- legal control: the enforcement of measures and policies that range from quarantine to land and water management practices. This approach to pest management must involve area-wide operations that include many rural households and are enacted for the common good of both farmers and society at large.

Amongst users and promoters of IPM, such as researchers, donors, policy makers, pesticide companies, and extension staff, there are significant differences in emphasis and approaches.
Some of the more fundamental differences are briefly discussed in this paper to identify IPM approaches that reflect and reinforce the goals of sustainable and equitable production systems:
- IPM systemic adjustment or structural change,
- The relative importance given to self-sustaining control methods,
- The stocks of knowledge used by IPM practitioners,
- Research for IPM,
- Changes within IPM science and extension,
- Institutional and policy reforms.

Concluding, there will be a need to focus on structural changes in agroecosystems, give greater importance to self-sustaining control methods, and draw on the local stocks of knowledge useful for pest management.
Future self-sustaining designs that minimize the need for pest control interventions will require more understanding of complex ecological systems. The move towards system design to minimize pest outbreaks calls for knowledge and decision making as IPM becomes more broadly coordinated with land and water management, conservation of biodiversity, public health protection and socio-economic development.

1195 92 - 10/122

Plant protection
Review, USA, biotechnology, sustainable agriculture, herbicide tolerant crops, human health, environment, economics, sociology

GOLDBURG, R. et al.

BIOTECHNOLOGY'S BITTER HARVEST: HERBICIDE-TOLERANT CROPS AND THE THREAT TO SUSTAINABLE AGRICULTURE.

A Report of the Biotechnology Working Group, USA, 1990, 73 pp.; available from Environmental Defense Fund, 257, Park Avenue South, New York, NY 10010; price USD 10.00

The objective of this report is to examine the impacts of herbicide-tolerant crops, trees and to recommend changes that will discourage the development and adoption of such crops and trees in U.S. agriculture and forestry.
Modern agriculture depends heavily on herbicides-chemical plant killers-to control weeds. Nearly 80% of the herbicides used annually in this country are applied in agricultural settings. Consumers, farmers, farmworkers, domesticated plants and animals, wildlife, and their habitats are exposed to weed killers.
Against the background of agriculture's current dependence on herbicides, biotechnology, agrichemical, and seed companies, as well as the U.S. Department of Agriculture and state agricultural institutions, are using genetic engineering to develop crops and trees resistant to herbicides. Widespread adoption of these crops and trees will lead to increased use of particular herbicides.
Biotechnology's Bitter Harvest examines the impact of agricultural biotechnology's first major product - crops genetically modified to tolerate chemical weed killers, or herbicides. Crops are being given genes that will enable them to tolerate or resist the toxic effects of herbicides. A major research focus of public and private research institutions, herbicide-tolerant crops involve most agricultural crops, including a number of food crops, in the United States.
First, the report examines the extent of current herbicide use and the research sponsored by corporations, federal and state governments on crops and trees that tolerate herbicides. Then, it briefly discusses the human health, environmental, social, and economic impacts of herbicides and herbicide-tolerant plants. Next, the report examines the promises against the realities of widespread use of herbicide-tolerant crops, exposing a variety of detrimental effects herbicide-tolerant crops and trees will have on farmers, consumers, and the environment. Finally, it outlines the promise of sustainable agriculture to provide alternative methods of weed control. Based on its analyses, the report makes recommendations to discourage the development and adoption of herbicide-tolerant crops and trees.
To those with high hopes for the environmental benefits from biotechnology, herbicide-tolerant crops are at best a distressing misstep, at worst a cynical marketing strategy. Both industry and

the publicly supported agricultural research establishment must direct their considerable talent and resources toward sustainable alternatives for weed management and other pest controls. The risks of prolonging the chemical era of agriculture are far too clear for farmers, consumers, and the environment. Sustainable practices provide an alternative that will never be realized if public research funds are wasted on such misguided products as herbicide-tolerant crops.
'Threat to Sustainable Agriculture' offers a well-researched critique of current genetic engineering efforts to develop herbicide-tolerant trees and crop plants. Written by a consortium of 18 environmental, farm, consumer and religious groups, and the Texas Department of Agriculture, the study emphasizes that herbicide-tolerant crops may lead to even greater herbicide use, further threatening both natural resources and human health.
The author's note, "Perhaps the greatest problem of herbicide tolerance is that it diverts us from the paths that really could lead to reduced chemical dependency in agriculture. As farmers have known for years, and in some cases are learning anew, responsible tillage practices, crop rotations, and intercropping are viable methods of managing weeds."

1196 92 - 10/123

Plant protection
Review, developed countries, developing countries, book, agriculture, wild plants, chemical impacts, agricultural waste, fertilizer, environmental pollution, pesticides, human health

RICHARDSON, M.L.

CHEMISTRY, AGRICULTURE AND THE ENVIRONMENT.

Publ. of The Royal Society of Chemistry; Thomas Graham House, Science Park, Cambridge CB4 4WF; ISBN 0-85186-228-4, 1991, 527 pp.

The aims of 'Chemistry, Agriculture and the Environment' are to highlight the essential role of chemistry in evaluating the usage of chemicals in agriculture and their effects on the environment.
The advent of chemical fertilizers leading to improved crop yields and the use of pesticides to protect and control agricultural products was heralded as a major breakthrough in the decades following the war. The problems associated with these developments then became apparent. The impact on the environment was seen to be widespread and led to a very close control in the use of these chemicals, within certain instances the complete banning of their use.
This book reviews the current status of the inter-dependence of the chemistry and ecotoxicity of agrochemicals and related substances. The book brings together the related chemistry and other sciences which are necessary in the multi-disciplinary approach required in minimizing the risk of the use of these chemicals. It explains the problems and their implication for the environment and for human and animal health, and how these problems may be alleviated or overcome.
The emphasis is on a critical assessment with a recognition of the advantages and disadvantages involved. This will help to elucidate the general debate concerning the use of chemicals in agriculture with a true recognition of the difficulties associated with the environment. The text does provide a very useful insight into many of these problems and in so doing gives a very valuable overview of this very difficult but important interface.
The editors have attempted to minimize overlap between chapters. However, in dealing with such important topics as: pollution of the biosphere from gaseous emissions; water, nitrates and pesticides; soil pollution from substances as diverse as silage, animal slurries, pesticides; effects on non-target species; and control measures, some overlap is inevitable. Such repetition should enhance the contents of the book in view of the various and diverse experiences expressed by the authors from such countries as Eastern and Western Europe, the United States of America, Costa Rica, India, China, Israel, Nigeria, etc.
Assessment of risk to the environment from the use of agrochemicals is the outcome of a series of processes involving risk identification, estimation, evaluation, and subsequent effective management. It is a matter to be considered seriously by

all those having responsibility for producing or handling these chemicals, ranging from those synthesizing agrochemicals to those applying such chemicals to soil or crops; in addition such applicators must also be aware of the potential harmful effects from natural products such as manure, silage, and from straw burning.
Use must be made of the information available in this book, particularly on the underlying chemistry, to minimize any harm and also to understand the mechanisms involved.

1197 92 - 10/124

Plant protection
Review, field trials, Africa, integrated plant protection, small-scale farmer, problem areas, plant protection strategies, plant resistance, biological control, traditional methods, varities

OLOO, G.W.

MISE AU POINT DE TECHNIQUES APPROPRIÉES DE LIR QUI SERONT UTILISÉS PAR LES PETITS AGRICULTEURS TRADITIONNELS D'AFRIQUE TROPICALE. (DEVELOPING APPROPRIATE IPM TECHNOLOGY FOR THE TRADITIONAL SMALL-SCALE FARMER IN TROPICAL AFRICA).

FAO Plant Prot. Bull., 38, 2, 1990, pp. 101-104

This paper aims to identify some of the major challenges that crop protection experts need to address in formulating and implementing pest management programmes, and to highlight the advantages of Integrated Pest Management (IPM) strategies in responding to the needs of the traditional farmer in tropical Africa.
Pest management forms a vital part of the food-production process, both in the field and in farm storage. The pest problem becomes more critical in the farming environment of the resource-poor traditional farmer in tropical Africa.
In principle, the following broad programme of action is advocated for developing IPM technologies for crop protection in Africa:
- identify the major pests and quantify losses caused by them in a given agro-ecosystem;
- study the biology, behaviour and population dynamics of the pests to understand the features that may be exploited for pest management;
- establish the role of local natural enemies and develop mass-rearing, or mass-culture for disease agents on insects;
- study and develop other suitable components of IPM, such as intercropping and other cultural practices;
- integrate these components into an appropriate IPM technology and test for compatibility and efficacy under different ecological conditions; and
- develop a simple protocol for monitoring the impact of IPM technology in the field.

For example, in field trials being carried out by the African Regional Pest Management Research and Development Network (PESTNET) at Katumani, Machakos in eastern Kenya, intercropping an early maturing maize variety (Katumani composite) with cowpea (var. ICV2) under marginal rainfall conditions increased the maize yield by 4.5 times over that of maize in a monocrop. However, intercropping hybrid maize (var. H511) with beans (Mwitimania) at Murinduku, Embu in eastern Kenya, resulted in a yield increase of maize by 1.5 times under only marginal to medium rainfall conditions.
Traditional farmers have for generations applied natural plant products with pesticidal activity for pest control which have the following advantages over synthetic pesticides: the materials are

obtained from local plants and are relatively safe, and include wood ash and smoke which are by-products of firewood that farmers use for cooking; other plants such as the neem tree and *Tephrosia* can be grown easily by the farmer; and if the products were to be processed, they would be used as substitutes for industrial pesticides in situations where chemical control is necessary.
The ultimate solution lies therefore with the farmer who has experienced the problems over generations, sometimes without knowing the cause, and who must be in the front line and a key partner in the fight against crop pests.

1198 92 - 10/125

Plant protection
Review, developing countries, biological control, pest management, biological control agents, constraints and opportunities

GREATHEAD, D.J.

BIOLOGICAL CONTROL IN DEVELOPING COUNTRIES: TOWARDS ITS WIDER APPLICATION IN SUSTAINABLE PEST MANAGEMENT.

Med. Fac. Landb, Rijksuniv. Gent, 55 (2a), 1990, pp. 217-223

Biological control is the use of living natural enemies - parasites, predators, pathogens - as pest control agents. The most attractive biological control technique is the introduction and permanent establishment of exotic species for long term pest suppression (known as classical biological control) because once in place no further input is required. Manipulations of the crop environment to enhance the impact of pre-existing natural enemies, referred to as conservation of natural enemies, may also provide long term control. When long term biological control is not possible, periodic applications of natural enemies may be made to achieve short term control by timed releases of native or exotic natural enemies to control pests over a season, or natural enemies may be applied as biological pesticides for immediate reduction of pest numbers. Usually more or less host specific natural enemies are screened to ensure that non-target organisms of economic importance or of conservation value are not harmed. In this way undesirable side effects are avoided and biological control has a minimum impact on the environment.
Biological control can provide a sustainable and environmentally acceptable pest management, often at little or no direct cost to the farmer and so it has many advantages, especially for the resource poor farmer in developing countries who cannot afford costly imported chemical pesticides.
Biological control offers more or less target specific pest control, which may be indefinitely sustainable at little or no recurrent cost. Therefore, it should be attractive, not only as a means of solving major pest problems of overriding importance but also as one of the central components of pest management in specific cropping systems. World-wide surveys indicate that the adoption of biological control as a pest control strategy varies greatly between regions, countries and crops. Some reasons for this uneven uptake are discussed in this paper.
Unfortunately biological control research does not receive the level of institutional and financial support given by chemical industry to the development, promotion and marketing of pesticides. The production and distribution of high yielding varieties of major crops is well supported, especially by the International Agricultural Research Centres and by industry.
The different approaches to applying biotic agents in pest control are reviewed in relation to their appropriateness to the various agricultural production systems found in developing countries,

e.g., plantations, cash crops, horticultural crops, subsistence farming. Some constraints to the wider application of biological controls are outlined; notably misconceptions over the mode of action of biological control agents and their safety, pressures to rely on chemical pesticides, lack of administrative support to facilitate implementation of biological controls and inadequate investment in research and development. Some current initiatives by various agencies to find ways of overcoming these constraints are discussed.

1199 92 - 10/126

Plant protection
Review, biotechnology, transgenic plants, insect pests, pesticides, crop yield, genetic engineering, inherent resistence

HILDER, V.A. and A.M.R. GATEHOUSE

TRANSFORMING PLANTS AS A MEANS OF CROP PROTECTION AGAINST INSECTS.

Outlook on Agriculture, 19, 3, 1990, pp. 170-183

In this paper the progress is discussed which is being made towards producing plants by introducing insect control genes into crops by plant genetic engineering.
Some 13% of the world's crops are lost directly to insect predations, with further losses attributable to plant diseases for which insects act as the transmission vectors.
It is estimated that in 1988 nearly 4 billion US dollars were spent on applying chemical insecticides to protect just three crops - cotton, maize and rice - from their insect pests. These crops account for approximately half the total worldwide insecticide usage.
More than 99.9% of the chemical applied, enters the environment in ways which have a number of undesirable consequences, such as the destruction of beneficial insects, promotion of secondary pests and contamination of food chains. No-one alive today is free from detectable levels of organochlorides derived from insecticides.
The use of crop varieties which are inherently resistant to, or at least tolerant of, insect pests would provide a solution to this problem. Such varieties have the advantages that protection is provided when and where required for maximal control of insect pests, and is confined within the plant, thereby restricting its effect to crop-eating insects. The production of such resistant lines has been a goal of many conventional plant breeding programs. Unfortunately there is often no source of inherent resistance in the germplasm which is available for breeding purposes in a particular crop, even using modern wide-crossing and embryo rescue techniques.
Plant genetic enginering could help to overcome this problem since, once a system for the stable transformation of a particular crop has been developed, genes may be introduced into the breeding lines from any source. Such sources can include unrelated plants, animals, microbes or even wholly synthetic genes. This opens up a virtually unlimited source of germplasm variability from which useful traits may be selected. Transformation systems have now been developed for most of the major crop species and for many other, locally important ones.
With the transformation system available, the key question becomes that of where to obtain useful genes for transfer. Two logical sources of insect control genes have been exploited so far: insect pathogenic microorganisms and plants themselves.
These sources are discussed in this paper.

The authors conclude that every encouragement should be given to careful attempts to investigate the claims that the approach of transforming plants to insect pest control is:
- user-friendly - there are no application costs or sophisticated technology involved in the use of such material on the farm; genetically engineered seed would be handled in exactly the same way as unmodified seed;
- ecologically-friendly - replacing some of the current pesticide usage with protection which is intrinsically biodegradable, specific to targeted insects, and confined within the plant;
- consumer-friendly - the gene products which have been transferred so far have been derived from the edible parts of food crops.

1200 92 - 10/127

Plant protection
Latin America, Brazil, field trial, VA-mycorrhiza, integrated plant protection, rubber trees

FELDMANN, F. et al.

UTILIZATION OF VA-MYCORRHIZA AS A FACTOR IN INTEGRATED PLANT PROTECTION.

Agriculture, Ecosystems and Environment, 29, 1989, pp. 131-135

The natural growth area of rubber trees is the tropical rainforest of Brazil in which very poor soils are present. In preliminary studies it was shown that rubber trees form a VA-mycorrhiza under natural growth conditions. The influence of VAM on plant pathogen interactions has been studied for a number of plants but rarely on woody plant species and therefore no conclusive data for trees like *Hevea brasiliensis* are available. Young *Hevea* trees reveal a rhythmical growth pattern, in which leaf flushing occurs. Leaves are produced every 6 to 8 weeks and need about 4 weeks for maturation. Within this phase four developmental stages (A to D) can be distinguished by morphological characteristics. The leaves are showing an expressed leaf age resistance to fungal attack. Stages A and B are generally susceptible to a high number of fungal pathogens, stage C is of intermediate resistance and stage D is not infectible by biotrophic leaf pathogens. In this study the influence of VAM inoculation, additionally to the indigenous VAM populations, plant growth, leaf development and resistance behaviour against *Microcyclus ulei*,the causal agent of the South American Leaf Blight, was evaluatd.
VA-mycorrhiza infected rubber trees reveal an increase in resistance against a foliar disease (South American Leaf Blight) caused by the ascomycete *Microcyclus ulei*. The lesion size and the production of spores of the pathogen were significantly lowered in VAM inoculated plants, whereas the number of lesions remained unchanged. This suggests that the resistance response of the plant is significantly influenced by VAM treatment and demonstrates that enhanced resistance is not due to inhibition of penetration or early growing phases of the pathogen but to the modification of late resistance responses.
The data presented here unequivocally show that the VAM-association causes physiological changes relevant to the resistance reactions in the leaves, even when no macroscopic modification of the plant can be seen.
The enhancement of the resistance of the plant along with the reduction of the pathogens spore production, here caused by a VAM-fungus, is an important epidemiological factor for the control of the South American Leaf Blight in rubber plantations of Brazil. The combination of VAM-inoculum with well designed plant management measures, crown budding, mixed cropping and the use of hyperparasites can lead to a complex system of integrated plant protection in Brazilian rubber cultivation.

1201 92 - 10/128

Plant protection
Asia, India, study, glasshouse, rice, leaf extracts, fungal pathogens

TEWARI, S.N. and M. NAYAK

ACTIVITY OF FOUR PLANT LEAF EXTRACTS AGAINST THREE FUNGAL PATHOGENS OF RICE.

Trop. Agric. (Trinidad), 68, 4, 1991, pp. 373-375

With a view to countering obvious pollution problems in the environment and avoiding the toxic effects of synthetic chemicals on non-target organisms, investigations on exploiting pesticides of plant origin are becoming increasingly important in the field of plant pathology.
Fresh leaves of *P. betle*, *O. sanctum*, *N. arbor-tristis* and *C. limon* were collected, washed thoroughly in tap water and sterile distilled water, oven dried at 45 ± 2°C and ground to obtain 1 kg dry powder from each. Each powder was extracted with 95% ethanol and concentrated through a rotary vacuum pump flash-evaporator to a syrupy form weighing 130 g from each powder.
The plants were selected for the present study to screen against the major fungal pathogens of rice in vitro and in vivo.
The leaf extracts were effective in reducing the radial in vitro growth was found to be the best, followed of the pathogens and in checking the spread of blast, brown spot and sheath blight diseases of rice in vivo. Though the leaf extracts from the other two plant species tested (*N. arbor-tristis* and *C. limon*) reduced the radial growth of the pathogens in vitro at a higher concentration, they failed to check their spread effectively in the glasshouse. *P. betle* and *O. sanctum* could be used as source of a pesticide of plant origin to combat the above three pathogens of rice in the field.
This is the first record for the control of three rice diseases in vivo using *P. betle* or *O. sanctum* leaf extracts.
Much of the plant kingdom still remains unexplored for possible exploitation against major fungal pathogens.

1202 92 - 10/129

Plant protection
Study, cassava, pathogens, biocontrol, CIAT

LOZANO, J.C.

A USEFUL APPROACH TO THE BIOCONTROL OF CASSAVA PATHOGENS.

In: Proc. of a Workshop for Integrated Pest Management of Root and Tuber Crops in the Tropics; IITA, Ibadan, Nigeria; Eds. Hahn and Caveness; 1987, pp. 86-94

This paper summarizes the research results obtained during the past 12 years on cassava pathogens, with emphasis on the use of fluorescent pseudomonads as biocontrol agents in different cassava production systems.
Investigations on biocontrol of crop diseases are increasing and are being seriously considered in many plant pathology programs around the world.
Research on the biocontrol of cassava pathogens was initiated at CIAT in 1975. Preliminary results are very encouraging, suggesting a useful, practical tool for controlling several pathological problems of cassava.
Darluca filum reduces disease severity and economic losses caused by *Uromyces* spp., a rust pathogen. Spray treatments with suspensions of *Pseudomonas putida* and *P. fluorescens* have reduced both number of angular leaf spots and leaf blights on susceptible cassava clones, and increased yields 2.7 times over untreated controls. Similar control treatments protected cassava cuttings against *Diplodia manihotis* and roots against postharvest root rot for 15 days in storage.
More investigation is needed into the practical storage of strains of fluorescent pseudomonads and into the distribution and multiplication of inoculum. Effective strains of these beneficial bacteria are available, and the methodology for their identification is known. Inoculating cuttings with bacteria is feasible in special situations, such as planting fields for material production, in order to control pathogens infesting the cuttings, and to protect against pathogens in infested soils. This technology may not be useful in traditional cassava production systems because the treatment requires technical work and aseptic handling during the production of the inoculum. Further research is also needed on the use of beneficial bacterial suspensions to treat cassava roots before storage in order to identify effective strains and develop treatment systems, giving levels of control similar to those obtained with thiabedazole. A likely development in the near future will be the use of growth-stimulating strains of fluorescent pseudomonads to treat both cuttings or plantlets before planting, for the promotion of root system growth.

1203 92 - 10/130

Plant protection
Africa, Egypt, study, faba bean, *Orobanche*, trap crop, flax

KHALAF, K.A.

EVALUATION OF THE BIOLOGICAL ACTIVITY OF FLAX AS A TRAP CROP AGAINST *OROBANCHE* PARASITISM OF *VICIA FABA*.

Trop. Agric. (Trinidad), 69, 1, 1992, pp. 35-38

The objective of the present work was to study the efficiency of flax as a trap crop in reducing *Orobanche* infestation on *Vicia faba* and the growth stages at which the stimulating germination factor was found in flax.
Crop species which stimulate germination in the seeds of parasitic plants, but are not themselves parasitized, are known as trap crops. In this respect, many investigations have reported that flax, a non-host, is regarded as a crop well suited for the control of *Orobanche* parasitism under field conditions because it is capable of including the seeds of *Orobanche* spp. to germinate, without itself being parasitized.
Three *Orobanche* species, *O. crenata*, *O. ramosa* and *O. aegytiaca*, failed to infect flax roots (*Linum usitatissimum*) at 30, 45 and 60 days from sowing, but heavy infection was observed with *O. crenata* on faba bean roots (*Vicia faba*) at 45 and 60 days from sowing. Flax seed exudates markedly induced the germination of *O. crenata* and *O. ramosa* in vitro; germination in *O. crenata* was much higher (75%) than in *O. ramosa* (16.6%).
The present work indicates that a stimulant exists in the flax crop non-host at the germination stage only (the first eight days after sowing). Flax roots free of infection by the three *Orobanche* spp. (*O. crenata*, *O. ramosa* and *O. aegyptiaca*) might be associated with the absence of the active material during the later course of the plant development, or with its fibre root anatomy.
The important views emerging from the present study are that the flax germination stimulus is formed during metabolic seed germination, and is characterized by possessing a broad spectrum of germination activity on numerous parasitic weeds and/or the flax exudates might contain more than one stimulant which differed in their biological response.
Ultimately, such response might support the view that although the flax plants showed a substantial influence in stimulating different parasitic seeds (*Orobanche* spp. and *Striga* spp.) in vitro, the flax plants have limited influence in reducing these parasitic weeds under field conditions, since the flax plants secrete the active material in a very limited period (germination stage).
Concluding, flax plants being used as a trap crop for controlling *Orobanche* parasitism on faba bean and other hosts must be considered impractical to a large extent under field conditions, since the flax plant exudate the active material only during the germination period.

1204 92 - 10/131

Plant protection
Review, book, insect pest management, integrated pest management, research, monitoring, forecasting, yield loss assessment, insecticides, application methods, economics, agronomic practices, host plant resistance, natural enemies, biological control, quarantine

DENT, D.

INSECT PEST MANAGEMENT.

CAB International, Wallingford Oxon OX10 8DE, UK, ISBN 0-851-98-66-8, 1991, 604 pp.

Pest control is probably the single most important factor in maintaining yield in modern farming practice. Pest problems may arise from any number of reasons, such as the adoption of a new farming technique, irrigation, cultivation of a new crop or even insecticide resistance or secondary pest outbreaks. The fact that crops come under attack from so many different types of pest is an additional problem that farmers and pest management specialists have to cope with.
Insect pest management focuses on dealing with insects only, but still recognizes that this is one of many groups of pests that have to be controlled. The book starts with an introduction to Integrated Pest Management (IPM), looking at social and economic factors, as well as research, monitoring and forecasting, yield loss assessment and all forms of control. There is detailed information about a range of insecticides, methodes of application, economic viability, ease of use, targeting and safety.
Cultural controls which need no external input, such as crop rotation, tillage practices and planting date, are examined in detail and shown to be worthwhile practices, as long as they are executed correctly and not relied on too heavily as the sole means of pest control. There are chapters on host plant resistance, natural enemies and classical biological control, interference und quarantine. The final part of the book examines how these techniques can be integrated into an insect pest management programme.
Designed to serve as a textbook, this book provides in-depth coverage of crop protection and applied entomology. Emphasis is placed throughout on the need for socio-economic evaluation of integrated pest management techniques, and detailed examples are taken from both temperate and tropical regions.
This is an useful book for all those working in plant production in general and crop protection in particular.

1205 92 - 10/132

Plant protection
Review, pest management, agricultural development, economics

REICHELDERFER, K.H.

ECONOMIC CONTRIBUTIONS OF PEST MANAGEMENT TO AGRICULTURAL DEVELOPMENT.

Tropical Pest Management, 35, (3), 1989, pp. 248-251

This article focuses on the contribution of pest control inputs and pest management skills to the transformation of traditional agriculture. The topic is covered in a general manner because little empirical evidence is available for use in providing specific illustrations of general relationships.
Increased use of pesticides in developing economies has been associated with an increased incidence of acute pesticide poisonings and potential for chronic health effects, as well as contamination of food and water supplies. These adverse impacts of pesticide use can become a constraint to agricultural development.
Acute and chronic health effects reduce the productivity of the agricultural labour force, thus limiting labour's contribution to agricultural development. High exposure rates to toxic chemicals by the population at large may also reduce the productivity of the urban labour force and limit economic growth. Environmental contamination can reduce the productivity of land - the most basic of production inputs. Management strategies which lead to the development of pesticide resistance depreciate the value of the crop protection input itself.
Agricultural development and environmental quality are not necessarily incompatible. Protection of the human and natural resource bases is a prerequisite for sustainable growth and development. The principal factor determining whether development efforts lead to environmental degradation or conservation is the focus of agricultural policies and programs.
Access to material inputs, such as pesticides, cannot foster growth and development. Concurrent attention to the development of pesticide safety and pest management skills is required to prevent these inputs from becoming limiting factors for economic growth.
Ideally, the production protection, safety, and environmental aspects of pest control should be simultaneously addressed at early stages of agricultural development. This can only be achieved by increasing farmers' awareness and understanding of the pest control opportunities afforded them, while implementing policies and programs that preclude a unilateral approach to crop production, protection, or environmental quality.

1206 92 - 10/133

Plant protection
Latin America, Colombia, integrated plant protection, intercropping, predator, cassava whitefly

GOLD, D.S. and M.A. ALTIERI

THE EFFECTS OF INTERCROPPING AND MIXED VARIETIES OF PREDATORS AND PARASITOIDS OF CASSAVA WHITEFLIES (HEMIPTERA: ALEYRODIDAE) IN COLOMBIA.

Bull. ent. Res., 79, 1989, pp. 115-121

In this paper, the responses of natural enemies of cassava whiteflies to different cropping systems and their role in bringing about reduced whitefly load in cassava intercropped with cowpea are reported.
In this regard, the effects of different cropping systems on the whitefly predator *Delphastus pusillus* (Le Conte) and on the combined action of the parasitoides *Amitus aleurodinus* Haldeman and *Eretmocerus aleyrodiphaga* (Risbec) are discussed.
The predator *D. pusillus* was low in numbers during the intercrop period and was significantly lower in cassava-cowpea plots than in other treatments for much of the trial. Correlation analysis of predators and prey indicated that the beetles displayed a functional response. *D. pusillus* was abundant for many months but was unable to control whitefly populations. Ratios of whiteflies to predators coupled with information on prey consumption suggest that predators played only a minor role in whitefly population dynamics. Bettle arrival in the field lagged behind that of the whiteflies, and the highest populations of *D. pusillus* were in the final month of the trial, reflecting a lack of synchronicity between predator and prey.
D. pusillus attacks a range of whitefly species, but within the systems employed in this study it can be considered a relative specialist because neither cowpea nor maize provided alternative hosts. *D. pusillus* was never observed on the associated crops, suggesting that they did not provide nectar or pollen to this bettle. However, the presence of cowpea and maize intercrops may have enhanced the activity of this predator. A functional response strongly suggested by beetle distribution in the postintercrop period was not in evidence when intercrops were in the field, and predator: prey ratios were highest in cassava-cowpea systems at this time.
Parasitism of *A. socialis* was a far more important mortality factor than predation. The role of parasitism in this species was even more important on CMC 40, where predator populations were very low, than on MCOL 2257. Rates of combined parasitism of *A. socialis* by *Amitus aleurodinus* and E. *aleyrodiphaga* were equal between treatments. Overall mortality of the pupal stage was also similar across cropping systems. Parasitism of *T. variabilis* was negligible, and for this whitefly *D. pusillus* was the most important natural enemy.

Intercropping cassava with cowpea reduced populations of the cassava whiteflies *Aleurotrachelus socialis* and *T. variabilis*. The effect of the intercrop was residual, with lower populations persisting for six months after cowpea harvest. However, predators were opportunistic, with higher populations correlated with greater numbers of prey in monocultures. Parasitism levels were independent of cropping system. Therefore, the natural enemies hypothesis can be rejected in explaining the lower populations of whiteflies found on intercropped cassava. Furthermore, the residual effect of the cowpea intercrop on whitefly populations cannot be explained by a build-up of natural enemies in this system during the intercrop period.
A. socialis and *T. variabilis* larvae suffered substantial mortality in addition to the effects of predators.
Differences in whitefly populations in various cropping systems, including residual effects, cannot be attributed to mortality factors.
In this regard, the effects of different cropping systems on the whitefly predator *Delphastus pusillus* (Le Conte) and on the combined action of the parasitoids *Amitus aleurodinus* Haldeman and *Eretmocerus aleyrodiphaga* (Risbec) are discussed.

1207 92 - 10/134

Plant protection
Africa, Nigeria, study, rain forest belt, lowlands, root crops, diseases, integrated pest management, traditional methods, agronomic practices, IITA

ODURO, K.A. et al.

PROSPECTS FOR TRADITIONAL AND CULTURAL PRACTICES IN INTEGRATED PEST MANAGEMENT OF SOME ROOT CROP DISEASES IN RIVERS STATE, NIGERIA.

In: Proc. of a Workshop for Integrated Pest Management of Root and Tuber Crops in the Tropics; IITA, Ibadan, Nigeria, 1987, pp. 185-187

In this paper evaluation was made of the role of traditional and cultural practices in controlling yam storage rot and cassava stem cutting rot in the soil in Rivers State.
Rivers State lies in the lowland rain forest belt of south-eastern Nigeria. The environment also creates favorable conditions for the development and spread of numerous plant pathogens.
Healthy, fairly uniformly-sized and newly harvested whole yam (*Dioscorea rotundata* var. Gboko) and palm oil were purchased from the local markets. Five of the yams were cut transversely into ten equal halves. Each of the ten cut surfaces was thoroughly smeared with 5 ml unsterilized palm oil and kept in an upright position for about 60 min to prevent the oil from dripping. To serve as the control, the remaining five tubers were similarly cut but the surfaces were left untreated. They were also held in a vertical position for 60 min.
All the tubers were later randomly spaced horizontally inside a wire-netted wooden box in the laboratory for protection against cockroaches and rodent attack. Observations were made of biodeterioration in the yam samples and at the end of 10 weeks each half-tuber was cut vertically into two to measure the depth of rotting.
Yam tubers which were treated with unsterilized palm oil resulted in less rotting by supporting fewer pathogens and by preventing formation of cracks which could serve as entry points for pathogens. Thus palm oil apparently had properties which protected stored yam tubers from rot.
Concluding the traditional and cultural control of the root crop diseases discussed in this paper could be adopted to supplement other control measures in farms and stores. These methods are cheap and feasible and within reach of peasant farmers.

1208 92 - 10/135

Plant protection
Africa, Nigeria, IITA, survey, cowpea, farming practices, insect pest control

ALGHALI, A.M.

STUDIES ON COWPEA FARMING PRACTICES IN NIGERIA, WITH EMPHASIS ON INSECT PEST CONTROL.

Trop. Pest Management, 37, (1), 1991, pp. 71-74

This survey was undertaken to gain an insight into current farming practices for cowpea, and to understand farmers' perceptions of the impact of insects on cowpea production, thus facilitating the development of appropriate IPM strategies that would be economic, efficient and feasible.
Cowpea was grown on smallholdings, mostly as an intercrop. In the intercrop plots the proportion of cowpea was mostly below 50%; it was grown either for grain or fodder or both. Most of the grains were for household consumption and the small excess sold in the market. Cowpea haulm was used as fodder for feeding animals and livestock. This would suggest that cowpea as currently grown is a secondary crop requiring low inputs.
There is a large deficit for cowpea grains, particularly in southern Nigeria where it is an important component of human diets. This deficit is offset by imports from the north, and from neighbouring countries such as Chad, Cameroun and Niger. Cowpea can be grown throughout Nigeria, and the potential for increasing yields on farmers' fields is enormous. A major constraint limiting grain yields was identified by the farmers as insect pests. But the farmers were incapable of taking positive action against the pests for various reasons. These included lack of capital to purchase costly inputs, access to improved seeds with some levels of resistance to insect pests, and lack of education on pest problems and control measures. Therefore, a rational pest control approach should be integrative and include:
- educating the farmers about available control tactics;
- identifying and developing IPM strategies that are low cost;
- creating an awareness in regional administrations of the necessity for IPM inputs to be readily available and affordable.
Most of the farmers interviewed planted their cowpea as intercrops with other food crops. The majority of farmers were unaware of the beneficial implications this may have for insect pest management. If cowpea production remains at subsistence level, with low inputs, farmers should be encouraged to continue with this cropping system, i.e. intercropping.
In Minjibirr, 80% of the farmers interviewed reported that cowpea was grown for fodder to feed cattle and livestock. In the Sudan savannah, with little and infrequent rainfail, vegetation for livestock feed is hard to get. The inhabitants in this area keep large herds of livestock and wander over long distances in search of feed during the dry periods. Therefore, fodder from crop

residues is very important for the inhabitants. The emphasis on fodder in this area is in conflict with IPM practices aimed at increasing grain production. Several workers have shown that cowpea plants become more vegetative as a result of insect attack in the early growth stages. Hence, more fodder is produced when the plants are damaged by insect pests. Therefore, in breeding cowpea cultivars for this area, emphasis should be on dual purpose for both grains and fodder, and pest control strategies should focus less on reducing direct insect damage. The focus should be on selecting cultivars with ability to compensate vegetatively for damage, and also translate some of their compensatory vegetation into grain yields, thus providing moderate fodder and grain yields. The farmers' preference for early-maturing cowpea in this area minimizes crop hazards resulting from the sparse and erratic rainfall.

1209 92 - 10/136

Plant protection
Africa, Senegal, field trial, pearl millet, insect pests, fertilizer, FAO, USAID, CILSS

GAHUKAR, R.T.

EFFECT OF VARIOUS FERTILIZERS AND RATES ON INSECT PEST/PEARL MILLET RELATIONSHIP IN SENEGAL.

Trop. Agric. (Trinidad), 69, 2, 1992, pp. 149-152

The work described in this paper was done in Senegal to study the relationship between infestation of stalk borer and spike worm and fertilizer application in traditional and improved pearl millet cultivars.
At present, economical and practical control measures are not available. Studies on the effectiveness and uses of cultural practices, resistant cultivars and natural enemies had been initiated. Among agronomic practices, application of chemical fertilizer is often used on high-yielding cultivars.
Experiments were conducted on a sandy-loam soil in a randomized block design with four replicates.
Application of complete fertilizer at 50-300 kg ha^{-1} to two pearl millet cultivars, Souna and IBV-8001, or urea at 50-200 kg ha^{-1} to cv. Souna, resulted in significantly increased levels of stalk infestation and larval abundance of the stalk borer, but superphosphate when applied at 50-200 kg ha^{-1} reduced stalk infestation. Urea applications reduced spike infestation caused by the spike worm, and larval numbers were lower in plots receiving urea or superphosphate than in non-fertilized plots.
Stalk borer incidence was greatest in plots receiving nitrogenous or complete fertilizer which may have caused the stalks to be more liable to attack.
Urea fertilization resulted in less spike damage and lower abundance of *H. albipunctella* larvae and superphosphate reduced only larval densities.
In Senegal, the pearl millet crop is systematically rotated with groundnut in some regions and nitrogenous fertilizer is generally not applied to the next crop after the legume. Application of complete or nitrogenous fertilizer may be avoided in southern regions where stalk borer attack is often severe, whereas these fertilizers would be advantageous in central and northern Senegal because spike worm is an economically important pest. At present, fertilizers are supplied by Government at subsidized prices or free of cost to farmers. The cost should be an important consideration in forthcoming recommendations because pearl millet is a subsistence crop in the Sahel. Thus, the influence of fertilizer application on insect abundance and plant damage should be considered in pest management strategies, particularly in improved/introduced high-yielding cultivars which are being tested in multilocational trials prior to their release to growers.

1210 92 - 10/137

Plant protection
Asia, India, study, survey, intercropping, agroforestry, oil palm, insect pests

DHILEEPAN, K.

INSECT PESTS OF INTERCROPS AND THEIR POTENTIAL TO INFEST OIL PALM IN AN OIL-PALM-BASED AGROFORESTRY SYSTEM IN INDIA.

Trop. Pest Management, 37, 1991, pp. 57-58

In the present study insect pests of various intercrops in the oil-palm-based agroforestry system were surveyed and their potential to infest oil palm was assessed.
The oil palm is usually grown as a monocrop. In small oil palm holdings the available wide interspace (9 m x 9 m) is used for interplanting of various shade-loving food crops. Similarly, interplanting of perennial crops such as cacao, coffee and rubber with oil palm has also been attempted. Intercropping of various forest trees such as Albizzia, Eucalyptus, Casuarina and Australian black wood, as well as cacao with oil palm in an oil-palm-based agroforestry system, was initiated.
The major problem in growing intercrops with oil palm is that they are susceptible to attack by a wide range of insect pests. There should be no risk of an intercrop pest attacking the oil palm and developing into a problem.
An on-going oil-palm-based agroforestry trial was surveyed at monthly intervals between 1985 and 1988, and the insect pests of intercrops as well as oil palm were recorded.
Among the seven species of crops grown as intercrops with oil palm, no pest incidence was noticed on Eucalyptus and Australian black wood. Pest incidence was noticed in all the other intercrops, and the attack was f.e. greater in cacao and Albizzia. In Casuarina the incidence of insect pests was occasional and less severe.
Insect pests of intercrops such as Albizzia and Casuarina are host-specific and do not infest oil palm.
Among the seven species of intercrops only cacao shared a common pest complex with oil palm.

1211 92 - 10/138

Plant protection
Asia, Philippines, IRRI, rice, weather, forecasting, insect pest outbreaks

PERFECT, T.J.

USING WEATHER DATA TO FORECAST INSECT PEST OUTBREAKS.

In: Proceed. of the Int. Workshop on the Impact of Weather Parameters on Growth and Yield of Rice, IRRI, Philippines, 1987, pp. 139-146

In this paper it is examined how weather influences the bionomics of migrant pests and the application of this examination to forecasting outbreaks is discussed. The situation for rice pests is considered, particularly the application of weather data to forecasting outbreaks of brown planthopper.
The development of forecasting systems to manage outbreaks of migrant pests is becoming increasingly important. Such systems normally are based on integrating meteorological and entomological data into a conceptual model that relates the probability of occurrence of outbreaks to a particular series of events which can be monitored. The advantages of this approach to forecasting are both tactical and strategical: those concerned with pest control can plan ahead to ensure that appropriate resources and the means to deploy them effectively are available where and when they will be needed. A strategic advantage of major importance is the potential for limiting the spread of outbreaks through timely control of early infestations, reducing the production of further migrants.
The author states that there is great potential for using weather data to forecast outbreaks of insect pests, particularly because other ability to access and process information from remote-sensing systems is increasing rapidly.
It appears that weather parameters are a critical factor in outbreak development, and thus a good predictor, only in situations where they represent a population-limiting factor. This is seen most frequently with temperature in the temperate zone and rainfall in the tropics.
In many situations, weather may play a very important part in determining the precise epidemiology of an outbreak, although it is not in itself a determinant of the outbreak. Rice leafhoppers and planthoppers and the virus diseases they transmit are an example.
The study of weather systems against the background of the ecology, behavior, and physiology of the insect pest and the distribution of the host plant can lead to improved predictions of dispersal patterns. This type of information can be of value in developing appropriate management strategies. The development of computer-based migration and population models for particular insects will be important in exploiting that forecasting potential.

1212 92 - 10/139

Plant protection
Africa, Kenya, insect pest management, survey, sorghum, maize, cowpea, crop borer, intercropping, agronomical practices, plant resistance, biological control farmer, socio-economic conditions

SAXENA, K.N. et al.

INSECT PEST MANAGEMENT AND SOCIO-ECONOMIC CIRCUMSTANCES OF SMALL-SCALE FARMERS FOR FOOD CROP PRODUCTION IN WESTERN KENYA: A CASE STUDY.

Insect Sci. Applic., 10, 4, 1989, pp. 443-462

The survey reported here involved interviews with 150 farmers in Western Kenya and was based on a questionnaire which comprised six sections. Five sections covered the farmers' background, farming practices, pest problems and their control, socio-economic conditions, and accessibility/willingness of the farmers to participate in the project. The last section included field observations on the insect pests of sorghum, maize and cowpea.
On the basis of the information obtained on above-mentioned aspects, criteria were defined for selecting 25 farmers in each division for on-farm trials.
Concluding, the following measures that need to be taken to counter the limitations and thereby assist the farmers in increasing food production can be recommended:
- Cultural practices like early planting, intercropping of appropriate crop combinations and destruction of crop residues help to suppress borer attack.
- Destruction of crop residues, though practised by some farmers, is not practised by the others, either because they are not aware of the advantage for pest control or because they use the crop residues in other ways. It is, therefore, important that the farmers in the project area are fully informed about the benefit of proper disposal of crop residues.
- Growing cultivars resistant or tolerant to pests is another important and widely accepted component of insect pest management. But most of the cultivars in use have little resistance to the borers. There is an urgent need to make the farmers fully aware of the existence of resistant cultivars and to provide seed for cultivation.
- Pesticides are hardly used by most farmers in the project area. In view of their hazardous effects, and the dangers of misuse due to poor information, their use by the farmers should be discouraged.

1213 92 - 10/140

Plant protection
Latin America, Mexico, study, semi-arid zone, highlands, agroecosystems, rodent communities

MELLINK, E.

RODENT COMMUNITIES ASSOCIATED WITH THREE TRADITIONAL AGROECOSYSTEMS IN THE SAN LUIS POTOSI PLATEAU, MEXICO.

Agriculture, Ecosystems and Environment, 33, 1991, pp. 363-375

This paper analyzes the rodent richness and abundance of the farmed and unfarmed areas of three agroecosystems in the San Luis Potosi Plateau, Mexico.
Increases in weed cover are generally associated with increases in rodent richness. Farms with weedy vegetation between buildings were found to hold larger and more diverse rodent populations than clean farms.
The variation in the rodent communities of agroecosystems is due to the structural differences of the latter. Understanding the relationship between the characteristics of the agrohabitats and the rodent communities should be useful for developing new principles of environmental management which must be the basis of new methods of rodent pest regulation.
The following conclusions can be drawn from this study:
- The simple agroecosystems had fewer species than their unfarmed counterparts, in contrast with the most diverse agroecosystem where no impoverishment occured. Only the simple system with abundant resources was subject to a population outbreak. This supports the hypotheses of structural heterogeneity-diversity and diversity-stability. The adoption of diverse agroecosystems might help to reduce rodent pest outbreaks.
- There was no clear edge effect. The edge was richer only when it included the structurally diverse agroecosystem and the very contrasting unfarmed area. Otherwise, it could be different only in numbers, due to a particular habitat found in the edge, but not as a result of the farming operation.
- The croplands had distinct rodent faunas, but although they tended to be more similar to each other than their unfarmed counterparts. No exclusive "farmland species" could be defined.
- Changes in the rodent communities could only be explained by a combination of multiple factors whose changes were a result of the rainfall pattern.

1214 92 - 10/141

Plant protection
Review, book, Africa, Zimbabwe, survey, grain storage losses, strategies, traditional methods

KETERERE, M. and D. GIGA

GRAIN STORAGE LOSSES IN ZIMBABWE.

ENDA, P.O.B. 3370, Dakar, Senegal, ISBN 0850-8526, 1991, 101 pp.

Within any rural region, the daily demand for food changes very little during any given year, but the food supply is seasonal and is very uneven on a month-to-month basis. Among other solutions, such as local food imports, storage is an important means of trying to match the uneven supply of food to demand. In areas where transport is poorly developed, storage is even more important.
The two strategies usually selected for coping with present and future demands of food are increasing food supplies by increasing production through allocation of more resources to agriculture, and reducing future demand by slowing population growth. A third, and complementary strategy, is that of reducing and preventing post-production food losses by improving the efficiency of storage. Reducing food losses means that less of the rural families' disposable income need be spent on food imports.
This book is the outcome of a survey of traditional farmers' grain storage in that country. It looks at methods of measuring damage during storage as well as measuring its reduction by improving storage facilities which nevertheless remain as close as possible to the traditional granary model. Results showed that farmers store maize for shorter periods because of high losses experienced as the storage period increases. The level of losses was also related to the type of grain being stored. Traditional maize varieties are more resistant to pest attack than hybrids and traditional storage structures were designed for traditional varieties. There is no point in encouraging farmers to grow improved, hybrid varieties in order to increase yields, if the extra yield is rapidly lost in storage.
The book ends with a number of recommendations, details of an improved traditional granary, and appendices which set out percentage damage against time after a variety of treatments.
Abstract from SPORE, altered.

1215 92 - 10/142

Plant protection
Review, USA, California, weed control, row crop systems, vegetable, flower

LEAP, J.

CONTROLLING WEEDS WITHOUT CHEMICALS.

The Cultivar, 9, No. 2, 1991. pp. 1-3

Herbicides make up 69% of the 700 million pounds of pesticides applied each year in the U.S. Thus, finding alternative methods for controlling weeds is critical to decreasing the use of synthetic chemicals in farming systems.
Weeds can be controlled in small-scale vegetable row crop systems without the use of herbicides and with a minimum of hand hoeing by using an integrated approach. This includes well-managed ground preparation and planting techniques, and timely cultivations. Planting and cultivation techniques that large-scale growers have used successfully for many years can be easily adapted to small- and medium-scale systems for effective weed control.
Small-scale vegetable growers - especially those who are producing for direct-market, roadside, or specialty markets - often must produce a variety of products over a period of time to maintain a customer base and maintain diversity.
One of the best ways to deal with multiple crops on a small scale is to develop a system where all crops are planted on the same row width. The same planting and cultivating units can then be used for all crops without a loss in time due to change-over. A common technique, which can be traced back to the horse cultivar, is to plant cultivate on a single line per bed with beds spaced 30 to 38 inches center to center. This technique allows for the greatest crop diversity and ease of mechanical weed management in a ridge-tilled system. If beds are formed, pre-irrigated and then cultivated prior to planting, weed pressure can be minimized and planting and cultivation simplified.
Vegetable crops most suited to between-row spacings of 30 to 38 inches include sweet corn, beans, potatoes, peppers, broccoli, cauliflower and cabbage. With the proper planting equipment, sweet corn, beans and peas can be easily direct-seeded to moisture by knocking down the beds at planting time (this entails pushing dirt off of the top of the bed to reach moist soil; seeds planted into moist soil don't require irrigation for germination). Peppers, tomatoes and the brassicas mentioned above are ideally suited to transplanting, provided quality transplants are used. Tomatoes, which require a wider spacing, can be grown on every other bed and the same cultivation equipment used. If perennial weeds are not a serious problem, and with proper management, these crops can all be produced in a relatively weed-free system with minimal hand labour and no herbicides.
One of the most effective tools for post-irrigation bed preparation and post-emergence crop cultivation in a ridge-tilled

system is the ground-driven rotary cultivator, also known as a lilliston cultivator. For the initial cultivation, while the crop is still small, reversed disc-hillers can be used to cut soil away from the plants, and sweeps and knives can be used to cut weeds off just below the soil surface. Timing in terms of weed size and soil moisture are critical at this stage for optimum weed suppression: ideally, weeds should be small and the soil dry enough to that weeds don't re-germinate, but moist enough to avoid crusting.
The following practices are the most important factors to include in a non-chemical weed control strategy:
- Allow an initial fallow period with repeated discing during summer months to bring perennial weed populations to manageable levels.
- Rotate cool-season and warm-season crops and rotate crops that compete well with weeds and those that are poor competitors.
- Prevent annual weed seed maturation in and around fields.
- Pre-irrigate after bedding-up to germinate weed seeds prior to planting.
- Carry out timely shallow cultivations to destroy weed seedlings during and after emergence.
- Plant to moisture to allow crops to get a jump on weeds.
- Transplant where practical to get a jump on weeds.
- Manage irrigation effectively.

By adhering to and integrating the above-mentioned agronomic practices, and by using rotary ground-driven cultivators in a single-line system, weeds in vegetable crops can be controlled effectively and economically without the use of herbicides.

1216 92 - 10/143

Plant protection
Review, book, weed management, ecological approaches

ALTIERI, M.A. and M. LIEBMANN

WEED MANAGEMENT IN AGROECOSYSTEMS: ECOLOGICAL APPROACHES.

CRC Press, USA, 1988, 354 pp. 15 pp. index

In this book nineteen authors explore many aspects of weed control without toxic herbicides. Altieri's usual comprehensive grasp notes not only impact of weeds, but also their uses and roles. Detailed description of weed physiology tied to ecological notations comes next. Seed data: seed banks, viability, loss, sources, germination, density, timing are all tied to individually important seeds. How do weeds get here? What makes some so invasive? What kinds of environments trigger or spread them? What natural enemies do they have?
Genetics are the basis on how weeds adapt to their environment. Allelopathy makes a strong impact; many weeds utilize this trait, but the trait may be turned against them, too. Techniques for this are discussed.
Consider environmental factors. What does water do, or light, or availability of nutrients? Then there are indirect effects of light, temperature, evaporating moisture, changes in nutrients, allelopathy interactions, changes in soil microorganisms.
Vegetation can be analyzed, so one can see that there is a set pattern of change in plants, and a choice of crops successions, rotations, harvesting equipment, drainage decisions, tilling times and depths.
Take a look at the farmer's point of view. Just how much damage comes from weeds? How can you lessen this? What techniques really work and where? Is there a way to get some good out of weeds?
What are the commercially available biological controls? Many are not yet on the market, or are still being studied. Insect response is another item; it is not always true that a diversified ecosystems has fewer pests. A pest may need 2 hosts, so a weed is not always to blame, nor the primary host. You may be thankful for some weeds that house natural enemies.
The last chapters concentrate on organic methods of weed control, special strategies for small scale farming and general guidelines.
This book is crowded with valuable hints.
This is a book one must have.
Abstract by Bargyla Reteaver.

1217 92 - 10/144

Plant protection
Review, book, post-harvest grain losses, GTZ

GWINNER, J. et al.

MANUAL ON THE PREVENTION OF POST-HARVEST GRAIN LOSSES.

Publ. of GTZ, Postf. 5180, D-6232 Eschborn 1, Germany, 1990, 294 pp.

The knowledge and experience accumulated in over a decade of advisory work by the GTZ Post-Harvest Project has now been collected and summarized in a new handbook, 'Manual on the prevention of post-harvest grain losses'. This has been written to provide practical instruction and assistance to storekeepers, plant protection technicians, agricultural extension and quarantine staff and all those who are concerned with storage problems in their daily work. Particular attention has been paid to the storage of cereals and legumes. Throughout the book, simple, low-cost facilities and storage methods have been described, appropriate to the requirements of developing countries.
In recent decades significant changes have taken place as a result of increased crop yields, the cultivation of new varieties that are often more susceptible to attack by storage pests than traditional ones, and the spread of new pests. These changes have diminished the effectiveness of established storage systems and there is now a need to adapt traditional practices and develop new alternatives. This handbook provides a practical link between old and new ideas.
The effects on stored produce of different climatic conditions, such as temperature and relative humidity, are explained. Farm and village level storage containers and buildings are described and illustrated as well as the construction of larger, centralized storage and stacking systems. There are details of the fungi and insects which damage stored crops, together with methods of control by insecticides, fumigation and integrated pest management techniques. Particular attention is given throughout to the safety measures which must be taken when using chemicals. The manual ends by addressing the problems of dealing with larger pests, such as rats.

1218 92 - 10/145

Plant protection
Asia, India, field trials, weed management systems, manual, chemical, biological, pigeonpea, economics, sole crop, intercropping

MADHIYAZHAGAN, R.

EVALUATION OF EFFICIENT WEED MANAGEMENT SYSTEMS IN PIGEONPEA (*CAJANUS CAJAN* L.)

J. Agronomy & Crop Science, 168, 1992, pp. 65-68

An investigation was undertaken to evolve effective and economic weed management practices for the sole and for intercropping systems involving pigeonpea. Field experiments were conducted to evaluate the different systems of weed management in pigeonpea.
Treatments consisted of three weed management systems namely manual (hand hoeing twice at 20 and 40 DAS) chemicals (fluchloralin, pendimethalin and oxadiazon) supplemented with one hand hoeing and biological (growing inter crops) combined with one hoeing along with unweeded check numbering twelve treatments replicated four times in randomized block design.
The results clearly show that the unweeded check plots recorded the highest total weed population of 132 and 165 m^{-2} respectively. At the early stages of observations there was significant reduction in weed population over unweeded check under the treatments receiving herbicides. The manual method of weed control was consistently weed free throughout the crop period. Among the three herbicides pendimethalin 0.50 kg ai ha^{-1} was superior to fluchloralin and oxadiazon in reducing the total weed population. Intercropping combined with one hand hoeing significantly reduced the weed population over intercropping alone.
The results clearly indicate that the highest grain yield was recorded under herbicide treated plots over unweeded check.
The severe weed competition in the unweeded check was responsible for the low yield in pigeonpea. Manual weed control method is as effective as chemical methods. However, the herbicides are more effective in controlling the weeds at the early stages of the crop growth. Pre-emergence application of pendimethalin 0.50 kg ha^{-1} with hand hoeing registered the highest grain yield compared with other herbicides.
The highest net return of Rs. 6483 and Rs. 5231 was realised by the intercropping of pigeonpea coupled with one initial hoeing. Among the herbicides tested pendimethalin 0.50 kg ha^{-1} supplemented with one hand hoeing fetched the net return of Rs. 5024 and Rs. 4450 ha^{-1} during two seasons respectively.

1219 92 - 10/146

Plant protection
Latin America, Peru, humid tropics, study, weed management, cropping systems, low-input system, herbicides, mulches, shifting cultivation, forest clearing

PLEASANT, J.M.

WEED MANAGEMENT IN A LOW-INPUT CROPPING SYSTEM IN THE PERUVIAN AMAZON REGION.

Trop. Agric. (Trinidad), 69, 3, 1992, pp. 250-258

A weed-control study in a five-crop sequence (rice-rice-cowpea-rice-cowpea) following forest clearing in the Peruvian Amazon was carried out.
Previous work has established that continuous cropping systems in the Peruvian Amazon are viable alternatives to shifting cultivation if appropriate amounts of lime and fertilizers are supplied. Herbicides have provided effective but costly weed control in these intensively managed (high-input) systems.
Low input systems are based on acid-tolerant cultivars and rely on moderate amounts of fertilizers and careful recycling of crop residues to maintain soil fertility. But weed control in this management system poses special problems. Complete reliance on herbicides is unacceptable because of the cost, and hand labour is often unavailable.
Weed control in a low-input system must focus on cultural practices that increase the crop's ability to compete with weeds and thereby eliminate some of thecostly control measures needed to maintain yields.
The results of this study revealed that tilled plots had more weeds than untilled in the first crop but fewer in the fifth. Mulching residues had little weed-controlling effect, and crop yields were always higher when residues where incorporated. High planting density reduced weed levels and increased crop yields. Herbicides were as effective as hand weeding in controlling weeds, but herbicide costs sharply limit their use in low-input systems. Rice yields fell by 54-100% in the absence of weed control but were reduced by less than 30% for cowpea. Sedges comprised 84% of the weeds in the first crop following forest clearing, but grasses dominated (79%) in the fifth crop.
As has been shown in other environments a practical and effective weed-management programme for continuously cropped systems must combine cultural practices with chemical and manual methods of control. The observations suggest that a similar integration of control measures is needed during this transitional period that bridges the time-span between forested land and the cultivatable fields of a permanent agriculture.

1220 92 - 10/147

Plant protection
Latin America, Mexico, weed control methods, crop rotations, maize, bean, intercropping

CHAVEZ, C.M.

POBLACIONES, BIOMASA Y BANCO DE SEMILLAS DE ARVENSES EN CULTIVOS DE MAIZ *ZEA MAYS* L. Y FRIJOL *PHASEOLUS VULGARIS* L. EFECTO DE MÉTODOS DE CONTROL Y ROTACIONES.
(WEED POPULATION, BIOMASS, AND SEED BANK IN MAIZE AND BEAN CROPS. EFFECTS OF CONTROL METHODS AND CROP ROTATIONS).

Tesis Maestria, Chapingo, Mexico, Colegio de Postgraduados, 1987, 192 pp.

The changes in weed population and groups in maize, beans, and maize/beans in rotation were assessed for the 4th consecutive yr, using 3 weed control measures:
- chemical control (linuron plus alachlor) in beans and atrazione plus metolachlor in maize;
- mechanical control (hoeing), and
- unweeded check.

In 1982 and 1983, *Amaranthus hybridus* was the dominant species as to population and DM, but in 1984 and 1985 *Simsia amplexicaulis* dominated. In 1985 (the 4th yr), *S. amplexicaulis* and the group of *Gramineae* were the most abundant under chemical control and *Simsia* and *Chenopodium album* in the unweeded check. Total DM of these species at crop harvest accounted for approx. 87 percent of total weed DM. Under mechanical control, the most abundant species were *Galinsoga parviflora* and the group of *Gramineae*, represented by *Eleusine multiflora*, *Eragrostis mexicana* spp. *mexicana*, and *Cynodon dactylon*; the DM of the group accounted for approx. 35 percent of total weed DM. Parameters used to evaluate the structure of the group of *Gramineae* were species diversity and equity. Forty-four species (7 more than in previous yr) were recorded. Results of diversity and equity indicated that the structure of the group was unaltered by weed control methods, since greater diversity occured under mechanical control and less diversity in the unweeded check. The highest bean seed yield was registered under mechanical control. The highest maize yield was obtained in the rotational scheme, yield increase being attributed to the increased soil fertility resulting from soil-N fixation by beans planted in the previous cycle. The highest density and wt. of weeds was registered in beans; competition therefore affected this crop more than it affected maize. *Amaranthus* and *Chenopodium* were the most abundant species found in the soil of the seed bank. The correlation between the no. of seeds in the soil with the no. of seedlings that emerged indicated a correlation between *Eleusine* seeds in bean and maize plantings (P less than 0.01); a correlation was also found between *Simsia* seeds in bean crops (P less than 0.05), indicating that it is possible to predict the presence of weeds in these crops.

1221 92 - 10/148

Plant protection
Africa, Nigeria, study, weed control, cassava, maize, cowpea, melon, groundnut, intercropping

ZUOFA, K. et al.

EFFECTS OF GROUNDNUT, COWPEA AND MELON ON WEED CONTROL AND YIELDS OF INTERCROPPED CASSAVA AND MAIZE.

Field Crops Research, 28, 1992, pp. 309-314

The objective of this study was to examine the effectiveness of groundnut, cowpea and melon as smother crops in the control of weeds in a cassava/maize mixture.
The traditional method used by peasant farmers to control weeds is hoeing, using household labour since hiring labour is expensive. For such farmers, use of herbicides is hampered by high cost and non-availability of chemicals. It is therefore imperative to find alternative methods of weed control acceptable to them.
Groundnut, cowpea and melon could serve as smother crops, help to reduce erosion, improve yield of crops, enhance the nutritional status of the growers' diet and bring additional income. Their ability to suppress weeds depends on cultivar, plant density, rate of growth and establishment of canopy cover, competitive ability, and fertility and moisture status of the soil.
The experiment discussed here consisted of three crops (Groundnut cv. DS 569, Cowpea cv. Ife Brown, and Melon cv. Western Local), each grown at two populations (20,000 and 40,000 plants ha^{-1}) with cassava + maize intercrop together with controls of cassava + maize intercrop and sole crops of each species.
The results show that intercropping cassava and maize with 20,000 plants ha^{-1} of smother crops gave the best weed control, highest total yields and land equivalent ratio.
At the higher population, not only vegetative growth but also seed yields were reduced.
Of the three smother crops, groundnut gave the best weed control, followed by cowpea and melon, although the differences observed in the weed weight were not significant.
Yield of sole cassava was significantly higher than that of intercropped cassava in the early season. Generally, intercropping reduced yield of cassava with or without smother crops in both seasons. For maize, there was a general increase in intercrop yield over that of the sole crop when smother crops were included in the mixture in the late season. In the early season, maize yield increased only when 20,000 groundnut plants ha^{-1} were used as the smother crop.
Intercropping cassava and maize with smother crops improved the yields of both crops over when they were intercropped without smother crops. This was probably due to better weed control achieved by the presence of the smother crops.