg/ha a.i. followed by Paraquat at 1 kg/ha a.i., or Dalapon /2,4 D amine at 3 kg/ha, 1 kg/ha at followed by Paraquat at 1 kg/ha a.i. or PCP at 5 kg/a.i./1000 1 diesel oil gave grain yields similar to that of the broadcast control.

The addition of phenoxy acid herbicides such as MCPA or 2,4 D amine with the translocated chemicals such as Dalapon or Amitrole followed by the contact chemicals such as Paraquat or PCP (oil) gave higher grain yields than the single application of the chemical or chemical mixtures.

The time taken to use chemicals in place of the normal land preparation practices was 8–12 days compared with normal land preparation being followed by farmers and taking 20 days to complete. However, one hectare of land can be ploughed and harrowed in one week. Thus, the data suggest that there is no saving in time by using chemicals in place of normal land preparation.

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