

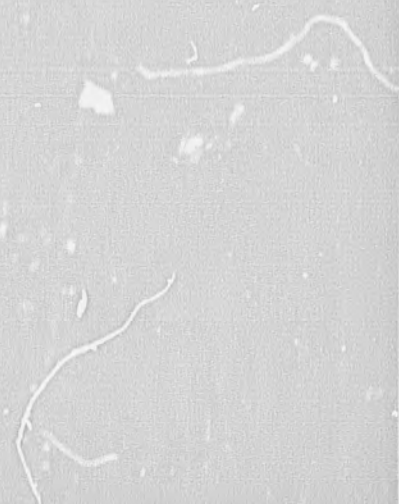
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**CHEMRAWN II**  
**Conference Handbook and Abstracts**



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PN- AAL- 952



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**CHEMRAWN II**  
**Conference Handbook and Abstracts**

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**International Conference on  
Chemistry and World Food Supplies:  
The New Frontiers**

December 6-10, 1982

Philippine International Convention Center  
Manila, Philippines



*Cosponsored by:*  
International Union of Pure and Applied Chemistry  
and  
International Rice Research Institute



**CHEMRAWN**  
**Chemical Research Applied to World Needs**

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# Contents

<b>Organization</b> .....	<b>ii</b>
<b>Messages</b>	
Bryant W. Rossiter .....	1
President Ferdinand E. Marcos .....	2
Imelda Romualdez Marcos .....	3
M. S. Swaminathan .....	4
Arturo R. Tanco, Jr. ....	5
Jesus T. Tanchanco .....	6
Emil Q. Javier .....	7
<b>Organizing Committee Members</b> .....	<b>9</b>
<b>Program Committee Members</b> .....	<b>9</b>
<b>Future Actions of Committee Members</b> .....	<b>10</b>
<b>Abstracts of Papers of Technical Sessions</b> .....	<b>11</b>
Plenary Sessions .....	12
Session A .....	14
Session B .....	18
Session C .....	22
Session D .....	27
Session E .....	31
Session F .....	35
Session G .....	39
<b>Abstracts of Papers of Poster Sessions</b> .....	<b>45</b>
Session A .....	46
Session B .....	74
Session C .....	104



## MESSAGE

Welcome to CHEMRAWN II. We are honored by your presence and trust that your participation in the "International Conference on Chemistry and World Food Supplies—The New Frontiers" will be of great value to you and those whom you serve.

CHEMRAWN II takes place within sight of the ever darkening clouds of world hunger and malnutrition. While wide-spread starvation has been alleviated in recent years, the growing need to feed a hungry world remains. Moreover, food related disasters strike suddenly and with little warning. A global interdependence on food means that two straight years of bad harvests in any one of the major grain-producing nations of the world could precipitate another food crisis like the one that occurred in 1972-74. Superimposed is a rapidly expanding world population. Given present population growth and trends, world population will expand to over 6 billion people by the end of the century. Eight of every ten persons will live in developing nations. Many will migrate to urban centers where food is not grown. Nearly 1500 cities of a million or more inhabitants will have to be supplied. In the next 40-50 years, world food production must again be increased by at least as much as was achieved from the dawn of agriculture 12,000 years ago.

The questions become emphatic: What areas of research and development have the greatest potential to significantly increase food production and improve food storage and processing? With limited time and resources, how do we clarify and prioritize goals? How do we improve communication, cooperation, and technological transfer? How do we unleash the full productive capacity of research, development, and educational and governmental organizations on a worldwide scale? The search for answers to these questions forms the purpose of our gathering.

The world food problem is one of enormous complexity involving many technical, political, environmental, and human issues. CHEMRAWN II cannot do everything, but we can do some things and this we are proceeding to do. I am confident that future generations will look back upon this meeting as a landmark event and that you, when asked about your participation, will state with pride—I was there.

A handwritten signature in cursive script that reads "Bryant W. Rossiter". The signature is written in black ink on a white background.

Bryant W. Rossiter  
Chairman, CHEMRAWN II



## MESSAGE

I am pleased to welcome the distinguished participants to the CHEMRAWN (Chemical Research Applied to World Needs: New Frontiers) II Conference.

This is an occasion not only for the warmest congratulations but also for a direct, courageous confrontation of the role that chemists, agricultural scientists, and food technologists must accept in the life of our nations, now being convulsed by change.

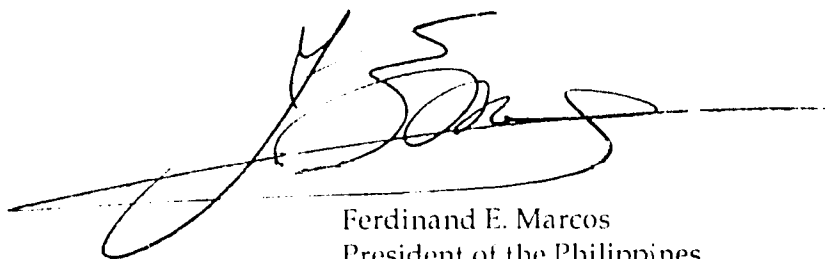
I am gratified by the information that the International Union of Pure and Applied Chemistry and the International Rice Research Institute have agreed to provide an independent, non-political, central forum for the discussion of critical needs and solutions relating to chemistry, agriculture, and food supplies.

But what strikes me most is the aptness and relevance of the Conference theme, "Chemistry and World Food Supplies—New Frontiers," to the challenging times. This commands the highest attention in our order of priorities in the context of the predictions made by demographers and economists that unless food production would be increased tremendously, there would be famine in the world.

This is the real challenge we have to face squarely.

And my hope is that, after careful reflection, we shall bring to the conference table a number of imperatives and recommendations having the potential to significantly increase food production and improve food storage and processing, strengthen scientific research in developing nations, and accelerate implementation of research priorities and objectives.

My best wishes for a pleasant and edifying sojourn in our land.



Ferdinand E. Marcos  
President of the Philippines



## MESSAGE

Food is one of the eleven basic needs of man, and with the burgeoning populations in the world the problem of adequate food and nutrition is a major global concern. The importance, therefore, of the International Conference on Chemistry and World Food Supplies – New Frontiers (CHEMRAWN II) cannot be overemphasized.

We commend the International Union of Pure and Applied Chemistry for its continuing efforts in identifying and addressing world needs and providing solutions through chemistry. As co-sponsor of this important conference, the International Rice Research Institute based in Los Baños, Philippines can perhaps share its expertise on how research and technology can be applied on other food products.

We are confident this forum for the discussion of critical needs and solutions relating to this chemistry, agriculture, and food supplies will make significant contributions on how to meet the mounting global food problems.

We extend our warm greetings and wish you a fruitful, successful conference.

A handwritten signature in black ink, reading "Imelda R. Marcos". The signature is fluid and cursive, with a long horizontal stroke at the end.

Imelda Romualdez Marcos





## MESSAGE

During the last 20 years, many countries in the tropics and subtropics have initiated programmes for the modernization of agriculture, including crop and animal husbandry, fisheries and forestry, through the spread of science-based technology. The impact has been striking. In the most densely populated countries of South Asia, the rate of gain in food production during the seventies has remained above the rate of growth in population. Rice production, for example, increased at over 3% per year between 1972 and 1979 in Bangladesh, Indonesia, South Korea, Pakistan, and Thailand and by over 5% in the Philippines. India has made striking advances in the production of food crops like wheat, rice, and potatoes. China, in spite of the limited area of arable land available for growing annual crops, has been able to feed a population of over a billion with very marginal imports. Burma and Sri-Lanka have also made good progress in recent years in improving rice production.

IRRI economists have estimated that between 1973 and 1978 in the nine countries—Burma, Bangladesh, India, Indonesia, Korea, Nepal, Pakistan, Thailand, and the Philippines—the use of modern varieties alone led to an additional production of about 15 to 20 million tons of rough rice, exclusive of complementary effects of fertilizer. The Asian farmer has shown that he will take to the new technology like fish to water, provided he is convinced that it will help to improve the economic well being of his family. No longer can the poor and often illiterate farmer be made the scapegoat for lack of agricultural progress.

While we should draw inspiration from the success of the agricultural development strategies of the Philippines and other Asian countries during the past decade, we should not become complacent and rest on our laurels. The efficiency of small farm management remains low and has led to a rise in the cost of production, which is inevitably followed by a rise in the prices of agricultural commodities. The improvement in productivity resulting from new technology has often not been adequate to offset the decreasing return to increasing labour input per hectare. Consequently, modern technology, low labour wage rate, and very high land prices all occur at the same place and time.

Since more than 50% of the national income and 60% of jobs come from the farm sector in most developing countries, the pace and nature of agricultural growth will have a dominant impact on the rate and pattern of economic advance.

Among the negative trends which should be guarded against, mention should be made of the growing conversion of farmland for non-farm uses, desertification of various kinds leading to a diminution or destruction of the biological potential of soil, and productivity advances being dependent upon an increasing consumption of non-renewable forms of energy. Recent experiences shows that sustained progress in agriculture can take place only when brawn, brain (technology), and bank (cash inputs) are blended symbiotically. The theme chosen for CHEMRAWN II, therefore, is timely. The conference should result in guidelines that will help to promote the onward march of agriculture.

M. S. Swaminathan  
Director General  
The International Rice Research Institute



## MESSAGE

I wish to extend my heart felt congratulations to the organizers and sponsors of CHEMRAWN II for initiating a forum which focuses on the significance of chemistry to the effort to contain the global food problem.

It is disheartening to note that research and technology are not receiving enough international assistance, both on a multilateral and bilateral basis.

Significantly, the work of the International Rice Research Institute (IRRI) has reversed the deficit situation in food production in the Philippines and many other countries in Asia. Other international research institutes all over the world have also had remarkable effects on food production and incomes in the developing countries.

The efforts of the Consultative Group for International Agricultural Research (CGIAR) to increase food production by mobilizing and coordinating financing for international agricultural research and by supporting numerous research centers all over the world, including IRRI in the Philippines, CIMMYT (International Wheat and Maize Improvement Center) in Mexico, and IITA (International Institute of Tropical Agriculture) in Nigeria is also commendable.

CGIAR's recent difficulties in raising funds for research programs is largely caused by the economic pinch felt by developed donor countries, despite the announcement of the United States in 1981 that it had increased its contribution to agricultural research.

In the light of these difficulties, I strongly encourage other developing countries to become donors. It may be of interest to note that the Philippines was the first non-OPEC developing country to become a CGIAR donor.

At the same time, I am also for larger bilateral assistance by developed countries in the national research efforts of developing countries, and this means increased funding for specific research programs as well as greater assistance to strengthen and streamline national research systems.

It is, therefore, with a sense of urgency and optimism that I look forward to the accomplishment of the objectives of this conference, particularly in identifying research directions and priorities for increased food production at the least possible costs, in terms of both capital and human resources, and in fostering cooperation among governments, industries, and universities for the speedier implementation of research priorities and goals.

Arturo R. Tanco, Jr.  
Minister



## MESSAGE

The decade of the '80s brings us a more urgent call to strengthen our collective efforts while taking a close focus on the world food supply and nutrition situation as populations continue to grow. This is more emphatically felt in developing countries where agriculture remains to be the livelihood of many.

The Philippines is one of the worlds developing countries that is constantly trying to catch up with current trends and demands of modernization, particularly in securing the people's food and nutrition requirements. The national food authority, as the country's guardian on this aspect, is happy to know that our country has been chosen to be the venue of this international conference.

Chemical research could indeed bring about beneficial results. It was certainly research that developed pesticides to increase food production, vitamins and minerals to ensure proper nutrition, preservations to prevent food spoilage, and modes for formulating useful and profitable products.

The theme "Chemistry and World Food Supplies: New Frontiers" then becomes an appropriate area to tackle as we advance our sights toward using chemical research as a tool to keep the peace by promoting the basic human need which is food. And it is in this regard that the CHEMRAWN II Conference becomes an undertaking of mutual concern between developed and developing countries. We at the NFA will look forward to the fruits of your deliberations as a boon to our agricultural production and food processing efforts.

To all of the participants, my personal best wishes and mabuhay.

Jesus T. Tanchanco  
Minister



## MESSAGE

For most of the developing world, providing food for their own peoples had been a colossal struggle, a perpetual frontier. For many it had been a struggle that had to be won not only every generation, but also every year, every season as the pressure of increasing populations, dwindling resources and calamities, natural and man-made, conspire to negate the modest gains achieved in the past.

But it is a fight that could, and must be, won. In the final analysis, it all depends upon the wills of peoples, governments, institutions, both national and international, and individuals, including and especially scientists and technologists.

As a country very much in the midst of a determined effort to mobilize all her resources to cope with the food issue, we therefore welcome this meaningful opportunity to play host to CHEMRAWN II. We wish the sponsors and all the participants the best in this most noble and humanitarian endeavour.

Emil Q. Javier  
Minister, National Science and  
Technology Authority  
and  
Chancellor, University of the  
Philippines at Los Baños

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# **Abstracts of Papers of Technical Sessions**

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# Plenary Sessions

**December 6, 1982  
Delegation Building, Third Floor  
Meeting Room 1**

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December 6, 1982

Meeting Room 1

## OUR GREATEST CHALLENGE - FEEDING A HUNGRY WORLD

M.S. Swaminathan  
International Rice Research Institute  
Manila, Philippines

The FAO study "Agriculture: Toward 2000" projects that the number of malnourished humans world-wide will reach 650 million by the end of the century. Developing countries are especially vulnerable, having to import twice as much grain today as ten years ago. Past plans and practices have not been effective in reversing the trend. Major problems compounding the severity of the situation include continual loss of farm land, deterioration of quality of arable land, rapid population growth, conflict of interest between and among producers and governments, and the lack of a coherent, integrated plan to confront the problem. This paper describes the use of a National Food Security System as a major step in addressing the situation. Major components of this system include a) ecological security, b) technological security, c) build-up of grain reserves, d) social security, e) drinking water security, f) nutrition education and g) population stabilization.

## AN OVERVIEW OF THE SOCIAL, ECONOMIC AND POLITICAL ISSUES UNDERLYING THE ROLE OF CHEMICAL RESEARCH IN WORLD FOOD NEEDS

W. David Hopper  
The World Bank, Washington, U.S.A.

The broad outlook for world food production rests heavily on the persistence of high priority government policies that will insure production incentives for farmers and large investment funds for a continuous expansion of the infrastructure of services to the farming community, including research, irrigation, plant nutrient supplies, and the development of input and product markets. For the next two to three decades, world food production should be adequate to meet a growing demand generated by population expansion and rising disposable income. Only sub-Saharan Africa is threatened by the portent of a major food catastrophe, and this can be avoided if corrective policies are introduced by governments and if improved farm and livestock technologies are found.



The expansion of food output in Asia and, to a lesser but important extent, in Latin America rests both on increases in yields and expansion in irrigation facilities. These sources of output growth will gradually become less important and new technological frontiers must be overcome if the output growth of the food supply is to match rising demand beyond the next two decades. Chemical research must be the source of new technologies for food production but this research must be initiated now; the historical time between the beginnings of a major research effort and the application of its findings by farmers is about thirty years. Sustained and large research activities also must continue on improving and extending the present array of agricultural techniques. All these research efforts depend on cooperation among agricultural scientists, especially those engaged in various aspects of applied chemistry.

#### THE FUTURE ROLE OF CHEMISTRY IN REMOVING CONSTRAINTS ON FOOD PRODUCTION AND UTILIZATION

Louis V. Planta  
Chairman of the Board of Directors and Managing Director  
CIBA-GEIGY Limited, 4002 Basle, Switzerland

The chemical industry, already of importance in improving the world's food supply, could play a bigger part. Present scientific knowledge and the potentially fertile land available would suffice to feed the world's population if various political, economic, financial and organizational questions could be resolved. A plea is made for greater co-operation between commercial enterprises, governments and international advisory organizations. With full regard to universal and local environmental and human needs, and within the priorities set by host country governments, the chemical industry is able and willing to use its knowledge and experience in the service of food production and to intensify its research efforts for the future. The role of the market economy as a spur to research is explained, together with the impossibility of "one-way street" technical aid which would rapidly deplete the financial resources on which the industry's research activity, and hence its viability, depends.

#### PHYSICAL, CHEMICAL AND BIOLOGICAL CONSTRAINTS ON FOOD PRODUCTION AND ON THE LEVEL AND EFFICIENT USE OF CHEMICAL INPUTS

Thomas R. Odhiambo  
International Center for Insect Physiology and Ecology, Kenya  
and  
P.A. Sanchez  
North Carolina State University, U.S.A.

No abstract available.

#### BASIC CHEMICAL RESEARCH AND FUTURE WORLD FOOD SUPPLIES

Melvin Calvin  
University of California - Berkeley, Berkeley, California, U.S.A.

No abstract available.

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# Session A

## Soil and Crop Management for Efficient Use of Water and Nutrients

December 7, 1982  
Delegation Building, Third Floor  
Meeting Room 1

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A-1

December 7, Meeting Room 1

### CONTRIBUTIONS OF CHEMISTRY TO REMOVING SOIL CONSTRAINTS TO CROP PRODUCTION

R. Scott Russell  
(formerly Director, Letcombe Laboratory)  
East Hanney, Wantage, Oxfordshire, OX12 OHQ, England  
and  
G.W. Cooke  
Rothamsted Experimental Station  
Harpenden, Hertfordshire, AL5 2JQ, England

Chemistry in relation to soil fertility has provided fertilizers and other agrochemicals, and is closely involved in all multidisciplinary studies of the soil-plant system. This research has increased our understanding of how the growth and function of root systems is regulated, and of ways in which the soil affects crop growth. Opportunities thus have been created for identifying constraints to crop production and for devising better methods to overcome them. Constraints due to physical conditions in the soil and to inadequate nutrients are emphasized. Fertilizers make it possible to remove all nutrient constraints, but information is needed on their interaction with other production factors, such as the supply of available water, before recommendations for applying them can have a sound scientific basis. Fertilizers are rarely used with the maximum possible efficiency and more research is needed to specify fertilizers to meet local needs in developing countries, to provide nitrogen fertilizers by methods which consume less energy, and to determine the amounts and methods of application which fit local conditions of soil, climate and cropping system. Considerable increases in crop yields should be possible with adequate research, development and advisory services.

**A-2**

December 7, Meeting Room 1

**DEVELOPING MORE EFFICIENT FERTILIZERS THROUGH FORMULATION,  
MANUFACTURING, AND DISTRIBUTION TECHNOLOGY**

Donald L. McCune, Managing Director  
International Fertilizer Development Center  
Muscle Shoals, Alabama 35660

Chemicals are being evaluated for their capacity to improve the agronomic efficiency of urea, the most widely used nitrogen fertilizer. Examples are inhibitors, coatings, and metal ions to reduce losses. Soil and liquid forms of conditioners are reducing losses through improved product quality. New manufacturing routes are being evaluated for their usefulness in processing raw materials more efficiently. For phosphate ores this includes direct acidulation, direct use of acid soils, and up-grading by beneficiation. Improvements in the manufacturing, handling, storage, and distribution of fertilizers, raw materials, and intermediates are being made. In all these aspects chemistry is playing an important role in providing "cost effective" fertilizers for farmers with the ultimate goal of increasing the world food supply.

**A-3**

December 7, Meeting Room 1

**MODIFYING CROP PERFORMANCE WITH GROWTH-REGULATING CHEMICALS**

Johan Bruinsma  
Department of Plant Physiology, Agricultural University  
Arboretumlaan 4, 6703 BD Wageningen, The Netherlands

In order to improve the quantity and quality of crop yields, production and distribution of materials within the crop plants have to be manipulated. The natural regulation of these processes, controlling the relative size, the composition and the (postharvest) life of plant organs, is exerted by plant hormones. A concise survey of the present knowledge of phytohormones is presented. Exogenous control of crop development, as in agricultural practice, is achieved with synthetic plant growth-regulating chemicals (PGR's), which interfere with the endogenous hormonal pattern. With PGR's, both morphogenesis and metabolism of crop plants can be influenced so that form and function are changed. Application of PGR's in cereals is described as an example of morphogenetic control to secure and increase grain yield. Uses in fruit culture demonstrate PGR effects on metabolism to improve, for example, harvesting and postharvest life.

**A-4**

December 7, Meeting Room 1

**IMPROVING THE PRODUCTIVITY OF PROBLEM RICE LANDS**

Felix M. Ponnampetuma  
The International Rice Research Institute, Philippines

No abstract available.

CHEMICAL APPROACHES TOWARDS INCREASING WATER AVAILABILITY  
TO CROPS INCLUDING MINIMUM TILLAGE SYSTEMS

R. Lal, A.S.R. Juo and B.T. Kang  
International Institute of Tropical Agriculture  
PMB 5320, Ibadan, Nigeria

Basic aspects of soil-water management in relation to crop production are described. No-tillage system with chemical weed control, the food crop/shrub inter-planted alley cropping system and the system of cover crop in situ mulch are promising cultural practices that improve soil moisture and nutrient availability and water use efficiency. For the easily compactable Alfisols and Inceptisols in the semi-arid tropics, both mechanical tillage for rough seed bed preparation to increase surface retention and weed-free fallow reduce evaporation, improve root growth and hence, enable better utilization by crops of stored water in the subsoil horizons. For crop production in the fine-textured, strongly acidic Oxisols and Ultisols in the subhumid regions, sub-soil liming and phosphate application improve crop water use efficiency through increased root growth. For much of the tropical regions where soils with low CEC and low water holding capacity are predominant, inadequate nutrient supply is a key factor limiting water use efficiency by crops.

NEW DEVELOPMENTS IN CHEMICAL CONTROL OF WEEDS

J.R. Corbett  
FBC Limited, Chesterford Park Research Station  
Saffron Walden, Essex CB10 1XL, England

Although over 150 herbicides are already available, there is active research worldwide by industry to improve upon them. Recent major advances include chiral wild oat herbicides, post-emergence herbicides for grass weeds, the translocated broad spectrum herbicide glyphosate, herbicide safeners, and the very active chlorsulfuron. Resistance to herbicides is unlikely to become a significant problem. Herbicides technically suitable for use in developing countries exist, and suitable application machinery is available.

New herbicides sought by industry are aimed at initial use by developed countries to allow recovery of the enormous costs incurred in discovery and development. Technically difficult problems for new products include tough perennial weeds, water weeds, parasitic weeds, and volunteer crops. The ideal herbicide of the future will have a broad weed spectrum and favourable crop selectivity and will be non-toxic to animals and of short environmental persistence. It is likely to be applied post-emergence and to be very active per unit weight. No technical reasons exist to prevent the discovery of better herbicides, but industry must not be unnecessarily constrained. In particular, registration procedures should be harmonised worldwide, and patent life extended to compensate for the long development period without sales.

**A-7**

December 7, Meeting Room 1

CHEMICAL TECHNIQUES FOR MONITORING ANALYSIS AND AVOIDING  
POLLUTION OF SOIL AND WATER RESOURCES

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No abstract available.

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# Session B

## Integrated Approaches to Pest Management

December 7, 1982  
Secretariat Building, Second Floor  
Meeting Room 2

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**B-1**

December 7, Meeting Room 11

### PRINCIPAL PESTS OF FOOD CROPS

J.C. Davies  
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No abstract available.

**B-2**

December 7, Meeting Room 11

### PRINCIPAL DISEASES OF FOOD CROPS

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Many diseases of food crops are prevalent in different parts of the world causing recurrent heavy losses. About 10-15% of total food production is lost due to diseases before the crops are harvested. Control measures against diseases over the past century have however yielded rich benefits. Most devastating diseases of major cereal food crops are now controllable through cultivation of disease-resistant varieties or a combination of chemical, physical, biological and cultural means. There is ample scope for improving the quantum and quality of plant protection technology presently available to farmers in developing countries, which will help further reduce the loss. The host-pathogen interactions are such that there is bound to be continuing struggle between the two. Continued and more concerted research efforts are required to improve the qualities in the host plants to withstand the onslaught of pathogens. More studies are needed on the methods to accurately assess the losses due to diseases, on the techniques for disease forecasting and to more effectively manage diseases at the time of outbreaks.

## INTERACTION AMONG PESTS, DISEASES AND WEEDS IN FARMING SYSTEMS

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Man's crops are ravaged by pests, diseases and weeds. There are frequently interactions among them, varying widely in degrees of complexity and in the extent of influence by other factors in the agroecosystem. Only rarely can these interactions be managed within biological or integrated control systems so that they result consistently in increased agricultural productivity. More frequently the interactions are disadvantageous to productivity; here, a detailed understanding of them is essential for design of effective control programmes. This paper gives examples of the many types of interaction including: biological control of one species by another, synergy or antagonism between species, alterations in competitiveness, transmission of diseases by pests, and the effect of weeds and volunteer crop plants on the survival of pests and diseases.

THE BIOCHEMICAL BASIS OF RESISTANCE IN HOST PLANTS  
TO INSECT PESTSM.D. Pathak<sup>1</sup> and D.Dale<sup>2</sup>

Director, Research and Training<sup>1</sup>, Senior Research Fellow<sup>2</sup>  
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Resistant varieties of cultivated crops are grown throughout the world either as a primary method or as an adjunct to other insect control measures. In most cases, the host plant resistance (HPR) is of biochemical nature. However, only few in-depth investigations on this subject have been undertaken. Lack of appropriate analytical and bioassay methods have been often the limiting factors to these studies. The phytochemicals involved in HPR mostly belong to groups like acetogenins, alkaloids, flavonoids, glycosides, isoprenoids, lignins, etc. They act as feeding deterrents, growth inhibitors, toxicants, ovipositional deterrents and repellents. Such chemicals could be of great practical significance as commercial pesticides because of their selective and non-polluting characters. Information about these chemicals also will aid the evaluation of breeding lines so as to further increase (in cultivated crops) the levels of resistance to insect pests.

**B-5**

December 7, Meeting Room 11

**NATURALLY OCCURRING PESTICIDES AND THEIR POTENTIAL**

R.C. Saxena  
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Pesticides will remain indispensable in the foreseeable future to avert crop losses caused by pests and thus meet the increasing demand for food supply in the world. However, the growing awareness of problems of pesticide resistance and detrimental effects on non-target organisms, including man, associated with the large-scale use of broad-spectrum pesticides, dictate the need for effective, biodegradable pesticides with greater selectivity. These problems have created a worldwide renewed interest in naturally occurring pest control agents. This paper reviews the status of pesticides of plant, insect or microbial origin and their synthetic analogs, and their potential for insect pest management in developed and developing countries.

**B-6**

December 7, Meeting Room 11

**PHEROMONES AND OTHER RECENT DEVELOPMENTS  
IN BIOCHEMICAL PEST MANAGEMENT**

P.O. Beevor, D.R. Hall and Brenda F. Nesbitt  
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The application of pheromones and other behaviour-modifying "semiochemicals" to pest management on food crops is reviewed with consideration of their advantages and disadvantages relative to conventional methods. The main scientific, commercial and organisational constraints which need to be overcome to permit full development of the potential of these chemicals as aids to food production and storage are discussed.

**B-7**

December 7, Meeting Room 11

**THE POTENTIAL FOR THE INTEGRATION OF PLANT RESISTANCE,  
AGRONOMIC, BIOLOGICAL, AND PHYSICAL/MECHANICAL TECHNIQUES;  
PESTICIDES FOR PEST CONTROL IN FARMING SYSTEMS**

Ida Nyoman Oka  
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Intensification of food production has also increased pest damage, which acts as a deterrent. For example, plant and leafhoppers combined with the grassy stunt and ragget stunt viruses (both vectored by the brown planthopper) and the rice tungto virus (vectored by the green leafhopper), have become most destructive rice



pests in East Asia. Intensive use of insecticides to control extremely difficult and expensive. Pest control strategies should knowledge of the complex relationships of the natural forces and populations in tropical environments. The concept of integrated pest management would be appropriate for stabilizing yields at a high level, least cost environment and most profitable to individual farmers. An interdisciplinary research approach is required. For field implementation close cooperation government authorities, extension services, field technicians, private village leaders and farmers is essential.

**B-8**

December 7, 1981

### ENVIRONMENTAL ASPECTS OF PEST MANAGEMENT

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With pests destroying nearly half of all potential food production despite the use of pesticides and other controls, there is an essential need for pest management. The benefits of good pest management practices are immense. Interventions and manipulations in agriculture for pest control may cause serious changes in the agroecosystem and the natural environment resulting in environmental and social costs. Although pesticides are more environmental and social problems than nonchemical alternative use of nonchemical biological and cultural controls is not without risk to problems which have not received adequate attention. Careful assessment of benefits and risks of both pesticides and nonchemical alternatives are

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# Session C

## The Role of Chemistry and Biochemistry in Improving Animal Production Systems

December 7, 1982  
Secretariat Building, Second Floor  
Meeting Room 3

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C-1

December 7, Meeting Room 12

### NITROGEN SOURCES AND ROUGHAGE IN RUMINANT NUTRITION

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Ruminants have the ability to utilize roughage by microbial fermentation to produce valuable animal protein, provided the nutrient requirements of the micro-organisms are fulfilled. Poor quality roughages must be supplemented with nitrogen if microbial protein synthesis is to be adequate for maintenance of live weight, but preformed amino acids are not required. For growth and milk production, supplementing roughage with additional fermentable carbohydrate and further nitrogen is necessary. Basic research allows prediction of amounts and sources of nitrogen for particular productive purposes, preventing wastage of protein and the possibility of toxicity arising from excessive amounts of non-protein nitrogen, e.g. urea, in the ration. More detailed knowledge is required of how microbial protein yield can be improved and how nitrogen can be conserved in the body. Adequate indigenous field trials are needed.

**THE USE OF SUGAR CANE AND BY-PRODUCTS FOR LIVESTOCK**

T.R. Preston

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Data are presented to support the hypothesis that the sugar cane crop offers unparalleled potential for converting natural resources in the tropics into livestock feed and fuel energy. The nutritive value of whole sugar cane is limited by the slow rate of digestion of the cell wall fibre which contributes little metabolizable energy to the animal and also reduces the efficiency of utilization of the valuable sugars through its negative effect on the rumen eco-system (due to slow rumen turnover rate). Future developments with this crop should be based on simple methods to separate juice from fibre. Sugar cane juice has supported performance rates in both ruminants and non-ruminants equal to, or exceeding, those obtained on cereal grain rations. The fibrous fraction, including any residual sugar, can be converted easily into charcoal, producer gas or an energy feed for draught animals.

**ADVANCES IN FODDER CONSERVATION TECHNIQUES**

Ernst Zimmer

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Compensation between requirements of producing animals and seasonal supply of nutrients from forage and other resources is the main task of fodder conservation. Principles of either drying or fermentation/enfiling are adapted, and techniques have been modified according to the specific needs, regions and agricultural systems. Key problems remain as to the extent of nutrient losses and respective land performance; and the effects of conservation on nutritive value intake and consequent animal performance. The current world status, irrespective of climatic region or evolution of agriculture, shows that the potential of grassland or forage crops is still underutilized; that hay making proves to be the least efficient technology; that enfiling promises better efficiency, but fermentation cannot yet be controlled within predictable parameters; and that huge quantities of byproducts and waste could extend the feedstock basis but are not being put adequately to use.

Fodder conservation can contribute to future food production through reducing conservation losses and improving voluntary intake, extending the use of byproducts and waste, and developing technologies appropriate for specific needs. Fodder conservation, as a type of biotechnology, requires a well-integrated interdisciplinary approach and specialized research facilities e.g. for animals, there is needed laboratory scale research, controlled environments and in vitro techniques. Future research should be directed to standardize and possibly improve, crop or substratum quality in terms of digestibility and suitability for conservation, and to control and influence the drying and fermentation processes by means of an

appropriate environment or additives. Pressing problems which need solutions are given in detail. Examples of these include the problem of prewilting and artificial desiccation, finding additives against fungal deterioration in moist hay, determining the protein value of silage, correlating the microbial activity and technical measures in the aerobic deterioration of silage, and understanding the ligno-cellulose complex in its application to improve digestibility.

**C-4**

December 7, Meeting Room 12

#### RECENT DEVELOPMENT IN FEED ADDITIVES

Zdenek Otto Müller

Coordinated National Programme for Livestock Feed Resources  
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The main achievements of research in feed additive science directed towards improvement of livestock performance and its economics is reviewed. The main areas covered are: vitamins, antibiotics, antimicrobial drugs, hormones, enzymes, arsenicals, lactobacilli, mold inhibitors, antioxidants, buffers, silage additives, miscellaneous feed additives such as synthetic energy and fibre sources, the use of zeolite, kaolin, taste improving substances, regulation of fly control and of insect growth via feed and others. The potency of new vitamin D isomers and their impact on growing poultry, egg shell quality, calcium absorption and mineralization of the bone are reviewed. Two constituents vitamin E and selenium are evaluated in terms of their deficiency, nutrition/pathology, mutual interchangeability, interaction with several additives, their effect on carcass quality and shelf-life of frozen poultry. Practical aspects of selenium toxicity modification by a polar factor contained in linseed meal and elimination of toxicity of *Pisum sativum* diets by vitamin E-selenium are some of the examples of recent research and its practical implication. The latest findings on other feed additives and their impact on present and future food production are described. The missing links, pressing tasks and the goals envisaged for future feed additive research and development are listed. Recommendations are outlined for research on new additives in general and also for both monogastric and polygastric animals.

**C-5**

December 7, Meeting Room 12

#### BIOCHEMICAL AND CHEMICAL CONTRIBUTIONS TO EFFICIENT SMALL SCALE PIG AND POULTRY SYSTEMS

A. Aumaitre

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Pig and poultry meat represented (1980) 60% of the total meat supply in Europe and North America, and more than 95% in some Asian countries. Intensification in production systems and improvement in performance of monogastric animals were achieved during the last 20 years due to more efficient control of reproduction, nutrition, environment, housing, and quality of animal products. Reproduction could

be controlled in birds by light intensity, and the reproductive cycle of sows by progestagens. Improving the performance of highly selected animals by feeding balanced diet has been based on intensive chemical, biochemical determination of nutrients, antinutritional or toxic factors in available and potential feed, as well as measurements of biological response of the animals. Feed supplement and growth promoters help to overcome poor environment. Control and improvement of animal products quality is the continuing goal.

**C-6**

December 7, Meeting Room 12

**AQUACULTURE SYSTEMS: PROBLEMS IN BREEDING AND FEEDING**

SPEAKER TO BE ANNOUNCED

No abstract available.

**C-7**

December 7, Meeting Room 12

**CHEMISTRY IN THE CONTROL OF RUMINANT ANIMAL DISEASES  
AND REDUCTION OF PHYSICAL AND BIOLOGICAL STRESS**

Robert H. Dunlop  
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Chemistry and biochemistry have emerged as the most important disciplines related to veterinary medicine in the potential for resolving the problems of animal disease. Biochemistry is essential to gaining an understanding of the basic veterinary biology of the productive performance and disease processes of ruminants. It plays an expanding role in developing new technologies for the manipulation of performance or the control of diseases. Analytical chemistry has helped to characterize naturally-occurring antibiotics and pharmaceuticals, as well as to monitor the pharmacokinetics of drugs and metabolites in the body compartment. Synthetic chemistry, linked to drug design, has generated new classes of pharmaceutical chemicals with many options for derivatives. It has also allowed the development of many modifications of the nucleus of complex antibiotics obtained from microorganisms. It serves as the spearhead of the development of products to treat or prevent animal diseases and to enhance the efficiency of livestock production. The important advances and the chemotherapy of ruminant diseases are assessed, along with the development of products to prevent metabolic disorders, relieve stress or enhance productivity.

## CHEMISTRY AND THE CONTROL OF ANIMAL TRYPANOSOMIASIS AND THEILERIOSIS

A.R. Gray

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Trypanosomiasis and theileriosis are widespread vector-borne diseases of livestock caused by several species of parasitic protozoa. Control measures for trypanosomiasis include tsetse control, mainly by insecticides, and chemotherapy. Control of theileriosis is based on acaricidal applications to livestock to destroy ticks, vaccination against Theileria annulata and, on a limited scale, against T.parva, and chemotherapy. The efficacy of existing control measures is variable and the diseases still exact a heavy toll on livestock numbers and productivity. In Africa, better methods for the control of tsetse populations and trypanosomiasis would release very large areas for mixed agriculture and livestock farming. In Africa and Asia, improved control of trypanosomiasis and theileriosis would greatly reduce livestock losses and allow improved meat and milk production. Chemical and biochemical research can assist disease control by the development of new classes of biodegradable insecticides and acaricides, less toxic and structurally new therapeutic drugs for treatment of infections, the identification and production of parasite antigens for vaccination and, possibly, the identification and multiplication of disease resistant varieties of livestock.

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# Session D

## Contributions of Chemistry and Biochemistry to Developing New and Improved Food Sources

December 7, 1982  
Delegation Building, Third Floor  
Meeting Room 11

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D-1

December 7, Meeting Room 9

### SYNTHETIC FOODS: TECHNICAL, ECONOMIC, AESTHETIC, AND CULTURAL ISSUES

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Food has always been a limiting factor in the survival of man. Faced by the hazards of a fundamentally hostile environment, humankind has managed to survive only through the evolutionary development of an incredible series of adaptation resulting in a exceptional flexibility to utilize a wide range of materials as substrate for their metabolic machinery. With the exception of the rat, no animal seeks and consumes a greater spectrum of food. In this, man surpasses the rat, because he alone has the ability to add further to his food resources by manipulation of his environment. In spite of these strategic advantages, man has almost always been faced by the spectre of famine. It has become overwhelmingly clear that the need for action to prevent starvation or at least the physical and mental enervation of malnutrition is an essential component of modern politics. The solution to these problems must lie in increased utilization of available resources. Solutions to the problem must include: modification of food materials for direct utilization by man; biological processes replaced by chemical synthesis; and the use of these nutrients and the formulation of new food products having nutrient composition closely resembling nutritional optimums. The development of this technology is only part of the solution. Food is not food until it is eaten. Thus, the resolution of these issues must also include better understanding of the

dynamics of food needs and wants. Further, with the development of sources of nutrients and food products to which man has had little exposure, better understanding of the possible toxicologic and nutritional hazards associated with the consumption of such products is essential since better marketing practises and efficient distribution systems result in broader exposure before any historical experiences with their use is obtained. Finally, society has developed a series of regulatory processes designed to protect humankind from ultimate disaster by inappropriate modification of the food supply. To a significant extent, such regulatory activities designed to be protective of human health are often antithetical to this goal by interfering with the innovative process. Each of these facts must be considered from the beginning in the resolution of the problems of the human food supply.

D-2

December 7, Meeting Room 9

### NEW PROTEIN SOURCES OF FOOD AND FEED

Yasuji Minoda

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Researches for new microbial protein sources of food and feed were focussed on yeasts from palm oil and hydrogen bacteria. An isolated strain which was identified with Torulopsis candida effectively assimilated crude and refined palm oil. The addition of surfactant, vigorous agitation and high oxygen supply accerelated the yeast cell growth, optimally at 30°C and a pH of 3.0. Cell yield under optimum conditions on 3% of palm oil was 95%. The other strain which could grow at about 40°C was isolated and identified with Candida tropicalis. Thermophilic hydrogen bacterium, Pseudomonas hydrogenothermophilia showed very rapid growth ( $\mu = 0.73 \text{ hr}^{-1}$ ) at 52°C on simple inorganic medium under a mixture of H<sub>2</sub>, O<sub>2</sub> and CO<sub>2</sub>. The most suitable medium and the best gas ratio for cell growth were determined. For each kilogram of bacterial cells, 5.4 m<sup>3</sup> of hydrogen was consumed and the carbon dioxide intake ratio was 65%. Protein contents of T.candida and P.hydrogenothermophilia were 46.8 and 75.0% respectively and the amino acid compositions of both proteins were well balanced. These organisms were thought to be promising strains for SCP production.

D-3

December 7, Meeting Room 9

### CONVERSION OF PLANT AND ANIMAL WASTE TO FOOD

Antoni Rutkowski

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Present plant and animal waste must be increasingly converted to food. Only a limited volume of waste is now utilized directly in food production. Waste can be partly converted by animal organisms into meat, milk or eggs, a conversion limited by local conditions. Research on the application of physical and chemical methods of waste conversion to food grade products is being widely pursued especially in the area of bioconversion. Attention must be given to attaining high quality and good nutritional properties in products obtained from waste.



**D-4**

December 7, Meeting Room 9

**IMPROVING THE SUPPLY, QUALITY AND UTILITY OF CARBOHYDRATES**

R. Rajalakshmi  
University of Boroda, India

No abstract available.

**D-5**

December 7, Meeting Room 9

**IMPROVING THE SUPPLY, QUALITY AND UTILITY OF FATS**

Joseph Moolayil  
Lever Brothers, Malaysia

No abstract available.

**D-6**

December 7, Meeting Room 9

**RUMEN-PROTECTED AMINO ACIDS**

Heribert Offermanns and Herbert Tanner  
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Addition of the limiting amino acids methionine and lysine to animal feeds allows over 5 million tons of protein annually to be saved or freed for other uses. To date, however, these savings have only been realized for monogastric animals. Based on our present knowledge, it should also be possible to provide polygastric animals with synthetic amino acids using a protected form. In contrast to poultry and swine, the feeds for sheep and cattle cannot be directly supplemented with synthetic amino acids since free amino acids are metabolized by the microorganisms in the rumen. At present, amino acids may be protected from microbiological catabolism by both physical and chemical methods. While results achieved thus far, especially with protected methionine, are quite promising, these developments are still in the beginning stages.

## IMPROVING THE SUPPLY, QUALITY, AND UTILITY OF PROTEINS

Soichi Arai

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Food proteins inevitably undergo deteriorative changes in the preharvest and postharvest process, jeopardizing both their supply and utility. The fundamental solution of this problem must aim at minimizing the factors involved in the deterioration and maximizing desirable properties of proteins. The sophisticated methodology currently available for this purpose, with special emphasis on the potential of novel techniques for enzymatic modification of proteins is reviewed. The subtlety and versatility of protein structures could permit their intentional modification in the form of covalent attachment of suitable amino acid esters with the aid of a protease action. Examples are given on improving the nutritive value of soy protein by attachment of L-methionine ethyl ester and of endowing hydrophilic proteins (e.g., gelatin) with a greater surface function by attachment of lipophilic L-leucine n-alkyl ester. The utility of the enzymatically modified proteins produced and further research needs are discussed.

## EXPANDING AND IMPROVING THE FOOD SUPPLY WITH ENZYME SYSTEMS

Bernard Wolnak

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The possibility of producing and using single enzyme systems to increase the food supply in the developing countries seems remote. However, multienzyme systems namely fermentations, offer a much more promising situation. Many of the major components required for the development and operation of a successful fermentation process are present in the developing countries. Such factors as the nutrients, micro-organisms, and manpower are or can be made available. The major components of equipment and capital can be obtained, particularly since such projects can be structured to return all invested capital and to make a profit. In addition, the products obtained from a fermentation plant, e.g., antibiotics, amino acids, and vitamins could materially assist the food supply in the developing countries. These concepts are discussed in detail.

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# Session E

## Chemistry and Biochemistry in the Processing and Storage of Food

December 7, 1982  
Delegation Building, Third Floor  
Meeting Room 12

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E-1

December 7, Meeting Room 10

### REVIEW OF STORAGE AND PROCESSING

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The present state of food processing and storage is discussed with special consideration of heat processing, irradiation, freezing preservation, dehydration, intermediate moisture foods, cooking extrusion, chemical-biological preservation and fabricated foods. Most typical chemical reactions occurring during processing and storage are also mentioned. A subsequent discussion is devoted to the aspects of storage and processing in developing countries.

## FISH PROCESSING

Torger Børresen and Terje Strøm  
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In recent years the total aquatic catch has been relatively constant at 70 million tonnes per year. Production can be increased by more efficient utilization of conventional resources, increased aquaculture, and exploitation of unconventional resources. This also requires improvement of existing preservation and processing technology. Examples of improved methods of preservation are chilled storage of fresh fish in a mixture of ice and seawater, chilling under controlled atmosphere containing CO<sub>2</sub>, and acid preservation. The lower organic acids like acetic or propionic acid may be used for processing of mince from small pelagic fishes, and in processes where fish material is autolysed by endogenous enzymes present in the fish. Fish mince should find a wider application in reformed and dry products. Fermented fish products should be further developed, particularly through the use of lactic acid bacteria. For a successful exploitation of unconventional resources, new technology has to be developed. The new principles of biotechnology and enzyme technology may provide important tools for this purpose.

## PROGRESS IN PRESERVATION OF FOOD THROUGH FERMENTATION

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Fermentation is a centuries old means of processing and preserving food. Most fermentations were originally spontaneous, e.g. souring of milk and production of cheese from the curd, production of wine from fruit juice, and production of vinegar from wines. Fermentation offers low-cost methods for preserving fresh vegetables by lactic acid fermentation, leavening bread, increasing the protein content of high starch substrates, and fortifying foods with important vitamins and essential amino acids. Fermentation provides the means whereby meat-like flavors and textures can be introduced into cereal grain/legume substrates decreasing the need for the inefficient cycling of vegetable proteins through animals. Fermentation is responsible for the wide diversity of flavors and textures in our foods; it also often decreases the cooking time and fuel requirements. Fermentation is a major means of processing foods at low cost to the developing world, and is likely to play an ever-increasingly important role in the future.

E-4

December 7, Meeting Room 10

AMINO ACID PRODUCTION AND USE TO IMPROVE  
NUTRITION OF FOODS AND FEEDS

Takekazu Akashi  
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The practical application and industrial production of amino acids are reviewed and future prospects explored. Emphasis is given to the relationships of amino acids to Asian food specialties and their flavoring properties. Monosodium glutamate, which induces the umami (tastiness) sensation, demonstrates physiological effects on food protein digestion. Amino acids may also significantly increase the nutritional value of grain, a major source of protein. Methionine and lysine have two decades of use in feed formulation. Tryptophan and theonine will probably follow. Amino acids as fish attractants will help develop fish culture. New amino acid applications for direct human use as well as animal use require more study. Adequate storage systems for foods with amino acids are required. The amino acid industry continues to improve conventional production processes through cost reduction and utilization of unused resources. Unique process combinations of fermentation with enzymation or organic synthesis should be developed through introduction of frontier technologies of fermentation and organic synthesis.

E-5

December 7, Meeting Room 10

CHEMICAL AND BIOCHEMICAL PRETREATMENT OF FOOD FOR DRYING

P.O. Ngoddy  
University of Nigeria, Nigeria

No abstract available.

E-6

December 7, Meeting Room 10

STUDIES ON HEAT TREATMENT OF WHEAT GRAINS IN CHINA

Reizheng Liu, Yiqiang Xiong, and Cheng Wang  
Cereal and Oil Chemistry Institute of China  
Beijing, China

Heat treatment of wheat as a traditional method to control insects in stored grain has been practiced in China for more than fifteen centuries. The results of a series of studies to improve this old method are reviewed. For effective control of insects, wheat grains are raised in temperature by sun-curing to 50-52°C, maintained there for at least 2 hours, and the grain moisture thus reduced to about 12%. The warmed grains are then placed a semi-airtight bin where the grain temperature is retained above 40°C for a week or so. Under these conditions, neither the chemical composition nor baking quality of wheat changes. For grain which is to be used as

seed, however, the above procedure only applies to newly-harvested dormant seeds. For newly harvested seed grains having passed through dormancy, the grain moisture content should be below 10% when heat treatment is practiced. For old seed harvested in a previous year, heat treatment is not recommended. Enzymatic studies as well as germination tests revealed that the aging process was accelerated by heat treatment, the effect of the treatment being influenced by the grain moisture content and the level of interseed carbon dioxide. Heat treatment of other grains is also discussed briefly.

**E-7**

December 7, Meeting Room 10

**REMOVAL BY PROCESSING OF NATURALLY OCCURRING  
TOXICANTS AND ANTINUTRIENTS**

I.E. Liener  
University of Minnesota, U.S.A.

No abstract available.

**E-8**

December 7, Meeting Room 10

**WATER ACTIVITY AND INTERMEDIATE MOISTURE FOODS**

M. Karel  
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Control of water activity is the principal factor in such important food preservation methods as dehydration, freezing, concentration, salting and production of intermediate moisture foods. Water activity appropriately describes water relations of foods, because it controls the equilibrium with respect to water between food components and between food and its environment. The dependence of water activity on food composition and on temperature is shown and methods given for predicting water activity of mixtures. Non-equilibrium situations due to phase changes in food (e.g. sugar recrystallization) and to other physical changes are described and their significance noted. A review is presented of the effects of water content and of water activity on food deterioration due to biological, chemical and physical mechanisms. An important application of the water activity concept is the production of intermediate moisture foods (IMF). A review is presented of principles and practice of marketing of "traditional" IMF in several areas of the world. Developments in the production of "novel" IMF utilizing less traditional water-activity-depressing solutes (e.g. glycerol, sorbitol) are described. Several important obstacles, requiring research and development, remain in the area of IMF development. These are reviewed and prospects for progress analyzed.

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# Session F

## Chemistry in the Assessment and Control of the Food Supply

December 7, 1982  
Delegation Building, Third Floor  
Meeting Room 9

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**F-1**

December 7, Meeting Room 305

NEW DEVELOPMENTS OF COOPERATION BETWEEN THE CHEMICAL  
AND FOOD INDUSTRIES TO IMPROVE THE CONTROL OF THE FOOD SUPPLY

Pierre Roessler  
Industrie Chimique de Mulhouse-Dornach, France

No abstract available.

**F-2**

December 7, Meeting Room 305

OVERVIEW OF ASSESSMENT AND CONTROL

R.A.N. Edwards  
University of New South Wales, Australia

No abstract available.

F-3

December 7, Meeting Room 305

EFFECTS ON NUTRITIONAL QUALITY OF CHEMICAL CHANGES IN FOOD LEGUMES  
FROM PROCESSING AND STORAGE

R. Bressani, J.E. Braham, and L.G. Elias  
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To demonstrate the effect on nutritive value, of chemical changes induced by storage and processing food, legumes were chosen because of their importance in human diets. Chemical components, most of them nutrients, found in foods as produced are affected by production, storage, processing and consumption conditions. The understanding of the chemical changes taking place is essential to maximize nutrient utilization. Improper storage will increase the hard-to-cook condition in common beans already initiated during post-harvest processing. Dry or wet processing techniques if properly carried out will inactivate anti-physiological substances and increase nutritive value. Improper processing will result in low digestibility of the protein. Germination and fermentation result in higher levels of vitamins and increased availability of nutrients, but germination effects have given contradictory results. Inadequate storage of processed food legumes reduce their nutritional value and thus the nutritional quality of diets. Recommendations for research are given.

F-4

December 7, Meeting Room 305

RAPID TESTING FOR CONTAMINANTS AND TOXICANTS IN FOODS

H.B.S. Conacher  
Health and Welfare, Canada

No abstract available.

F-5

December 7, Meeting Room 305

RAPID, SIMPLE TESTING FOR NUTRIENTS AS AN AID  
TO SELECTIVE BREEDING

Bienvenido O. Juliano  
The International Rice Research Institute, Philippines

No abstract available.



**MULTIVARIATE ANALYSIS OF RAW MATERIALS**

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Techniques have recently been developed for providing a rapid prediction of the composition of agricultural products. The basic technology involves computer analysis of structural transmittants or structural reflectance curves of the product being measured. The major constituents of starch, protein, water, and oil can all be measured using near-infrared diffuse reflectors spectra. Measurements are made very rapidly with little or no sample preparation. Spectral transmittance or reflectance data in the visible region are used to predict chlorophyll anthocyanins, carotenoids, and other components having absorption bands in this region. These measurements are made on sample slices, homogenates, or intact samples.

Examples of this technology that are discussed include: protein and moisture content of ground wheat; oil content of intact sunflower and soybean seeds; fat, moisture, and protein content of meat; chlorophyll and lycopene content of intact tomatoes; and moisture and protein content of bulk samples of wheat without grinding. The composition of such samples is predicted with a precision equal to or better than that which is obtained by normal chemical procedures.

**THE IMPORTANT DIFFERENCE BETWEEN CHEMICAL ANALYSIS AND  
BIOLOGICAL AVAILABILITY**

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The nutrients present in a food are usually incompletely absorbed and the amount available may be influenced, either enhanced or depressed, by other ingredients of that food or of the remainder of the diet. Chemical/physical measurements of nutrients are reproducible and relatively precise but rarely reveal availability. Animal assays provide information of the amounts of nutrients available to the test animal but methods are lengthy and the results invariably cover a wide range. Extrapolation to man presents additional problems. However, a limited amount of information has been obtained from human experiments. While chemical/physical methods must continue to provide the greater part of the required information, all such determinations must be verified by bioassay when novel foods, new varieties and novel methods of processing are involved. If the food is expected to make a significant contribution to the diet, final verification on human subjects will be needed.

## PROBLEMS OF CORRELATION AND DEFINITION OF ANALYTICAL TECHNIQUES

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The growing, international interdependence of food production and commerce requires setting approved and sound methods of food analysis for consumer protection. Both differences in food laws and traditionally developed procedures hinder the introduction of such methods. Modern, instrumental procedures alone cannot offer a remedy, because their application often hinders error recognition. Therefore, it seems necessary to equalize internationally, the analysts' level of knowledge by encouraging better, personal rapport among them. Inter-laboratory studies can also be useful for correlating various analytical techniques and, thereby, achieve standardized methods that will be generally recognized.

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# Session G

## The Forward Edge

**December 8 and 9, 1982  
Delegation Building, Third Floor  
Meeting Room 1**

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G-1

December 8, Meeting Room 1

### OVERVIEW OF THE POTENTIALS AND PROSPECTS IN GENETIC ENGINEERING

Lawrence Bogorad  
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In principle, if even a minute amount of a gene product can be purified, the DNA sequence that specifies the protein can be identified, isolated from all the other genes of the organism, cloned, analyzed and introduced into another species. The enormous broadening of the gene pool available for altering cultivated organisms result from advances in molecular biology and in recombinant DNA technology developed within the last five to ten years.

Our ability to move genes from one organism to another is not matched by the ability to control their functioning in new environments. This is a major problem that remains to be solved. The solutions will come, in large part, from the application of genetic engineering methods and basic research. For many practical purposes, it will probably be necessary to move blocks of genes between organisms. The present limitation lies less in how many genes can be moved than in understanding how they are functionally related. While these problems are difficult, current progress creates optimism with respect to their solution.

G-2

December 8, Meeting Room 1

APPLICATIONS OF GENETIC ENGINEERING TO PLANT AND  
ANIMAL PRODUCTION

Jeff Schell  
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No abstract available.

G-3

December 8, Meeting Room 1

THE APPLICATION OF WIDE CROSSES TO PLANTS

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Wide crosses are defined as those in which the chromosomes of the two contributing species do not normally pair in the hybrid. Wide crosses are made either to increase genetic variability in existing cultivated species or to develop new crop species. Four major constraints to successful completion and/or utilization of wide crosses (incompatibility, embryo absorption, hybrid sterility, gene transfer) and methods to minimize constraints are discussed. Through improved technology, hybrids have been made between species previously considered non-crossable. Genes, primarily those governing disease or insect resistance, have been transferred from alien to cultivated species. Relatively few have been put to practical use. Impact of transferred genes on increasing food crop production has been negligible, but the potential value for stabilizing and improving crop production is considerable. Only one of many new allopolyploids that have been synthesized, Triticale, has been established as a new cultivated food crop. Its potential is discussed.

Research on wide crosses is not well supported and its potential value not sufficiently appreciated. Lack of knowledge of the mechanisms of speciation, of the factors involved in the stabilization of new species, and why some species hybrids cannot be made, are the most limiting impediments. Overcoming these impediments requires added personnel, adequate financing, and an official dedication to advancing wide cross research.

IMPROVED CONVENTIONAL STRATEGIES AND METHODS FOR SELECTION  
AND UTILIZATION OF GERMPLASM

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Plant breeding, both an art and a science, depends largely on the skill and judgment of individual plant breeders who utilize their scientific knowledge and plant breeding experience, in cooperation with the laws of probability, for production of improved cultivars. Plant breeders use continually updated combinations of effective hybridization/selection procedures and modern technological aids. Chief goals are yield and stability of yield, durable pest resistance and useful genetic diversity. Genetic yield gains of major field crops in the United States have averaged about 1 percent per year during the past 40 years and show no sign of levelling off. The genetic component usually has comprised about 50-70% of total yield gains. It is hypothesized that research inputs, rather than biological ceilings, control rates of genetic improvement of cultivar performance. Plant breeding's most needed research input today is additional fundamental knowledge about plant biology. This would require increased support of the basic biological sciences that serve plant breeding, and the training of scientists in both plant breeding and the basic biological sciences in order to facilitate integration of the two fields.

CHEMICAL, BIOCHEMICAL, GENETIC, BIOLOGICAL AND AGRONOMIC  
APPROACHES TO IMPROVED OR ALTERNATE TECHNOLOGIES  
TO PROVIDE FIXED NITROGEN

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Facts and assumptions on the global feed/food outlook dictate a 3%/a growth in crop production with increased fixed N input a major requirement. The major current technologies and their products of processes are synthetic fertilizer N, fertilizer-N-responsive crops, N fixing legumes and recycling wastes. Improved or alternate technologies are desirable on an economic fossil energy and self-sufficiency basis but are not essential. The knowledge base of the chemistry, biochemistry, genetics, biology and agronomy of N fixation has expanded greatly during the past two decades and continues to expand. Major limitations of N fixing systems have been identified and possible new approaches perceived. Potential improved or alternate technologies for the near, mid and long-term are described. Some are based on existing technology while others will require new technology.

## THE ROLE OF GROWTH REGULATORS AND HORMONES IN ENHANCING FOOD PRODUCTION

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Plant growth regulators are expected to play an important role in the efforts to double the world food supply by the end of this century. Although the search for plant growth regulators differs in numerous ways from that for pesticides, it lends itself to more (crop) specific, concentrated, and directed efforts that can be utilized on a smaller scale by smaller companies and countries. The diversity of effects already established for plant growth regulators promises a continuing optimistic future for them with considerable savings in energy and costs. Increasing the yield of a crop for a given area of land through their use means incremental gain, the only outlay for which is usually the cost of the plant growth regulator and its application and, sometimes, extra processing costs.

THE POTENTIAL CONTRIBUTION OF CELL AND PLANT TISSUE  
CULTURE TO CROP IMPROVEMENT

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Plant tissue culture involves the culture of cells, tissues and organs of plants in aseptic conditions in culture media that allow for their growth and proliferation. Tissue culture is now a basic technique for plant propagation and an excellent auxiliary tool in the breeding of economically important plant species. The methodology allows for a single plant cell to proliferate, producing amorphous cell conglomerates called callus which in turn, under appropriate conditions, differentiate into tissues, organs or intact plants. Five main types of plant tissue culture technology are considered: callus culture, cell suspensions, organ culture, meristem culture and protoplasts culture. Through these methodologies the plant material can be manipulated in such way to obtain clones or to obtain genetic variants. Plant cell and tissue culture technique, with all its implications, will play an important future role in the improvement of economic crops. A complete application of this technology to plant molecular genetics and to basic investigations will require the establishment of research needs and priorities, which are presented and discussed.

## PHOTOSYNTHETIC ACTIVITY AND PARTITIONING

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Photosynthesis, translocation, partitioning, growth and storage constitute an integrated set of processes linked by many interactions, and each should be viewed within that context. Although the duration of photosynthetic activity has increased during crop improvement, maximum photosynthetic rate has not done so, probably because of the need for compromise between greater leaf area and faster photosynthesis. Also, rubisco, the major photosynthetic enzyme, has been highly conserved in evolution, and the selection of forms with lower  $K_m$  ( $CO_2$ ) or oxygenase activities seems unlikely. Past increases in yield potential have come from changes in the partitioning of assimilates and nutrients due to reduced growth of non-harvested organs, more prolonged and faster storage, and enhanced competitiveness of the storage organs; i.e. from changes in the regulatory processes rather than in the photosynthetic processes. The prospects for further change, and the relevant research priorities, are considered.

## NEW APPROACHES TO MEAT AND MILK PRODUCTION

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There remains tremendous potential for increasing animal products for human use with current resources by applying research developments. Microbial synthesis through genetic engineering or improved chemical methods should make practical the synthesis of essential amino acids to allow widespread supplementation of cereal grains. This would reduce the protein needs for nonruminants including swine, poultry and humans and greatly extend existing protein supplies. Both precise control of reproduction in food producing animals through use of hormones and other chemicals, and the use of growth hormones, estrogens and androgens, and antimicrobial drugs, can result in significant improvements in overall production efficiency. The combined effects of treating crop residues to increase nutrient availability, the application of plant growth regulators to maintain plants in a vegetative and highly digestible state and the use of regulators of rumen metabolism such as the ionophore drugs to increase efficiency of energy utilization especially from fibrous feedstuff are all means of greatly increasing the productivity from existing resources. These developments, combined with genetic improvement, improved nutrient balance and more effective disease control, lead to optimism about the future contributions of animal products to the world's food supply.

**BIORATIONAL DESIGN OF CHEMICALS**

Hans Geissbuhler, Urs Muller, Johannes Paul Pachlatko and Hans-Rudolf Waespe  
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Biorational approaches in the design of new bioactive chemicals must be pursued, perfected and accelerated to ameliorate the selectivity vis-a-vis non-target organisms and to assist in improving a diminishing success rate observed with conventional approaches. The analysis of the present state of the art demonstrates that biorational reflections have been of minor importance in the discovery and development of presently used chemicals. Four major categories of impediments have been identified: 1) the relatively high success rate of conventional approaches in the past, 2) the multitude of organisms and control factors involved in determining the efficacy and fate of chemicals, 3) the complexity and irrelevance of testing systems, 4) a continuing and significant lack of basic scientific knowledge. Measures to overcome these impediments are projected and the required priorities are defined. An area which needs particular attention is the physiology of crops, insect pests, diseases and weeds, under the subtropical and tropical conditions of developing countries.

Special Plenary Session

December 9, Meeting Room 1

**FOOD AND ENERGY - INTERDEPENDENT WORLD NEEDS**

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The future availability of food is ultimately dependent on the availability of energy. Apart from relatively small contributions from nuclear and hydroelectric sources, energy, like food, is a product of the photosynthetic process. Can both food and energy be provided in future, on a renewable basis, by photosynthesis?

Natural photosynthesis is inefficient, energy intensive and requires fertile soil. Artificial photosynthesis using purely chemical "in vitro" processes is potentially more efficient and adaptable to barren land. The present state of research in this field is summarised.



# **Abstracts of Papers of Poster Sessions**

**Poster Session A**  
**December 7 & 8, 1982**  
**1715 - 1915**  
**Delegation Building, Third Floor, Lobby**

**PS. A-1**

**EFFECTS OF WINGED BEAN (*PSOPHOCARPUS TETRAGONOLOBUS*) MEAL  
ON BROILER PERFORMANCE**

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Winged bean (*Psophocarpus tetragonolobus*) is a promising legume for developing countries due to its high protein and oil content. Current research has focused mainly on its direct use as human food. The present work was done to determine the suitability of replacing soy meal with winged bean meal in chicken rations. The effects on broiler performance of replacing soybean meal with winged bean meal were determined in a series of two experiments using different varieties. In Experiment I, soybean meal was replaced by winged bean meal at 0, 19, 44, 74 and 95% on a protein basis. No statistically significant differences were observed among the different rations in metabolizable energy, nitrogen retention and broiler performance as measured by gain in weights and feed conversion (feed/gain), although there was an indication of adverse effects at 95% replacement. To confirm these results, a second experiment using more birds/treatment was undertaken. In Experiment II, replacement at 75% and 100% decreased metabolizable energy and led to poorer broiler performance. Broilers on winged bean diets gained 14% lower weight and the feed conversion was 22% poorer compared to the soybean control. Nitrogen retention by the broilers on winged bean diets was lower but not statistically significant. The hulls in the winged bean may have caused the decrease in metabolic energy that led to the poorer response of the broilers.

**PS. A-2**

**PREDICTION OF ION EXCHANGE SELECTIVITIES OF ALKALI  
METALS AND ALKALINE EARTH METAL CATIONS FOR SOIL CLAYS AND RESIN**

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The release of a trivalent complex of cobalt, tris 1,2 propylene diamine  $\text{Co(III), Co(pn)}_3^{3+}$ , from montmorillonite, vermiculite and Amberlite IRC-50 cation exchange resin matrices has been studied for different concentrations of  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$ ,  $\text{Mg}^{+2}$ ,  $\text{Sr}^{+2}$  and  $\text{Mg}^{+2}$  ions. Plots of the log of the selectivity coefficient against the hydrated ionic radii of the monovalent ions are non-linear for montmorillonite and vermiculite, but linear for the IRC-50 resin. For the bivalent ions, similar plots show a good linear relationship for all three exchangers. Similar plots against the reciprocal of the Debye-Huckel parameters,  $1/a^0$ , (as obtained from the chlorides of both the monovalent and bivalent ions) yield good straight lines for the clay minerals and resin. It is suggested that the

selectivity of all alkali and alkaline earth metal ions for the clay minerals can be predicted from only a few scattered data in a log (selectivity coefficient) vs.  $1/a^0$  plot of the monovalent and bivalent ions. Similar predictions for amberlite IRC-50 can be made from plots against either the hydrated ionic radius or  $1/a^0$ . These results are interpreted in the light of the architectural peculiarities of the absorbents vis-a-vis interlayer collapse and the ion fixation tendencies of some of the ions.

### PS. A-3

#### EVALUATION FOR WHEAT OF ROCK PHOSPHATE - TRIPLE SUPERPHOSPHATE MIXTURES AFTER INCUBATION WITH ORGANIC MATTER

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A pot culture experiment was conducted to study the availability of P from the incubated mixture of Mussoorie rock phosphate (MRP) and triple superphosphate (TSP) with organic matter (fresh cattle dung) to a wheat crop in a Camborthid soil. In the absence of organic matter, dry matter yield of wheat increased curvilinearly with increasing water solubility (WSP) of mixtures. Further, 80% WSP was on a par with 100% WSP at the 50 ppm P level, while at the 100 and 200 ppm level, 60% WSP was as effective as 80 and 100% WSP. The uptake and % utilization of P increased linearly with increasing WSP of the fertilizer. Incubation of phosphates in cattle dung for 15 weeks largely nullified the effect of WSP mixtures on all the indices of P availability. Availability coefficient ratios of mineral acid soluble P vis-a-vis water soluble P fractions were of higher order, with respect to uptake. Interestingly, utilization of rock P at 50 ppm P was only 3.6% in the absence of organic matter while it was as high as 38.0% after having been incubated with cattle dung. Incubation also enhanced the effectiveness of water soluble phosphate.

### PS. A-4

#### THE USE OF CROP RESIDUES FOR INCREASED CROP PRODUCTION IN IRRIGATED VERTISOLS

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Agricultural production in deep Vertisols or black soils is low though they have high yield potential. Vertisols have moderate reserves of plant nutrients and high water retention capacity. Alleviation of major constraints such as restricted drainage, moisture stress, P deficiency, salinity, alkalinity and water logging consequent to irrigation of Vertisols offer opportunities for raising agricultural production.

Two years of field experimentation on Vertisols under irrigation have indicated the possibility of increasing the grain yields of sweet corn and wheat from 0.2 to 4.1 t/ha and from 0.3 to 3.0 t/ha respectively through the incorporation of corn stalks at the rate of 7.5 t/ha with 100N: 75 P<sub>2</sub>O<sub>5</sub>: 37.5 K<sub>2</sub>O kg/ha for corn and only 50 kg N/ha for the post-rainy wheat crop in a double cropped system. This technology has resulted in profits up to 200 per cent on the investment. Application of cornstalks has increased the Olsen's extractable soil P from 4.35 to 9.61 mg/kg providing adequate supply of P for corn and wheat. Correlation of available phosphorus with grain yields of corn and wheat were significant (r = 0.61\*\*). The technology has helped to remove constraints to increased agricultural production in irrigated Vertisols by preventing soil salinity and/or alkalinity, and has resulted in the efficient utilization of water and plant nutrient resources. The technology needs to be tested in different agroclimatic zones covered with Vertisols.

#### PS. A-5

#### FORAGE CROP MANAGEMENT FOR THE PREVENTION OF GROUNDWATER POLLUTION FROM IRRIGATION WITH MUNICIPAL EFFLUENT

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During the period 1978-82 irrigation experiments were carried out using secondary effluent on Rhodes grass (Chloris gayana Kunt.) wheat (Triticum aestivum L.) and corn (Zea mays L.) grown in a sand dune soil, and Rhodes grass in a fine-textured soil (vertisol). The objective was to establish appropriate management for applying the waste water efficiently while preventing deep seepage and pollution of ground water.

Our results showed that if the amount of effluent applied does not exceed 0.8 of class A pan evaporation, there is no NO<sub>3</sub>-N movement below the root zone of Rhodes grass in sand dunes. The corresponding values for wheat and corn were 1.0 and 1.2, respectively, but the NO<sub>3</sub>-N concentration in the seepage water was generally high at the beginning of the season (10-50 mg/l), and dropped to below 10 mg/l during the period of active growth. The process of nitrification in the vertisol was not complete and ammonium ion was still found in the seepage water. The concentration of NO<sub>3</sub>-N was very low, but when cutting was postponed, nitrate concentration in the seepage water generally increased. The BOD and COD of the seepage water was reduced by 95% and 65-98% of the irrigation water. Municipal effluent may be used for the irrigation of forage crops, without danger of nitrate pollution, if appropriate management is employed.

## PS. A-6

### BUDGETING OF NATIVE AND APPLIED POTASSIUM FOR POTENTIAL YIELD OF WETLAND RICE IN MOLLISOLS OF INDIA<sup>1</sup>

K.C.K. Reddy<sup>2</sup>, K.P.R. Vittal<sup>2</sup>, and K.V. Raman<sup>3</sup>

In mollisols (Uttar Pradesh, India), wetland rice (IR-8) was grown in the field at 0, 40, 60, 80, 120 and 200 K kg/ha along with other recommended nutrients during monsoon. Potassium in the soil and in the plants at transplanting, maximum tillering, panicle primordia initiation and harvest were determined. The yield potential of rice (78 q/ha) did not change with applied K due to high native availability (211 kg/ha) and rate of release (134 kg/ha). From budgeting of plant and soil K it was observed that more K was released from the reserves of non-exchangeable K under unfertilized conditions than with fertilized. The release increased with crop growth up to panicle primordia initiation, after which the K uptake by the plants ceased.

Plant K concentration increased from the seedling to the maximum tillering stage and then decreased up to harvest. However, uptake increased from the seedling (1.5 kg/ha) through the maximum tillering stage (138 kg/ha) to panicle primordia initiation (256 kg/ha). From K at panicle primordia initiation, significant quantities from lamina (45%), sheath (41%) and root (60%) contributed, for panicle (22 kg/ha) and for stem (54 kg/ha), raising the latter's content to 110 kg/ha by the time of harvest. This relocation might have provided required strength to the stem to support the panicle. Further, there was a loss of about 20 kg/ha in total uptake indicating a feedback mechanism of K to soil from plants during senescence. To sustain the potential yields over extended periods it is strongly suggested that the plant residues be incorporated into the soil as 90% of the plant K was found in the shoots at harvest.

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## PS. A-7

### INFLUENCE OF PHYSICAL EDAPHIC FACTORS ON PHOSPHORUS DIFFUSION IN SOIL AT DIFFERENT LEVELS OF APPLIED PHOSPHORUS

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Self-diffusion coefficients of phosphorus,  $D_p$ , were determined in lateritic soil (Kharagpur sandy loam, a typical Acrorthox) at different levels (0, 50 and 100 ppm P) of applied phosphorus using the Lewis and Quirk method. The effects of moisture (0.33, 1 and 5 bar tension), temperature (25, 30 and 35°C) and bulk density (1.40, 1.55 and 1.70 g cm<sup>-3</sup>) were investigated. The P self-diffusion coefficient decreased with increasing soil moisture tension but showed an increase with

increasing of the amount of applied phosphorus. This latter effect was more prominent at higher moisture potentials. There was a linear increase in P diffusion with increasing temperature, which was greater at higher levels of applied P. In the absence of applied P, an increase in soil bulk density has no significant effect on P diffusion. At the other levels of applied P, an increase in bulk density from 1.40 to 1.55 g cm<sup>-3</sup> significantly increased the P diffusion. The results indicated that better utilization of applied P requires adequate soil moisture, and that soils of dry regions require greater P application. The study brings out the importance of physical edaphic factors in characterising P availability in terms of its diffusion, especially in situations where higher levels of P are to be applied.

#### PS. A-8

### USE OF FRESH CHICKEN MANURE IN FRESHWATER FISHPONDS

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Fresh manure from broiler birds was added to 400 sq.m. ponds at the rates of 250, 500, 750, 1000, 3000, 5000, 5600 and 10,000 birds per hectare of pond. Tilapia (Sarotherodon niloticus), common carp (Cyprinus carpio) and snakehead (Channa striata) were stocked at the rate of 20,000 per ha. The fish were cultured for 90 days. The highest net fish yield of 2669 kg/ha were obtained with 5000 birds/ha. Cursory analysis suggests that phosphate and BOD may be more important than nitrogen or fiber in determining tilapia yield.

#### PS. A-9

### PLANT NUTRIENT EFFECTS ON AMINO ACID-PROTEIN RELATIONSHIPS IN RICE GRAIN

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Rice, cv RD 7, grown in pot experiments with increasing applications of N, P and K produced grain with widely varying N-content (0.81-2.26% N in DM). The total amino acid composition of the rough rice was mainly dependent on N content of grain. Increasing N concentrations were associated with decreases in protein of most amino acids (g/16 g N) including lysine (4.62-3.32), threonine (4.09-3.48), methionine (3.40-2.15), cystine (2.48-1.98) and tryptophan (1.99-1.15). Varying phosphorus and potassium applications, although influencing grain yield, affected the amino acid composition only indirectly through their effects on N concentration. When expressed as mg amino acid per 100 g dry matter all amino acids increased with increasing N content. Linear regression equations were calculated and significant correlations were found between concentrations of most (g/16 g N) or all (mg/100 g DM) amino acids and N content of grain. For lysine the following relationships were established: g Lys/16 g N = 4.83-0.68 x % N (r = -0.89) and mg Lys/100 g DM = 52.5 + 201 x % N (r = 0.99). The results show the possibility of calculating the amino

acid composition of grain of a particular variety on the basis of N concentration alone. Lysine was limiting in all samples and threonine became limiting at N contents of grain higher than about 1.10%. The protein quality as expressed by the chemical score varied from 84 to 60.

#### PS. A-10

### TAXONOMY (FAMILY LEVEL) OF SOME POLYPEDONS IN THE MAHANADI CATCHMENT (INDIA) AND THEIR MANAGEMENT FOR VARIOUS CROPS

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Five representative pedons in the Bilaspur district under the Mahanadi Catchment have been previously classified into sub-group levels. An attempt has now been made to classify them into family levels with sound, concrete and efficient management suggestions for growing various crops. The Adpathra series has been classified as a member of the fine loamy skeletal kaolinitic nonacidic micro family of Lithic Ustorthents, which is not suitable for cultivated crops but suited to range management. The soils of the Bawankera and Suabahara series are members of the fine loamy kaolinitic isohyperthermic family of Ultic Paleustalfs and the fine loamy mixed isohyperthermic family of Udic Paleustalfs respectively. Both soils have good potential for growing cultivated crops, but require various management practices. The soils of the Fulwari and Patewa series are members of the very fine clayey kaolinitic isohyperthermic level family of Vertic Ochraqualfs and the fine clayey mixed isohyperthermic family of Udertic Paleustalfs respectively, which are well protected from erosion by bunds and terraces. The soils and high ground water tables are adapted to fine variety rice which, using irrigation, can increase food production through a multicrop system.

#### PS. A-11

### NITROGEN FIXING ASSOCIATIONS IN THE AERIAL PART OF PLANT STEMS

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Two types of nitrogen fixing associations have been found on the aerial parts of stems of many plant species. One is the symbiotic nitrogen fixing stem-nodules associated with Rhizobium. They are found in a rather small group of leguminous plant species including Aeschynomene indica and Sesbania sesban. The second type is an associative nitrogen fixing stem-scar containing facultative anaerobes. It occurs in many plant species distributed in a wide range of plant families. They include Leguminosae, Rhizophoraceae, Aquifoliaceae, Euphorbiaceae, Ulmaceae, Oleaceae, Rosaceae and others.

From our studies of artificial infection and anatomical examination of tissues, especially with stem-nodules of Aeschynomene indica, we concluded these nitrogen fixing associations are established by aerial infection of nitrogen fixing microbes. The development of acetylene reducing activity of stem scars was significant in an atmosphere of 2-5% pO<sub>2</sub> which would be expected inside of the living stems. Isolated facultative anaerobes from the stem scars fixed <sup>15</sup>N<sub>2</sub> and were identified as *Enterobacter* and *Klebsiella*.

#### **PS. A-12**

### **HERBICIDE-INDUCED CHROMOSOMAL ABERRATIONS AND SEEDLING MUTATIONS IN SEEDS OF SORGHUM**

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Dormant seeds of sorghum were treated with varying concentrations of Hedonal herbicide for 6 hours at 30°C, the lowest concentration being about twice the recommended spray for weed control. LC-50 for seedling height was found at approximately 0.15%; for pollen fertility, 0.12%; and for seedset, 0.16%. While the non-lethal concentrations caused euploidy as the only type of M<sub>1</sub> chromosomal aberration, the lethal concentrations produced both euploidy and chromosomal breakages observed as interchanges at MI and fragments and bridges at AI. Mutation frequency ranged from 3.64-12.35% per 100 M<sub>1</sub> spikes and 1.28-25.42% per 1000 M<sub>2</sub> chlorophyll deficient seedlings. The F<sub>2</sub> and BC segregation ratios showed that virescent seedling was a monogenic recessive induced mutation. While the yellow-striped seedling from plants with the normal diploid genome was inherited as a recessive unit character, the F<sub>2</sub> progeny from two euploid plants segregated in a ratio of approximately 35:1, indicating inheritance of a duplex type of autotetraploidy. Pollen abortion and low seedset were the only traits associated with the MI interchanges and AI fragments and bridges. These results point to possible genetic risks from both low and high concentrations of the herbicide.

#### **PS. A-13**

### **CHEMICAL AND BIOCHEMICAL ACTIVITY AND REACTIVITY OF ALGAE MARINE PRODUCTS (CYTOZYME) ON CROPS**

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The chemical and biochemical activity and reactivity of Cytozyme Crop+ (as a marine algal product) sprayed systematically on sugarcane and on cereal crops has been studied. Its role related to photosynthesis and N fixation is discussed. In the form of Seed+ and Soil+ it has been applied to seeds and soils respectively. For seeds the results have been compared to mutant varieties. Judgments on its effect on raising agricultural productivity, including soil and crop management,



pollution and application of chemical fertilizers have been made. These judgments were based on crop photosynthesis, crop logging and yields for Crop+; on germination % and growth rate for Seed+; and on soil microbial analysis for Soil+.

#### **PS. A-14**

##### **STUDIES ON THE CONVERSION OF VARIOUS PHOSPHATE ROCKS TO A NEW PHOSPHORUS FERTILIZER SUITABLE FOR SHORT TERM CROPS**

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The known solid state reaction of apatite with soda ash and quartz has been applied to determine the optimum conditions for the production of a fertilizer. In this study rock phosphate samples from Sri Lanka (Eppawela), Brazil (Jacupiranga), South Africa (Phalaborwa) and Senegal (Pallo) were investigated as to their potential for yielding a new phosphate fertilizer. The molar ratio of 1:2:1 for apatite, soda ash and quartz respectively was found to be suitable for Eppawela and Jacupiranga samples while for a Phalaborwa sample the molar ratio of 4:8:3 was sufficient. A temperature of 900°C and a sintering time of 2 hours gave the best yield of available phosphorus. A Pallo sample was found to be not suitable for the process. The products obtained with Eppawela, Jacupiranga and Phalaborwa rocks contained rhenanite,  $\text{CaNaPO}_4$ , as the major phase while their free lime content was negligible. Silica may be replaced by potash feldspar in the composition to produce a potash-containing phosphorus fertilizer. The products were found to be soluble in 2% citric acid, and almost 100% of their total phosphorus content is available for plant nutrition. Preliminary field trials carried out on paddy plants indicated that, on application to slightly acidic wet soils, the new fertilizer's activity is comparable with that of ordinary superphosphate fertilizers.

#### **PS. A-15**

##### **YIELD AND NUTRITION OF RICE AS INFLUENCED BY DURATION OF PRESUBMERGENCE AND AMENDMENTS IN A HIGHLY SODIC SOIL**

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Field experiments were conducted to evaluate the effect of amendments: gypsum (12.5 tonnes/ha), farmyard manure (30 tonnes/ha), and rice husk (30 tonnes/ha), with a control of no amendment, at 3 levels of duration of presubmergence (0, 15 and 30 days) prior to the transplanting of rice in a highly sodic soil (pH 10.6, ESP 94). Effects on soil properties, growth, yield and chemical composition of rice were noted. Beneficial effects of presubmergence on the grain yield of rice was conspicuous over the treatments which had no prior flooding. This effect was more pronounced with farmyard manure and rice husk compared to gypsum and the control. Though gypsum reduced the soil pH and exchangeable sodium to a larger extent and produced higher yields than farmyard manure at 0 and 15 days presubmergence, both were found equally effective at 30 days so far as the yield and nutrition of the

crop were concerned. Effects of duration of presubmergence and amendments on the availability of iron, manganese, zinc and phosphorus and their role in the nutrition of rice crop are discussed. The results suggest that a period of 15 to 30 days of presubmergence is very important for better rice yields when calcareous sodic soils are to be reclaimed by organic amendments like farmyard manure.

#### **PS. A-16**

##### **MANAGEMENT OF EXCESSIVE PERMEABLE RICE SOIL**

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A large area of acid lateritic soils around Kharagpur (West Bengal) has a top thin layer of soil (25 to 60 cm), mostly of detrital material, underlain by a deep and highly porous lateritic crust. The soil has low inherent fertility and there is no source for supplemental irrigation. Water received through precipitation is rapidly lost by deep percolation. With the objective of increasing the production of rainfed upland paddy in this tract, compaction with the help roller (800 kg) at the surface and subsurface layers was carried out under farmers field conditions. Increase in compaction markedly increased the bulk density and also reduced the hydraulic conductivity more than two-fold. A significant yield increase was obtained in compacted plots, an increase attributed to the reduction of deep percolation losses. The percentage increase in grain yield was about 50-55% with six passes of the roller. The increased yield may also be related to an increased nutrient content per unit volume of soil when the bulk density increases. The effect of compaction on salt distribution was studied under laboratory conditions. The time required for the water front to reach a desired distance was several times greater in higher bulk density soil. This may be due to reduction in non-capillary pore space resulting from increased bulk density. The study indicated that the depth to peak salt concentration decreased with the increase in bulk density, and at the same time the maximum salt peak concentration tended to increase. There was a two-fold decrease in the depth to peak salt concentration at higher bulk density. This suggests less leaching losses of nutrients like added nitrogen under high density conditions.

#### **PS. A-17**

##### **RAISING RICE PRODUCTION IN EGYPTIAN SALINE SOILS**

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The yields of rice crops grown in soils with initial salinities of various degree, or when irrigation drainage waters of medium and poor suitability have been used, are very low compared with the potential yields. Experiments carried out annually have led to evaluation of some local varieties and crosses of rice for salt tolerance. Young rice seedlings are highly sensitive to salt with any slight increase in the specific electrical conductivity of the soil solution above 4

mmhos/cm at 25<sup>0</sup>C being very harmful to newly germinated seed. The yields of grain and straw are decreased by increasing water salinity to 4000 ppm. The grain/straw ratio declined from 0.4 to 0.27 as salinity increased from 300 (control) to 4000 ppm. Giza 159 variety is superior to all other varieties and strains tested in the yield of both grain and straw.

In the case of temporary (short-duration) salinity, the grain yield depended on salt concentration of irrigation water, duration of applied salinity, stage of development at salinity initiation and length of period following subjection to salinity. Straw is less responsive to temporary salinity than grain and is generally affected only under relatively high salinities. The optimum water requirement for rice is 8000 m<sup>3</sup>/fed (196 cm depth of water) including the amount needed for soil preparation.

#### **PS. A-18**

##### **PHOSPHORUS AVAILABILITY TO CROPS IN CALCAREOUS SOILS**

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The methods for determining available phosphorus of Olsen, Egner-Riehm (ammonium lactate and calcium lactate), Bray (two extractant concentrations), Joret-Hebert, and distilled water extraction, were studied. Calcium dihydrogenphosphate was applied at rates of 0, 100, 200, 300, 400 and 500 kg P<sub>2</sub>O<sub>5</sub>/ha to fodder sorghum planted in pots. Two soils were used: silty loam with 15.7 me/100g of total exchange capacity, and sandy loam with 12.4 me/100g of TEC. Both soils were poor in phosphorus by Olsen's method. The experiments had 5 replications. All methods, excepting calcium lactate in one soil, showed more soil phosphorus extracted with increased rates. It is possible to calculate critical levels for each method for sorghum, except with calcium lactate and ammonium lactate. With the help of a trial where simple calcium superphosphate was applied to soil, it is concluded that for both phosphorus sources the amount of added P that is available to plants is the same theoretically, but the plants responded to the reactive form and not to the fertilizer. It is deduced that methods of determining available phosphorus and critical levels are valid for each P source.

#### **PS. A-19**

##### **THE IMPORTANCE OF CHEMICAL ANTIDOTES IMPROVING THE SELECTIVITY OF HERBICIDES IN EFFECTIVE WEED CONTROL**

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Chemical weed control is extremely important to any good program of crop production. Unfortunately, numerous highly active herbicides cannot be directly

exploited since application at rates necessary for effective weed control cause considerable damage to the crops as well. However, the addition of chemicals as antidotes (safeners, protectants) can substantially decrease or completely eliminate crop injury without affecting herbicidal activity. These chemical antidotes allow: a wider selectivity of the safety margin of herbicides so that higher doses can be used; the control of a wider range of weed species closely related to the crop; and the use of cheaper and/or more effective herbicides otherwise not practicable in the particular crop. New antidotes are usually protective only to a single or a few species of plant against a single or a few species of herbicide. However, on the basis of systematic chemical reactivity - biological activity studies, we have recognized and synthesized a type of compound which proved to be very effective as an antidote protecting corn plants against injury by thiocarbamate (EPTC) and chloroacetanilide (acetochlor) herbicides both in laboratory and field experiments. Because of its high botanical specificity our experimental antidote can be applied as a tank-mix which will provide effective control of monocotyledons, resulting in a crop yield identical with that obtained by hand tillage.

#### **PS. A-20**

##### **AMMONIA EXCRETION BY AZOTOBACTER CHROCOCCUM AND ITS EFFECT ON CROPS**

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There are wild type strains of Azotobacter chroococcum in nature which have the ability to excrete ammonia. A few promising cultures with a high ammonia excreting ability were further improved and their effect on crops was studied. A.chroococcum strains were found to excrete up to 40 g/ml of ammonia when grown in Jensen's medium under stationary condition at 30°C. Among the factors (physical, chemical and biological) studied manganese incorporation ( $1 \times 10^{-7}$  M) in the medium was found to increase ammonia excretion from 40 g/ml to 80 g/ml. The effect of ammonia, excreted by Azotobacter on (1) legume crops - Moon together with Rhizobium and Pseudomonas (2) non-legume - wheat and maize together with Pseudomonas was found to be significant. The mechanism of ammonia excretion is discussed.

#### **PS. A-21**

##### **PHOSPHORUS SORPTION PATTERNS UNDER CONTROLLED REDOX POTENTIAL**

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Samples of the Crowley silt loam soil have been thoroughly mixed with 0.4% ground rice straw and 0.01 mol/L CaCl<sub>2</sub> solution, and then either purged with nitrogen to obtain reducing conditions (E<sub>h</sub> = -220 mv) or treated with atmospheric air to reach oxidising conditions. Using the addition of 2 levels of P (10 ppm and 100 ppm), applied in the form of calcium dihydrogen phosphate, it has been determined that more P was adsorbed under the reduced condition with the effect more

pronounced at the higher level of P fertilization. After 288 hours there was 55.92% and 90.20% adsorption of P in the oxidized and reduced samples respectively. For the lower level (10 ppm P) most of the P adsorption took place in the first 12 hours for the oxidized soil, and in the first 3 hours for the reduced soil. At the higher level (100 ppm P), P adsorption in the aerobic case increased steadily for the 288 hours, but in the anaerobic case levelled off after 96 hours.

#### **PS. A-22**

### **ON-FARM RESEARCH FOR IMPROVING MAIZE PRODUCTION IN EGYPT**

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The aim of this work, using a package of simple improved agronomic practices, was to overcome the major problems constraining maize production in Egypt. High-yielding maize varieties, Pioneer - 514 and Giza -2, were used, plant density and rate of N fertilizer addition were increased, foliar micro-fertilizer was applied and weeds were controlled. A forage crop (Surdan - 79) was cultivated in 1/10 of the maize area of each farmer to avoid defoliation and detasselling of maize. Traditional maize fields were used as controls. The results showed that the average yield of maize grains was increased from 3.5 t/ha in the control fields up to 8.1 t/ha in the demonstration fields (in an area of 323 ha). At harvest time Pioneer 514 also gave 39.5 t of green stalks/ha for animal feeding. The yield of green fodder from Surdan-79 was 115.2 ha during three successive cuttings. It was concluded that the use of these improved agronomic practices gave significantly increased production of maize: 7.3 ton of grains plus 28.8 ton of green fodder, in comparison with 3.5 ton of grain and no more than 11.9 ton of detached leaves from traditional fields.

#### **PS. A-23**

### **NITRIFICATION INHIBITORS AND SLOW-RELEASE NITROGEN FERTILIZERS FOR INCREASING RICE PRODUCTION**

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Of the world's 145 million hectares of land producing rice 90% is in Asia, and 40% of the world's population, mostly in Asia, uses rice as a major source of calories. Rapid population increase in many Asian countries poses a potential severe malnutrition problem and an adequate supply of rice is a necessity. High yielding rice varieties such as IR-8 have increased rice production but have high nitrogen demands. Available data show that only 30-40% of applied N is utilized the rest being lost through volatilization, denitrification and leaching. Use of specific nitrification inhibitors (N-Serve, AM, DCD etc.) or indigenous materials such as neem (*Azadirachta indica* Juss) cake along with conventional N fertilizers, slow-release N fertilizers (sulphur coated urea, isobutylidene diurea etc.), urea supergranules or briquettes increases the efficiency of such N application resulting

in higher rice yields. These new chemicals and new fertilizers hold considerable promise for increasing rice production in the world.

#### PS. A-24

##### GASEOUS N LOSSES FROM SOILS UNDER CONTINUOUS WHEAT VERSUS A WHEAT-FALLOW ROTATION

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Field studies were conducted over a two year period (May to October inclusive) to assess gaseous losses of nitrogen ( $N_2 + N_2O$ ) from two Black Chernozemic soils (Hamlin cl and Hoey cl) under continuous wheat (w-w) and wheat-summerfallow (w-f) rotations. Gaseous N losses from cropped fields were very low in both years ranging from 1.5 to 3 kg N/ha; up to 75% of this nitrogen was generally lost during the early spring period (April to May). In contrast, losses from summerfallow fields were several-fold higher; the 2 year cumulative gaseous losses of N for the w-f rotation was two to six times higher than the continuous wheat rotation.  $^{15}N$  labelled balance studies were carried out on microplots established on the same two sites during the 1981 growing season. Cumulative N losses measured during the period May 26 to August 31 using the acetylene technique were 1.2 and 1.8 kg N/ha at the Hamlin cl and Hoey cl sites, respectively. These results agree closely with the amount of nitrogen which could not be accounted for in the  $^{15}N$  balance studies (1.2 + 2.1 and 2.3 + 3.1 kg N/ha, respectively). While the acetylene technique is highly labor intensive, these studies indicate it has a major advantage over the  $^{15}N$  balance approach, namely, the capability to assess short term response of denitrification to rainfall events in particular.

#### PS. A-25

##### POTENTIAL OF BOTANICAL SPECIES FOR CROP PROTECTION BY SMALL-SCALE FARMERS IN DEVELOPING COUNTRIES

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Some botanical species appear to have potential as effective, economic, convenient, and environmentally safe alternatives to commercially prepared pesticides for crop protection. A literature review of over 10,000 plant entries revealed about 1,900 species purported to possess some desirable pest control property (pesticidal, attractant, repellent, anti-feedant, or allelopathic). Approximately 70 appear to have suitable characteristics (ease of growth and low maintenance needs, possible complementary economic uses, and safety and convenience in the local preparation and use of the pest control material obtained therefrom). A recent survey of nine developing countries (Bangladesh, India, Malaysia, Mauritius, Mexico, Pakistan, Philippines, Sri Lanka, and Thailand) described about

50 species possessing similar characteristics. Pest control properties of many of these species have not been previously reported. Some 90 botanical species have been short-listed as holding a high potential, and their growth habits and pests they are reported to control summarized. Judgemental and preliminary ratings based on ease of growth, input needs, and the likely convenience in the local preparation and use of the pest control materials obtained therefrom have been given.

A coordinated multi-disciplinary 5-year research project is being planned, in cooperation with various national and international agricultural research agencies, to: (i) test the efficacy of selected botanical pest control materials (pcm) against major crop pests in the field and/or in storage; (ii) investigate alternative and locally reproducible methods for pcm preparation; (iii) determine farmer reaction to pcm use; (iv) evaluate feasibility of village cottage industry preparing pcm; (v) assess environmental impact of pcm use; and (vi) assess impact of pcm use on food preparation, nutrition availability, and the local economy.

#### PS. A-26

### EFFECT OF N,P,K,S AND Zn ON THE NUTRITION OF RICE PLANTS UNDER BANGLADESH CONDITIONS

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Experiments were conducted in the Sonatola silt loam soil with modern varieties of rice developed by BRRI (BR-4 as Aman and BR-3 as Boro and Aus) using the treatment combinations: Control,  $N_{45}$ ,  $N_{90}$ ,  $N_{90}P_{80}$ ,  $N_{90}P_{80}K_{60}$ ,  $N_{90}P_{80}K_{60}S_{30}$ ,  $N_{90}P_{80}K_{60}S_{30}Zn_4$ , and  $N_{135}P_{80}K_{60}S_{30}Zn_4$ ; in the case of Boro  $N_{60}$ ,  $N_{120}$  and  $N_{180}$ . Two Aman experiments were carried out in farmers' fields in the same soil series for comparison. The results for Aman-1980, Boro-1981, Aus-1981 and Aman 1980 are reported. They show that the deficiency of N is wide-spread and the lower dose of N was superior to the high one in kg yield/kg N added. However, the effect of P and K was not clear. The application of S significantly increased the yield of rice grown during the Aman season of 1980 in the wet year, but failed to bring any beneficial effect in the same season of 1981 in the dry year; its effect in Aus was very prominent. The effect of Zn was significant in all seasons except in the Aman of 1980. The combined effect of all fertilizers brought about the highest yield and benefit cost ratio. This shows that S and Zn additions to the NPK fertilizers are very important for sustained rice production with modern varieties under intensive cropping. The addition of fertilizers also increased the uptake of the nutrient elements.

**PS. A-27**

**ROCK PHOSPHATE MOBILIZATION INDUCED BY SYMBIOTIC N<sub>2</sub> FIXATION**

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While utilizing symbiotically fixed nitrogen, legumes absorb from the soil more nutrient cations than anions. As a result of this alkaline uptake pattern, the soil pH will decrease, especially in the rhizosphere. In sand cultures, decreases of 1.5 pH unit were recorded with soybean. In soil cultures over a 1/2-year period, alfalfa lowered the pH by more than one unit. In contrast, legumes making use of NO<sub>3</sub>-N show an acidic uptake pattern in which more nutrient anions than cations are absorbed. In such a situation legumes, like gramineous plants, exert a pH-raising effect on the soil. It has previously been shown that legumes are capable of utilizing rock phosphate P much more efficiently when making use of symbiotically fixed N<sub>2</sub>, with its concurrent pH-lowering effect, than when making use of NO<sub>3</sub>-N with its concurrent pH-raising effect. This can have important implications for developing countries possessing rock phosphate deposits, since such phosphates will be especially useful when applied to leguminous crops. The results of recent investigations are presented.

**PS. A-28**

**INFLUENCE OF CHEMICAL CHANGES IN INCREASING  
THE YIELD OF OIL PALM IN MALAYSIA**

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Oil palms are grown in many types of soils in Malaysia. The yield of the fresh fruit bunch varies according to soil type. Besides the fertile inland soils, acid sulfate soils and brackish-water soils are also planted with these palms and with many other crops. Through the use of chemicals coupled with water-table management, thus causing changes in the chemical properties of the soils, crop yields have increased significantly. It is now possible to produce a good yield for a number of crops on these problem soils.



**PS. A-29**

**INSECTICIDE INDUCED CHANGE IN CERTAIN GENETIC ATTRIBUTES  
AND IN NODULATION OF PHASEOULUS AUREUS L.**

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Indiscriminate and increasing use of pesticides in modern agropractice is a potent source of pollution often causing hazards in crop production. The impact of soil-applied insecticides on the physiology of *Phaseolus aureus* L. with respect to changes in genetic attributes (e.g. root characteristics and changes in metabolic activities) has been studied. Two types of insecticides, organochlorine and organophosphorus, were applied to soil. The organochlorine alone and with FYM induced a noticeable change in root distribution characteristic of dicotyledoneous plants, mainly an enlarged root system. Further it reduced both the size of the nodules and the leghemoglobin content. No such effect was apparent with organophosphorus insecticides. No apparent relationship was found between the nitrogen content in the plant and leghemoglobin content in their nodules. Both insecticides delayed initiation of flowering, however, delay was increased with the organophosphorus compound when combined with FYM. The results suggest an increase in productivity due to higher translocation of nutrients through an enlarged root system.

**PS. A-30**

**RESERVES OF EFFECTIVE FERTILITY OF SOIL**

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The potential fertility of soil depends on the thickness of the plough layer, the quality of the mineralogical and biochemical composition, and especially on the use of the reserves of effective fertility in the soil. The optimum density of the plough and underplough layers is important for increasing effective soil fertility. Soil density and soil friability are affected by moving systems of tractors and agricultural machines. The influence of such moving machine systems on the volumetric mass of both plough and underplough layers and on the consequent plant yield has been investigated for sand clay (average podzolic on moraine sand clay). Laboratory compression studies at a level of 2 kg/cm<sup>2</sup> have been carried out on the friable layer, equivalent to repetitive passage of heavy tractors. Heavy machine loads tend to be absorbed in the upper layers. Maintaining soil in a friable condition may require lighter machines. The effect of mechanical deformation of soil has been found to extend beyond the plough layer, and through the possible existence of a buffer layer lessens the effect of heavy machines. The damping

effect may be due to elimination of some air from the soil. Creating optimum conditions in both the plough layer and underplough horizons may be achieved by using machines which cause reduced specific pressure on the soil.

#### PS. A-31

#### MANAGING PSEUDOMONS SOLANACEARUM WILT

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Bacterial wilt incited by Pseudomonas solanacearum Smith is a serious problem in the tropics and subtropics for solanaceous crops like potato, brinjal, tomato and chillies. Average losses vary from 10-70%. The pathogen primarily survives in vegetative propagative material and soil/weed hosts. Studies were carried out for effective disease control/management.

Fungicidal and bactericidal chemicals available in the market and pre-released chemicals were tried in combination with cultural practices. Twenty-seven chemicals were tried. The cultural practices used were keeping the land fallow, exposing the ploughed fields to summer heat (April to June), straw burning (straw was spread and burnt into 20 cm deep furrows prepared at a distance of 40-50 cm) and straw burning plus summer ploughing. The potato tubers/tomato seedlings were dipped in respective chemical solutions (100 ppm, 500 ppm, or 2000 ppm as appropriate) for 30 minutes after being given a 1 cm deep incision. They were then planted in infested soil. Among the chemicals EL 222 9EC (Lilly Research Centre Ltd., Windlesham, Surrey, England), CGA 46505 (Ciba Geigy, Switzerland), Co 90014/2 (Electrochemical Industry, Munchen), Benodanil (BASF, W. Germany) and Vitavax were found promising. These chemicals delayed the symptom appearance by 42 days and also reduced the wilting by 55-70% over the control. Burning of straw and summer ploughing reduced the wilt incidence by 65-80%.

The delayed symptom appearance from chemical treatment shows the effectiveness of chemicals in preventing infection although the chemical effect appears diluted with time. The reduced wilt incidence by straw burning and summer ploughing shows their efficacy in reducing the soil inoculum. Tuber treatment with any of the above chemicals coupled with straw burning/summer ploughing in warmer countries is bound to reduce wilt incidence to an insignificant level, thereby increasing yields of potato and other solanaceous crops.

**PS. A-32**

**BALANCED FERTILIZER USE BASED ON SOIL ANALYSIS TO OBTAIN TARGETTED  
LEVELS OF FOOD PRODUCTION IN INDIA**

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Soil testing is an important service function with regard to high yielding crop varieties and hybrids. Under this project the technique used is to apply fertilizer based on soil analysis for a specific yield target. Three basic parameters are deduced from soil test-crop response field experiments: (1) nutrient requirement for a given level of grain production; (2) % efficiency of soil available nutrients as measured by the soil test method; and (3) % efficiency of added fertilizer nutrient. Data have been obtained for Paddy (IR-20) in alluvial soils of Tanjore and for wheat (WL-711) in alluvial soil of Punjab. From these data simple adjustment equations are generated to provide fertilizer recommendations in N, P and K for specific yield targets. Similar data have been generated for a range of crops such as Sorghum, Gram, Soybean, Maize, Cotton, Rapeseed, Sugarcane, Potato and Jute growth in different soil-agro-climatic regions. Simple follow-up trials in farmers' fields have demonstrated that, by using this method of fertilization and all other appropriate agronomic practices, it is possible to achieve the yield targetted within +10% deviation. The extension applications of this approach are (1) in promoting balanced fertilization for the same fertilizer investment; (2) planning for different targets of food production and promotion of appropriate fertilizer consumption in an area; and (3) planning for different yield targets in a multiple cropping system so as to maximize fertilizer use efficiency and maintain soil fertility.

**PS. A-33**

**NEEM, CHINABERRY, AND CUSTARD-APPLE: ANTIFEEDANT AND  
INSECTICIDAL EFFECTS OF SEED OILS ON LEAFHOPPER AND  
PLANTHOPPER PESTS OF RICE AND THEIR PREDATORS**

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Seed oils of neem (Azadirachta indica A. Juss), Chinaberry (Melia azedarach L.), and custard-apple (Annona sp.) were evaluated in the laboratory for antifeedant and insecticidal effects on the green leafhopper, Nephotettix virescens (Distant), the brown planthopper, Nilaparvata lugens (Stal), and the whitebacked planthopper, Sogatella furcifera Horvath. Food intake by newly-emerged females decreased significantly on the susceptible Taichung Native 1 rice plants sprayed with oils @  $\geq$  5 mg/plant. Low doses of these oils ( $\geq$  5  $\mu$ g/insect) caused significantly high mortalities of N. lugens and S. furcifera females, but only custard-apple oil caused any significant mortality of N. virescens. These oils were relatively nontoxic to common predators, such as the spider, Lycosa pseudoannulata (Boes. & Str.), and the mirid bug, Cyrtorhinus lividipennis (Reuter). The selective action of these oils

suggests that they can be used for integrated control of rice leafhoppers and planthoppers.

#### PS. A-34

### COMPLEXES OF Co(II), Ni(II), Cu(II) AND Fe(III) WITH SCHIFF BASE AND THEIR BIOLOGICAL RELEVANCE

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Metal chelates and the Schiff bases show bactericidal and fungicidal activities against a large number of bacteria and fungi. Some metal complexes of a new Schiff base, 1-2'-furyl glyoxal aspartic acid anil have been synthesized and the bonding characteristics of these compounds studied by electronic, IR, EPR, and magnetic methods. The ligand and metal complexes were tested against a number of fungi and bacteria *in vitro* by the agar diffusion technique (paper disc method). Of these compounds, Ni(II), Cu(II) and Fe(III) complexes of the ligand were found to be remarkably active against Collectotrichum capsici and Helminthosporium sativum but inactive against other three fungi viz. Ascochyta rabei, Penicillium nigricans, and Aspergillus niger. The ligand showed no activity except against Helminthosporium sativum. In the bacterial studies, the ligand showed little activity against Escherichia coli while against the other two it was inactive. In the case of metal complexes, only Co(II), Ni(II) and Cu(II) complexes showed lesser activity in comparison to the ligand against Escherichia coli and Bacillus subtilis whereas, against Staphylococcus aureus, no compound was active except the Co(II) complex which showed slight activity. Some of these metal complexes may thus provide an effective control of these bacteria and fungi in several plants and animals.

#### PS. A-35

### THE PROCESSING OF ACID TROPICAL PEAT DEPOSITS TO YIELD PRODUCTIVE SOILS, METHANE AND SLOW-RELEASE FERTILIZER

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Millions of hectares of underutilized acid organic peats and mucks in the humid tropics constitute a tremendous reserve of energy- and nutrient-rich biomass. Some deposits are high in sulfate sulfur which is converted to hydrogen and metal sulfides under reducing conditions and to sulfuric acid when drainage and aeration are better. Many attempts have been made to use peat deposits directly for estate crops like rubber, oil palm, coconut and pineapples, and for rice production in the case of the acid sulfate soils. However, rates of return on investment have usually been low, due to tree-fall following drainage and oxidative subsidence, high fertilizer and lime requirements and to plant damage in the case of the acid sulfate

deposits. A flow-sheet is presented which outlines a viable scheme for the conversion of these surficial organic deposits to methane and relatively high-analysis, slow-release organic fertilizer for use on fragile agricultural soils invariably present within easy transport distance of the peat deposits. The scheme features batch digestors, easily movable by buffalo-power when empty, the use of plastic surfaces to avoid the need for reinoculation with methanogens, and the addition of small amounts of readily purchasable N-P materials for pH control, for maximizing methane production, and for increasing the value of the digest residue as fertilizer. For acid sulfate soils, an extra water extraction step is required for removal of the sulfates for conversion to ammonium sulfate, a valuable rice fertilizer. After peat removal and processing the organo-mineral soils can be made available to smallholders for agricultural use given water control, or can be allowed to flood for use as fish ponds or for biomass production under aquaculture.

### PS. A-36

#### STUDIES ON ASSOCIATIVE $N_2$ -FIXATION BY ANTIBIOTIC RESISTANT MUTANTS OF AZOSPIRILLUM WITH GENOTYPES OF CHEENA (Panicum miliaceum) IN CALCAREOUS SOIL

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Nitrogen is undoubtedly the most critical nutrient limiting crop production in tropical agriculture. Its requirement is only partially met through industrial nitrogen fixation and most of it is obtained through biological means. The possibilities of exploiting the process of  $N_2$ -fixation described as associative symbiosis has assumed importance recently. The organism Spirillum lipoferum has been reported to grow both in and on the roots of tropical plants. The present study reports on associative  $N_2$ -fixation by antibiotic resistant mutants of Azospirillum brasilense with genotypes of cheena in calcareous soil. N-methyl-N-nitro-N-nitrosoguanidine (MNNG) induced mutation frequencies resistant to streptomycin, spectinomycin, erythromycin and novomycin were studied in Azospirillum brasilense. A. brasilense and its five mutants viz. STR 1, STR 2, SPTR 1, ERYR 1, NOVR 1, and five genotypes of cheena viz. BR 7, MS 4872, RAU M1, RAU M2, and RAU M3, were used for field experiment in a split plot design with an initial dose of 35 kg N/ha in calcareous soil. Mutant strains STR 1, and ERYR 1 showed maximum grain yield (30 and 31.5 q/ha respectively) and nitrogenase activity with genotypes BR 7 and RAU M2. The interaction between strains and genotypes was significant. Differential response of A. brasilense and its mutants with different genotypes was also observed. Mutant NOVR 1 was ineffective giving no better yields than uninoculated controls (26.5 q/ha).

**PS. A-37**

**THE ROLE OF CHEMISTRY IN SOIL AND CROP MANAGEMENT FOR EFFICIENT USE  
OF NUTRIENTS TO IMPROVE PRODUCTIVITY OF INDIAN SOILS**

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Indian soils are found to be generally poor in nitrogen. About 46% of the soils are low in phosphorus, and under neutral and alkaline conditions phosphorus materials need a high degree of water solubility. In acid soils there is scope to use rock phosphate either singly or mixed with other soluble material. Nearly 20% of the soils are low and 42% medium in potassium. Continuous cropping without replenishment of potassium has led to a decrease in the availability of these essential nutrients. Deficiencies of phosphorus, potassium, zinc, sulphur and a few other micro-nutrients would assume serious proportions in areas which are presently deficient or marginal. Thus it is necessary to monitor the changes in the availability of plant nutrients through systematic surveys on established benchmark soils. Intensive studies have been carried out on physical, chemical and mineralogical properties of nearly 64 benchmark soils identified and mapped in the country. Interpretations are given as to the land suitability classes for irrigation and productivity potential with respect to different levels of management. Soil fertility investigations are likely to get more diversified. Nutrient requirements with respect to pulses and oilseeds, fodder and fibre crops should also receive concentrated attention.

**PS. A-38**

**EFFECT OF HORMONES ON GROWTH AND NITROGEN FIXATION IN NOSTOC HATEI**

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Effects on N-fixation and growth of Nostoc hatei in rice crops through use of commercially recommended growth promoting substances such as Celmone, Planofix, IAA, GA3 and Kinetin were studied. These compounds stimulated the algal growth at lower concentrations. Higher concentrations of 100 ppm or more were detrimental. GA3 however, proved to be stimulatory even at 100 ppm. Celmone and Planofix stimulated the algal growth at 1 and 10 ppm; and Kinetin at 1 ppm. IAA slightly inhibited the growth although it stimulated the N-fixation at 0.5-10.0 ppm. Nitrogen fixation was unaffected by Celmone, Planofix and gibberellic acid and was reduced by Kinetin. Heterocyst formation was affected by all the compounds except GA3. Application of these hormones in agricultural practices, therefore, may not be harmful to this alga which is used as a biofertilizer in this region.

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**PS. A-39**

**PRELIMINARY INVESTIGATIONS ON THE USE OF EARTHWORMS  
AS POULTRY FEED**

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Due to the shortage of proper raw materials for poultry feed, particularly in North Eastern India, preliminary investigations were made on the use of locally available earthworms which are abundant. The nutritional values of four earthworms such as Metaphire (= Pheretima) postuma (Vaillant), Metaphire (= Pheretima) houletti (Perrier), Amyntus (= Pheretima) diffringens (Braid) and Amyntus (= Pheretima) alexandri (Beddard) for chickens were determined by analysing their crude and true protein, calcium, fat, carbohydrate and phosphorus content. The effect of the earthworm meal on the growth and weight of broilers was measured. These findings are discussed in comparison with those of other investigators.

**PS. A-40**

**MODIFICATION OF SEX-EXPRESSION BY CHEMICAL  
TREATMENTS IN MIMORDICA CHARANTIA L.**

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In order to modify the expression of sex for its application in hybrid seed production and crop improvement in bitter melon (Mimordica charantia L.), the plants at three true leaved stage were treated one to nine times with aqueous foliar sprays of 50, 100 and 150 ppm  $\text{CdCl}_2$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{CoCl}_2$ ,  $\text{MnCl}_2$ ,  $\text{CuCl}_2$ ,  $\text{AgNO}_3$ , CCC (Chlorocholine chloride (2-chloroethyl) trimethylammonium chloride) and Ethephon (2-chloroethylphosphonic acid). The changes in maleness, including proportion of male to female flowers and time for formation of the first male flower, have been evaluated and details are presented. Pollen viability has also been compared with untreated control plants. Changes in the endogenous levels of IAA and IAA-oxidase in the leaves of treated and untreated plants at the time of floral bud initiation were also studied. Plants with increased femaleness are to be used in making prospective parental lines for their utilization in hybrid seed production and crop improvement.

**PS. A-41**

**EFFICIENCY OF CHEMICAL NITROGEN FERTILIZERS APPLIED TO RICE IN ASIA**

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Urea, which is the major chemical fertilizer applied to wetland rice, is notoriously inefficient. Research with  $^{15}\text{N}$  shows that when urea is broadcast on paddy fields, as applied by Asian farmers, only 25-30% of the nitrogen is absorbed by the rice plant and 30-60% of the nitrogen is lost from the soil-plant system. Field measurements using a micrometeorological method show that up to 50% of the urea is lost through ammonia volatilization. The rate of ammonia loss depends on the concentration of nitrogen in the floodwater, the pH and the alkalinity in the water, the temperature and wind speed, and the sink strength of the plant root system. Chemical and physical modifications of urea have been developed to limit the concentration of nitrogen which appears in the floodwater after fertilizer application and so reduce losses. This can be achieved by coating the urea with sulfur or organic polymers to slow the release rate of nitrogen or by producing large particles of urea, such as briquettes or supergranules which are conveniently sized for deep placement in the puddled soil. Another approach is to retard the hydrolysis of urea to ammonium carbonate using urease inhibitors, such as phenyl phosphorodiamidate (PPD), which thus allow the plant to compete with the ammonia loss mechanism. A similar concept is to increase the rate of plant absorption of nitrogen by including a plant growth stimulator, such as triacetonol, with the urea.

**PS. A-42**

**ASSIMILATE TRANSPORT CAPACITY AS A FACTOR LIMITING PROTEIN  
DEPOSITION IN THE RICE (ORYZA SATIVA L.) CARYOPSIS**

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Progress in the important objective of raising protein content in rice has been restricted by lack of suitable screening methods early in crop growth and by the pronounced genotype-environment interaction for this character. Studies to determine the primary limiting factors controlling protein deposition in the rice grain are being undertaken with the objective of developing screening procedures for identification of rice genotypes with optimum efficiency in grain protein deposition. The biosynthetic capacity of the rice endosperm does not limit starch or protein synthesis. The transport of  $^{14}\text{C}$ -labelled assimilates from the maternal pericarp tissue of the caryopsis into the filial aleurone and endosperm cells has been studied. Assimilates are carried into the rice grain via the pericarp vascular bundle and the nucellar epidemis, and are then actively transported to the sites of synthesis across cell membranes and cell wall at the nucellus/aleurone interface. This step is a constraint to the supply of assimilates to the endosperm and



therefore limits storage product deposition. Assimilate flux through the nucellus is regulated by the rate of water loss from the grain and the relative rates of transport of amino acids and carbohydrates from the maternal to the filial tissue. Both the final percentage protein content and the distribution of protein bodies within the grain are governed by these factors.

The identification of these constraints will allow screening for naturally-occurring and induced variation in transport tissue characteristics of rice, and aid selection for greater protein content and better protein body distribution.

#### **PS. A-43**

### **DV/TCC AS AN INDEX FOR DETERMINING THE QUALITY OF IRRIGATION WATER**

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Irrigational use of saline ground water in regions such as North Gujarat, parts of Uttar Pradesh, Rajasthan and Bihar is not infrequent. There are reports from these areas that waters of 3600 ppm and above are being used without deteriorating the soil conditions even after persistent use. Standards for irrigation water quality therefore need to be reconsidered. Standards such as S.A.R., Adj-S.A.R., R.S.C., S.S.P., etc. along with considerations for crops and soils, are the vogue. Different relationships from these standards have been noted in our earlier work using the ratio of divalent cations to total cation concentration (DV/TCC). Field data show that water with a DV/TCC of 0.3 and more did not have a deleterious effect on soils and crops. Further studies are presented which indicate that the ratio of DV/TCC may prove to be a useful water quality index.

#### **PS. A-44**

### **PARTITIONING OF NITRATE REDUCTASE ACTIVITY FOR PROTEIN ENHANCEMENT IN TRITICALE**

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Protein formation occurs in the grain after anthesis, when grain is in its developmental stage. Maximum nitrate reductase activity (NRA) is essential because it is the rate limiting enzyme in wheat and triticale protein synthesis. Studies on TL 419, the first commercial triticale variety, indicate that much of NRA was in the lower leaves (formed and senesce before anthesis) with a lower amount in the flagleaf (theoretically it contributes 40% during ear development). Better genotype selection for maximum NRA in flagleaf (after anthesis) would substantially enrich the protein of the first man-made drought tolerant cereal - Triticale. In the post-anthesis state the principal objective is to increase longevity of the photosynthetic surfaces, with large LAI, erect leaves etc.

**PS. A-45**

**NATURALLY OCCURRING PESTICIDES AND THEIR POTENTIAL**

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The widespread use of insecticides brings problems of resistance, environmental pollution and hazards to non-target organisms. To mitigate these, a large number of indigenous plant materials were screened from which custard apple (Annona squamosa Linn.), neem (Azadirachta indica Adr, Juss.), garlic (Allium sativum Linn.), arrow root (Maranta arundinacea), Kachura (Kaempferia galanga) and Oleoresin (Chrysanthemum cinerascifolium Trev.) showed promise in controlling household and insect pests of significance to storage. The bioactive components are amonaine from custard apple seed, azadirachtin from neem seed, diallyl disulfide from garlic clove, benzyl isoquinoline and barbarine from arrow root tuber, galangin (dioxy flavanol) from Kachura rhizome possessing a camphoraceous odour, and oleoresin (contains 14.8% pyrethrin - I & 15.2% pyrethrin - II) from Chrysanthemum flowers. Custard apple has shown toxicity to Musca domestica nebulosa Fabr., Callosobruchus chinensis and Rhizopertha domonica and caused diuresis among last instar nymphs of Periplaneta americana Linn; Neem, custard apple and garlic have caused growth retardant effect in P.americana and Sitophilus oryzae Linn, and they have served as synergist, neem for custard apple and garlic for oleoresin against C.chinensis, R.dominica and M.d.nebulosa. Arrow root and Kachura are strongly repellent against M.d.nebulosa, Culex fatigans and against six different species of storage beetles and Cimex lectularius. Further, Kachura has shown synergism with DDT, and arrow root with both DDT and Lindane against M.d.nebulosa.

**PS. A-46**

**PHEROMONE TRAPS TO MONITOR THE ASIAN CORN BORER  
IN A PEST MANAGEMENT PROGRAM**

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Virgin females of the Asian Corn Borer, Ostrinia furnacalis (Guenee), are known to emit a pheromone that attracts male moths. Extracts from females and synthesized pheromone were compared against virgin females as bait for traps. Trap design and location were also tested to improve the reliability and utility of traps. Trap data provide immediate information about local moth populations and should also be useful in pest population predictions. A population model has been developed which relies on trap data to predict the time of future generation peaks. Pest predictions along with scouting can reduce the control cost and uncertainty of pest problems.

**PS. A-47**

**ABSCISIC ACID AND RESPONSES TO WATER STRESS IN RICE**

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Abscisic acid (ABA) application to young rice plants results in closure of stomata and in inhibition of shoot growth. Both effects are characteristic of water-stressed plants. Stomatal reopening and recovery of growth rate occur rapidly following cessation of ABA treatment. The amount of ABA present in leaves of rice increases dramatically when plants or detached leaves experience water deficit. Only small reductions in turgor potential ( $<0.2$  MPa) are required to cause significant increases in ABA. The rise in ABA level is closely linked to the closure of stomata in water-stressed plants. Genotypic variation was observed for growth responses to exogenous ABA. Differences between rice genotypes in the capacity to accumulate ABA in response to water stress were also demonstrated using a standard detached leaf test. Crosses prepared between genotypes contrasting in ABA accumulation are being used to generate closely-related lines suitable for evaluating effects of differing ABA levels on plant survival and productivity during drought.

**PS. A-48**

**IMPACT OF CHEMICAL CONTROL OF NEMATODES  
ON YIELD OF BANANA, POTATO AND SOME VEGETABLE CROPS**

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A number of nematicides such as Aldicarb, Oxamyl, Ethoprop, Fenamiphos, and Carbofuran were evaluated for the control of different species of nematodes attacking banana, potato, tomato and cabbage. Data obtained indicate significant control of nematodes resulting in improved plant growth and significant increase in yield. On Cavendish banana, the nematicide treatments to control Radopholus similis significantly increase the fruit size, weight and number of fruits per bunch. It is now recommended practice to apply nematicides at least twice a year in banana plantations covering over 25,000 hectares in Mindanao. Annually over 50 million pesos worth of nematicides are spent by banana growers to control the nematodes. On white potato, nematicide treatments, applied as soil incorporation before planting, to control cyst, lesion, and stubby root nematodes resulted in over 50% yield increase. The highest yield obtained was 32 tons/ha from Fenamiphos treatment as compared with 13 tons/ha of the non-treated control. Likewise, the nematicides effectively controlled root-knot nematodes attacking cabbage and tomato resulting in 30-120% yield increase. However, due to high cost of the chemicals, nematicide

treatments of soil infested with nematodes is recommended only on high cash-value crops.

#### **PS. A-49**

### **CHEMICAL ALLEVIATION OF SALINITY AND SOIL COMPACTION EFFECTS ON GROWTH OF RICE SEEDLINGS**

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The effect of 3,5 dichloro-4-hydroxybenzoic acid (DCHB) on rice seedlings with their roots in saline conditions and in compact soils were investigated. Treatment with DCHB improved seedling growth under these adverse cultural conditions, the roots benefitting more than the shoots. Inclusion of DCHB in the growth medium significantly reduced and sometimes eliminated the inhibitory effect of salt on root elongation. The uptake of sodium and chlorine was also enhanced by the presence of DCHB in the salt-treated seedlings. When incorporated in compact soil with a bulk density of  $1.5 \text{ g cm}^{-3}$ , low concentration of DCHB significantly increased root growth.

#### **PS. A-50**

### **PHYSIO-CHEMICAL CHANGES IN DEVELOPING RAMBUTAN FRUITS**

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Chemical and physiological changes in the developing fruits of 'Seematjan' rambutan was monitored from fruit set up to maturity in order to establish criteria for determining the proper time of harvest. Respiration rate was high during the first two weeks from fruit set ( $170-180 \text{ mg CO}_2/\text{kg/hr}$ ) at  $20^\circ\text{C}$ . It decreased with increasing age of the fruit from  $120 \text{ mg/kg/hr}$  on the third week down to  $58 \text{ mg CO}_2/\text{kg/hr}$  on the 13th week. The patterns of respiratory drift confirm that rambutan is a non-climacteric fruit. Ethylene production followed a similar trend to respiration. Development of the aril (edible portion), was complete on the 12th week after fruit set. Soluble solids content (SSC) increased significantly from the 12th to the 13th week (13% to 18%) and thereafter increased insignificantly up to the 16th week. SSC at this stage was 20%. Titratable acidity decreased significantly from 1.17% to 0.51% from the 12th to 13th week and thereafter slowly decreased up to the 16th week. Total sugars and dry matter increased whereas starch decreased as the fruit approached maturity. 'Seematjan' rambutan can be harvested at the earliest on the 13th week from fruit set. The fruits are as good as at a latter stage on the basis of their physio-chemical attributes, although there is the incomplete color development of the spinterns.

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**PS. B-1**

**EFFECT OF THE MILLING PROCESS ON CRUDE PROTEIN, AMINO ACID,  
WATER-SOLUBLE VITAMIN AND PHYTIC ACID CONTENT  
IN RICE GRAIN AND ITS MILLED PRODUCTS**

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The changes in content of crude protein, amino acid, three watersoluble vitamins (thiamine, riboflavin, niacin), and phytic acid in two local rice grain varieties during the milling process were determined. These nutrients were determined in paddy rice and in brown rice, lightly-milled, moderately milled, and well-milled. Their concentrations were also estimated in the grain by-products (bran, polish and germ). The results showed a slight decrease after the milling process, but a greater decrease after polishing. The bran, polish and germ fractions represent a good source of these nutrients. Phytic acid decreases gradually during milling, and depends on the degree of polishing. Rice, in addition to bread, is a major portion of our Egyptian diet. The author recommends that a national plan should be implemented immediately to enhance the quality of rice by fortification of well-milled rice with nutrients.

**PS. B-2**

**PRODUCTION OF ODOURLESS CASSAVA FLOUR (FUFU)**

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Cassava (Manihot esculenta Crantz) is one of the major Nigerian food crops. It is eaten as garri and fufu and, to a lesser scale, is used to make tapiocca. Garri (Cassava tuber peeled, grated, partially fermented, dried and fried) is eaten by all classes of Nigerians. The popularity of garri has encouraged research work on its mechanized production, preservation and chemical (cyanide) analysis. Fufu (cooked mass of fermented cassava tubers) is not popular with the majority of urban dwellers. Fufu, but for an inherently bad odour which is disliked by many, is better than garri because it has less fibre and cyanide. In appearance, it is comparable to cooked semolina and powdered rice. If fufu were deodorised, it would be acceptable. This project, therefore, aims at deodorising fufu flour, which, if successful, will increase the use of cassava flour (for garri, it is very limited). It will thus contribute to the Nigerian Government efforts to make food abundant. Fermented tubers digested with hydrogen peroxide and dried were found to be free from the bad odor and were easily converted to odorless fufu. Cheaper methods of production, testing for changes in the properties of the flour and the adaptation of the method to large-scale production are still being investigated.

### PS. B-3

#### PREDICTION OF THE PROTEIN QUALITY OF MAIZE (*Zea mays* Linn) DURING STORAGE BY SOME BIOCHEMICAL PARAMETERS

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Maize (Western Yellow, variety FARZ 7) was stored outdoors in cribs and indoors in polythene-lined hessian sacks. It was treated with pirimiphos-methyl insecticide at 10 ppm dosage and stored for twelve months. Controls (without insecticide treatment) were set up in parallel. Samples were drawn monthly for the first eight months and bimonthly thereafter till the end of storage. They were analysed for total amino acids, available lysine and methionine, dye-binding capacity, and nitrogen solubility (chemical indices of protein quality). In addition, biological evaluation of protein quality using weanling albino white rats (Wistar strain) was carried out. The various chemical predictors of protein quality were regressed normally (after adjustment to pass through zero) against biological indices of protein quality.

Available lysine and methionine, dye-binding capacity and nitrogen solubility in 6N HCl and 0.5M NaCl vary significantly ( $P < 0.001$ ) correlated with weight gain, NPR, NPU<sub>(st)</sub> and AD but less significantly ( $P < 0.01$ ) with PER and TD. The high correlation between chemical and biological indices of maize protein quality suggest the use of quick laboratory analyses to predict maize protein quality and detect the deleterious effects of storage. The traditional methods of chemical analysis upon which maize purchases are based, viz: protein content, fail to do this.

### PS. B-4

#### THE ROLE OF CHEMISTRY AND BIOCHEMISTRY IN THE PREPARATION OF FOOD EXTRACTION OF PROTEINS FROM GREEN LEAVES

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Protein can be extracted from green leaves by pulping and pressing which breaks the cell walls of the leaves, and yields a juice which carries most of the leaf protein. The protein can be precipitated by heating to about 75°C or by adjusting the pH to 4.5. After filtering and washing the curd is dried in an oven at about 65°C. The product is green and contains all the essential amino acids in adequate amount, except for methionine. Experiments with chicks and pigs showed that the product is as nutritious as the more expensive fishmeal, and is more nutritious than soybean meal. Clinical trials showed that it can cure kwashiorkor in 5 weeks. It is very cheap to produce, especially in tropical countries, where there are green leaves throughout the year.

## PS. B-5

### SPOILAGE FUNGI OF SOME NIGERIAN FRUITS - MANGOES AND AVOCADO PEARS

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The aim of this study was to isolate and determine the spoilage fungi on mangoes and avocado pears, the possible stage of infection and the effect of storage on fungal load. In African mango (*Irvingia Gabonensis*), cherry mango (*Mangifera Indica*) and avocado pear (*Persea americana*) fungi species related to Botrytis, Colletotrichum and Glomerella in cultural and morphological characteristics were identified. Oidium and Rhizopus species were identified in the mangoes only, while cercospora species was identified in the avocado pear only. Some yeast cells were also identified. The fungi attacked the unripe matured fruits but the microbial load of the ripe fruits was more than that of the unripe ones. It was difficult to determine the exact point of attack as traces of fungi were seen in the immature fruits. Refrigerated storage reduced the microbial load as compared with room temperature storage. Preliminary pathogenicity test showed some of the fungi to be pathogenic. It is suggested that harvesting the fruits at maturity just before ripening may reduce the microbial load.

## PS. B-6

### EXTRACTION OF CHEMICAL COMPONENTS FROM FOODS

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Separation processes often account for most of the cost of a food component, reflecting either the need for processing large amounts of extra material or the necessity of freeing the food from minor toxic components. Novel extraction techniques are being developed including: (1) Alcoholic extraction to simultaneously recover oil and remove aflatoxins from oilseeds. Use of isopropanol permits a ten-fold reduction in aflatoxin content binding of antinutritional gossypol, and efficient extraction of oil from cottonseed. (2) Aqueous processing of oilseeds is an intermediate technology to extract oil and protein simultaneously from oil-bearing materials. From bitter, poisonous lupin (Lupinus mutabilis) it also removes water-soluble alkaloids and produces a nutritionally sound protein concentrate. (3) Dry fractionation of starch and protein from beans (Phaseolus vulgaris). Protein content can be upgraded from 25% to almost 50% via fine grinding-air classification. A starch fraction is also produced having only 14% protein. These and other similar separation techniques are reviewed and discussed.

## PS. B-7

### QUALITY ASPECTS OF HEATED-AIR DRYING OF SOYBEANS

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The objective of this study was to determine the effect of fluidized-bed drying conditions on moisture content and on some quality aspects of soybean seed. Quality assessment was based on seed germination, seedling vigour, free fatty acid content, fatty acid composition, peroxide value and yield of the extracted oil. The colour of crude and refined oils was also measured before and after a heat bleach test using a photometric method. Results showed that soybean is a slow-drying seed in comparison to other oilseeds. Drying curves for different air temperatures are discussed. Seed germination and seedling vigour clearly showed the onset of heat damage and that not one of the criteria used was more sensitive than the others. Air temperature of 40-55°C did not adversely affect soybeans of 14-18% initial m.c. The initial m.c. had a significant effect, as air temperatures above 65, 60 and 55°C substantially damaged soybeans of 14, 16 and 18% m.c. respectively. Heating soybeans up to 60°C at a fixed m.c. (in sealed tubes) increased the susceptibility to heat damage for 16 and 18% m.c. but not for 14%. Oil yield, free fatty acid content and fatty acid composition were not affected by any of the heat treatments. The peroxide value, however, showed some increase at temperatures above 50°C. The conditioned controls were significantly higher in germination, oil yield and FFA content than the unconditioned ones. Fluidizing at room temperature did not affect germination. Results on the effects of processing on the colour of the crude oil are also presented.

## PS. B-8

### CHEMICAL AND NUTRITIONAL EVALUATION OF SEVERAL PHILIPPINE INDIGENOUS FOOD LEGUMES

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A study was initiated to determine the chemical and nutritional qualities of several legumes indigenous to the Philippines, namely, sam-samping (Clitoria ternatea), sabawel (Mucuna curanii), batao (Dolichos lablab), sword bean (Canavalia gladiata), jack bean (Canavalia ensiformis), tapilan (Vigna umbellata), and balatong aso (Cassia occidentalis (Linn.)). The protein content of the mature seeds ranged from 17 to 31%. Balatong aso and tapilan had lower protein levels (17-23%) while sabawel, sword bean and sam-samping had the highest (31%). Starch was the predominant substance (37-49%) followed by protein. Fat content was only 2-3.5%. Among these samples, balatong also exhibited the highest crude fiber of 13% while sword bean and tapilan had relatively lower levels of 3-6%. Tannin content (as % catechin) was highest in a sabawel accession (35%) and sam-samping (11.4%). Trypsin inhibitor activity of batao was highest (26-44 units/ mg sample), followed by sabawel (16-20). The *in vitro* digestibility of sabawel was lowest (62%), and balatong aso the highest (74-77%) as compared to cowpea (74%) and mungbean (80%).



Total HCN potential was low in the mature seeds (0 to 1.2 umoles HCN/g fresh weight).

The green pods of sabawel, jack bean and sword bean had protein levels of 11-18%. Carbohydrate was the major constituent (60-71%). Tannin was relatively low 1-6% (as % catechin). Total HCN potential was also low in the green pods and green seeds of the cultivars tested.

#### PS. B-9

### LARGE-SCALE PREPARATION OF FUNGAL LINAMARASE FOR USE IN CASSAVA (Manihot esculenta) PROCESSING

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The successful use of linamarase (EC.3.2.1; linamarin  $\beta$ -D-glucoside glycohydrolase) preparations from the cassava cortex or tuber for rapid detoxification of fermenting grated cassava during gari manufacture, and for the quantitative determination of cyanide in cassava and cassava products has recently been reported. A screening of over 40 fungal isolates for their ability to synthesize linamarase resulted in the identification and selection of Aspergillus sydowi capable of producing linamarase in commercial quantities when grown at 37°C for 10 days in flasks containing a liquid medium of either potato dextrose-streptomycin (2%), oatmeal streptomycin (2%), or Czapek Dox. Trial use of lyophilized linamarase in both laboratory and commercial-scale gari production resulted in a phenomenal increase in the rate and extent of detoxification of the fermenting mash, yielding gari with practically little or no cyanide. Factors that may accelerate the widespread adoption of linamarase as raw material in gari manufacture include (a) small capital investment (b) ability of aspergillus sydowi to synthesize this enzyme in large quantities (c) ease of isolation of the enzyme from the growth medium.

#### PS. B-10

### A NEW CHROMATOGRAPHIC METHOD FOR THE IDENTIFICATION OF SPECIES USED IN PROCESSED MEATS

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The serological and electrophoretic methods which are routinely used for identifying the species in frozen meat samples are not effective with processed meat products. The histidine dipeptides anserine, carnosine and ophidine are present in muscle in markedly different amounts in the species commonly used for the production of meat for human consumption. It has recently been reported that these peptides can be separated by ion exchange from extracts of processed meats. Their concentration in muscle and the anserine: carnosine: ophidine ratio can be used to identify the species and to obtain an estimate of the amount of lean meat in the

product. The method has been used to compare tinned hams and other products. Data are presented on the application of the method to the problem of the detection of kangaroo and horse meat added to cooked meat products. The method has a potential for monitoring the quality of products reputed to contain lean meat.

#### **PS. B-11**

### **SOLUBILITY FRACTIONS AND GEL ELECTROPHORESIS OF VIGNA MUNGO GRAIN PROTEINS**

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Blackgram (Vigna mungo) is an essential ingredient of certain typical breakfast dishes of South India. The batter prepared from a definite ratio of this legume and rice gives a soft, spongy texture to leavened foods which no other legume can provide or substitute. The batter quality has been attributed to the globulin and arabinogalactan present in grains of Vigna mungo. Previous studies of the protein were concerned only with a single variety. This study probed the globulin fractions of genetically different strains.

In the 200 varieties screened, the protein content ranged from 15.62% to 29.90% with a mean value of 19.86%. Four purelines were selected and their total protein extracts subjected to SDS-PAGE. The visual pattern showed 31-39 polypeptides. The protein fraction of nine varieties were studied. The highest nitrogen percentage was found in the globulins, followed by albumins in certain varieties and by glutelins in others. In all varieties, prolamins were in least amount. The SDS-PAGE of the albumin and globulin fractions of two mutants and their parent revealed no qualitative difference in albumin fraction. A polypeptide with an approximate molecular weight of 65,000 daltons, however appeared in the globulin fractions of the mutants. The properties of this polypeptide will be discussed.

#### **PS. B-12**

### **EFFECT OF CHEMICAL MODIFICATION OF INTACT SORGHUM ENDOSPERM ON ITS COOKING QUALITIES**

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In India, Sudan, Nigeria and China sorghum grain is dehusked, cooked and served like rice. Earlier work by the authors has shown that the modern sorghum hybrids cooked to an acceptable product only after an exceptionally long time, and that longer cooking time was an inherent characteristic of the sorghum endosperm structure which needs to be disrupted to reduce cooking time to an acceptable level. Different types of dehulled sorghum have been treated with various chemicals to modify the endosperm. The cooking time was reduced to about 25 minutes with increased solubility of protein and with a change in protein matrix and protein

bodies as seen under a scanning electron microscope. Using differential scanning calorimetry, attempts are being made to follow the change in the nature of the protein and starch and the speed of digestion of protein and starch.

#### **PS. B-13**

##### **TECHNOLOGICAL PROBLEMS IN CHILEAN ABALONE (CONCHOLEPAS CONCHOLEPAS): HARDNESS AND SURFACE PIGMENTS REMOTION. A BIOCHEMICAL APPROACH**

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The effect of pH, NaCl, phosphates (tripolyphosphate, pyrophosphate, orthophosphate, hexametaphosphate), calcium and magnesium on water holding capacity (WHC) of thermally treated abalone was studied. The pH effect is minimal at 5.2 and maximal at pH 3 and 10. With NaCl concentrations of 2-4-8% and different pH values, a denaturing effect upon muscle protein develops. Phosphates promote an increase in WHC at pH above 5.0. Calcium and magnesium decrease WHC at pH above 7.0. The changes in WHC are explained by modification in charge that influences the distance between the protein chains. After thermal treatment, water retention modified the organoleptic properties, especially texture. We found an inverse correlation between hardness and water retention. Immersion in polyphosphate solutions increases WHC, but an undesirable external gelatinous layer appears. Immersion in papaine to increase tenderness is problematic because of its poor diffusion into the muscle bulk. Two other incorporation methods in the circulatory system of abalone were investigated: a) immersion in vivo; incorporation of different phosphate solutions through the blood system was noted, b) injection in vivo; the best injection area for distribution in the muscle was the Leiblein gland cavity, determined by dye tracers. By injection of different phosphate solutions, WHC was increased up to 20% without the external gelatinized layer. Although the effects of enzymic activity upon the muscle were quite evident, no improvement in texture was obtained by injection of papaine. A 15 minute ultrasonic treatment eliminated surface pigments without causing any harm to the muscle. It was superior to the usual immersion in 30-35% NaCl.

#### **PS. B-14**

##### **AMINO ACID PROFILES OF SEED PROTEIN CONTENTS OF UPLAND RICES, AND KODO AND FINGER MILLETS GROWN UNDER FERTILIZER N AND AZO AND AZOSP INOCULATIONS**

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Upland rice and minor millets are conventionally grown without any fertilization by tribal people in a widespread area of Central India. The rice and millets are grown in denuded terrains (latosols, vertisols) and in highlands (latosols and oxisols). Any improvement in the crops requires N fertilization and

the use of low cost biofertilizers. Topbred lines of Upland Rice, Kaveri and JR 15-55, and of Kodo millet IPS 147-1 and of Finger Millet, PR 202 responsive to high N input were studied at graded level of N artificial fertilizer alone as well as in combination with biofertilizers. For the rice cultivars Azotobacter chroococcum, and for the millet cultivars, Azospirillum lipoferum were the inoculants. In rice they gave a 25% higher protein yield when combined with 0/45 kg N/ha; and in Kodo and Finger Millet they produced 68% higher protein when combined with 10 kg N/ha. The incremental protein produced due to N fertilizer by itself or in combination with the N fixing inoculants was analyzed for amino acid profiles by Liquimat III. The profiles of these cereal proteins will be presented and their significance discussed.

PS.B-15

### ECONOMIC ASPECTS OF IMBALANCE OF ESSENTIAL AMINO ACIDS IN WORLD PROTEIN SUPPLIES

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Correlation between total protein supply (Y, g.), gross domestic product (X, per capita per year, US 1976 dollars), and animal protein ratios (Z, %) were calculated as follows for 163 countries, using their 1976 average GDP.

$$\begin{aligned}\log X &= 0.0313Y + 0.6721 & R &= 0.862 \\ \log X &= 0.0333Z + 1.7941 & R &= 0.909\end{aligned}$$

Protein demand toward the year 2000 in various regions was estimated on the basis of the above correlations and recent GDP trends. Protein increase in developing regions however, shows only small improvement. Where supplies of protein are limited the values of available essential amino acids (EAA) as a 1975-77 average were computed to determine the 1st, 2nd, and 3rd limiting amino acids (LAA) and the 1st LAA to be supplemented. An imbalance of EAA can be classified into two groups with a deficiency of lysine (approx. 100,000 t.) as 1st LAA in low GDP category and with a deficiency of threonine (approx. 150,000 t.) as 1st LAA in the high GDP category. The EAA imbalance relative to the GDP of each country and region has an economic significance that is discussed in terms of future prospects.

**PS. B-16**

### **WASTE-FREE PROCESSING OF CASSAVA**

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Plants like cassava with high starch and protein yields per unit area are produced in great amounts in tropical areas, with an average yield of 20-40 t/ha. The cassava root yields 5-15 t/ha starch. The leaf gives 2-3 t/ha of protein of good amino acid composition. Utilization of the fodder is adversely affected by the cyanoglucoside in the root (70-500 ppm) and in the leaf (100-1000 ppm). At present only the tuber is processed by biological glucoside decomposition involving heavy losses, while the considerable amount of peelings obtained in the cleaning process of the tuber (10-12%) as well as the stalks and leaves are actually waste. By combination of chemical and biological methods we have developed a waste-free process, providing alcohol and a fodder rich in protein as end products, and utilizing the fibrous fractions as fuel. One process involves washing the tubers, peeling, cubing, biological and chemical treatment, enzymatic hydrolysis, followed by fermentation and distillation providing alcohol (cca 0.17 m<sup>3</sup> alcohol/t cassava). In the second process the peeling wastes of the first process are mixed with a grist composed mainly of vegetable stalks and leaves. After biological-chemical treatment the residue from the alcohol distillation (stillage containing autolyzed yeast) is added to the mixture to which, after drying, urea and other feed additives (e.g. premixes, vitamins, etc.) are added. A protein-rich raw material for fodder is thus produced.

**PC. B-17**

### **THE EFFECT ON FROZEN BEEF QUALITY CHARACTERISTICS OF THAWING, CUTTING AND TRANSPORTATION**

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Results have been obtained that indicate that the processing of frozen beef imported to Egypt has significantly altered its quality properties. Thawing, cutting, packaging and transportation resulted in the reduction of sarcomere length by about 11.5% in comparison to the original frozen beef which was considered as the reference standard. A carcass weight loss of 5.25% was observed after thawing due to the separation of meat fluids. These fluids contained soluble proteins since four free amino acids were detected in them using paper chromatography. The chemical analysis of the imported meat was altered, and fading in its spectral reflectance was noticed. Meat tenderness declined. The bacterial load on the meat surface was raised to relatively high counts during all stages of handling, although coliform bacteria were not detected.

**PS. B-18**

**GROWTH OF ASPERGILLUS NIGER AND BOD REDUCTION IN  
SOYBEAN CURD WASTE LIQUOR**

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Waste liquor produced in soybean-curd plants is high in biochemical oxygen demand (BOD), and represents a serious pollution problem. It was found that soybean-curd waste liquor supports the growth of A.niger. Still culture of A.niger in this waste liquor reduced BOD over 90% in 14 days, about 95% in a stirred culture in 5 days. Waste liquor supplemented with 2% glucose enhanced the yields of mycelium and citric acid by 2 and 13 fold, respectively. Maxima of 12.8 mg/ml mycelium and 6.40 mg/ml citric acid were found. On the other hand, addition of 0.5% guar gum to waste liquor also increased the yields of mycelium, invertase and  $\alpha$ -galactosidase. Under this condition, the 5.4 fold increase in the production of  $\alpha$ -galactosidase was most pronounced. A maximum of 29.2 unit/ml of  $\alpha$ -galactosidase was obtained after 60 hr cultivation.

**PS. B-19**

**CHEMICAL COMPOUNDS OF MUNA (MINTHOSTACHIS MOLLIS) ESSENTIAL OIL  
AND ITS SPROUT INHIBITION AND INSECTICIDE ACTIVITY DURING FOOD STORAGE**

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Muna (Minthostachis or Bistropogon mollis) is well known in the Andean countries. Plants collected from the highlands of Peru were extracted for the essential oil. The plant is traditionally used as a germination inhibitor for potatoes in these countries, thereby reducing the losses during storage up to periods of one year. We have confirmed the sprouting-inhibiting activity of the muna essential oil with potatoes under different storage conditions. Details of the experiments are presented. In a second group of studies, the insecticidal properties of the muna plant against Stegobinus paniceum and Sitophilus granarius were investigated. The action was complete by using the essential oil or leaves even at a high dilution. Preliminary studies were performed to isolate and identify the active compound of the muna by using thin-layer chromatography and the results are presented. Muna could be used as a natural insecticide and sprout inhibitor in food storage, reducing losses. Muna is not expected to be harmful, since it is used for making tea and as a remedy in the Andean region, but further studies must be performed to demonstrate its safety.

**PS. B-20**

**THE POTENTIAL ROLE OF CHEMICAL SPROUT CONTROL IN SHORT-TERM  
NON-REFRIGERATED STORAGE OF TABLE POTATOES IN THE NORTH INDIAN PLAINS**

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The development of technologies for short-term non-refrigerated storage of potatoes would ensure better returns to the farmer by avoiding market gluts and distress sales, and result in better availability and less fluctuation in the prices for the consumer. A number of chemical sprout suppressants have been tested under different climatic conditions. Maleic hydrazide (MH) was found to be most suitable for table potatoes under short-term non-refrigerated storage in the plains. Under the relatively high temperatures prevailing, volatile post-harvest sprout suppressants like CIPC were not very effective. Application of chemical sprout suppressant combined with storage of the potatoes in an insulated store equipped with a system of passive evaporative cooling gave satisfactory storage of potatoes for 3 to 4 months without refrigeration. Details of the chemical treatment, the prototype storage structure, and the results obtained during one storage season are presented.

**PS. B-21**

**EXTRACTION OF OIL AND PROTEIN FROM COCONUT KERNEL**

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A method had been previously reported for the extraction of oil and protein from fresh coconut kernel. A modification of this separation process has been investigated using the Sharples Super Centrifuge (Model 1A motor driven open type laboratory machine) fitted with a separator rotor having two outlets. The extract (pH 10.6) was fed by gravity from the bottom. A jelly-like cream collected in the separating bowl and no cream flowed through the outlet. The oil recovery from this cream was 40-50%. Remaining cream passed through the other outlet in the aqueous layer. Preheating of the extract did not reduce the gelation of the cream. The effect of centrifugal force and temperature was studied using an IEC B-20A centrifuge. The oil recovery at 4°C increased linearly with centrifugal force from 52% (1000 g) to 96% (5000 g) while the corresponding increases at 27°C were 40% and 58% respectively.

**PS. B-22**

**WINGED BEAN IN HUMAN NUTRITION: CHANGES IN CHEMICAL COMPOSITION  
DURING SEED DEVELOPMENT; ISOLATION, CHARACTERIZATION AND FUNCTIONAL  
PROPERTIES OF PROTEINS; AND UTILIZATION FOR ENRICHMENT OF  
BREAD AND COOKIES**

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Three cultivars of winged bean were analysed for total dry matter, crude fat, nitrogenous constituents, minerals and cooking behaviour at different stages of seed maturity. Accumulation of dry matter, crude fat and nitrogen occurred during seed development whereas the content of non-protein nitrogen and tryptophan decreased significantly. Reduction in polyphenol content was observed at all the stages of seed development. There was a significant decrease in total phosphorus content with concomitant increase in the proportion of phytate phosphorus throughout seed development. In mature seeds, phytate phosphorus accounted for 66-73% of total phosphorus. As the seeds matured moisture content decreased and the cooking time increased significantly. A protein concentrate (71.45% protein, dry weight) was prepared from mature winged bean seeds. Solubility of the protein concentrate was minimal at a pH of 4.0. Sodium dodecyl sulfate-polycrylamide gel electrophoresis (SDS-PAGE) of the bean flour protein and protein concentrate indicated 9 subunits each, with apparent molecular weight ranges of 27,000-380,000 and 14,200-143,000 daltons, respectively. The least gelation concentration and water and oil absorption capacities of the seed flour and the protein concentrate were determined. Emulsion and foaming properties of the protein concentrate were investigated. The effect of moist heat on seed protein digestibility was assessed *in vitro*. The protein concentrate was lower in tannins, trypsin, chymotrypsin, and amylase inhibition compared to bean flour. Whole flour (5-20%), defatted flour (5-20%) and protein concentrate (5%) were added to wheat flour. Bread and cookies were prepared and evaluated for physico-chemical, nutritional and organoleptic properties, as compared with 100% wheat flour bread and cookies.

**PS. B-23**

**DEPURATION OF OYSTERS CULTURED IN ESTUARIES**

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Tropical oysters (*Crassostrea Iradelei* and *Crassostrea Malabonensis*) grow very well in estuarines but may be subject to easily ingested pollutants. In sixteen samplings in a one month period, five samples of oysters contained *E.Coli* counts from 50 to 232 MPN/25 g. Four samples were positive for salmonella and one was positive for shigella. Oysters can cleanse themselves of harmful bacteria by depuration. When laid in tanks of flowing sterilized water for a specific duration, through a filtering process, the oysters release the bacteria as faeces or pseudofaeces. A batch of freshly harvested oysters were randomly divided into a control and an experimental group. The control group was found to have a coliform



count of 525 MPN/25 g and an E.Coli count of 195 MPN/25 g. The experimental group was deputed for 24 hours and found to have coliform and E.Coli counts of only 150 MPN/25 g and 50 MPN/25 g respectively. Oysters grown in some estuarines need to be deputed to safeguard public health.

#### PS. B-24

##### IMPROVEMENT IN THE NUTRITIVE VALUE OF WHEAT FLOUR BY SUPPLEMENTING WITH PEANUT AND CHICKPEA FLOURS

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Wheat is the staple cereal of Pakistan. Over 72% of calorie and 76% of protein intake (daily) of an average person are obtained from cereals. Lysine is the major limiting amino acid in wheat. The objective of our study was to increase the protein content of the flour as well as its lysine content using locally available vegetable sources of protein. Peanut meal (flour) which has a high protein content, but is low in lysine, and chickpea flour which has a low protein content, but is high in lysine were used. A mixture of peanut flour and chickpea flour in equal proportion (1:1) was prepared and 10, 20 and 30% of this was utilized for supplementing wheat flour for the preparation of bread (roti). These breads were compared with roti prepared from wheat flour alone using PER, NPU and chemical score (for lysine), organoleptic properties and baking characteristics as criteria. Wheat flour, peanut flour and chickpea flour (on dry weight basis) have a protein content of 12.37%, 51.87% and 23.20% respectively and a lysine content (mg/g N) of 181, 241 and 413 respectively. The 20% level was found to be the economically optimum level of supplement. The adjusted PER (Casein = 2.5) and NPU of wheat bread (control) were 1.19 and 44.0, and with the 20% supplement, the PER of wheat bread increased to 1.60 and NPU to 53.0. The chemical score increased from 53 to 68. The organoleptic tests of the supplemented wheat bread showed acceptance even up to the 30% supplement level. Farinographic and calorimetric studies showed that the flour strength improved slightly with supplement. These studies are important for improving nutrition as there has been a significant increase in protein content (from 12.37 to 16.55%) and in the protein nutritional quality of bread (lysine content increased from 181 to 232 mg/gN). The addition of peanut - chickpea flour mixture to wheat flour can be carried out conveniently in flour mills.

#### PS. B-25

##### PHYSICO-CHEMICAL PROPERTIES OF LEATHERBACK TURTLE EGGS (DERMOCLEYS CORIACEA)

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The physical and chemical characteristics of leatherback turtle (Dermocleys coriacea) eggs found in Malaysia were studied. The elemental, vitamin, fatty acid,

amino acid and other chemical compositions in yolk, albumin and whole eggs were compared to those of chicken eggs (Gallus domesticus). Dermocleys eggs are soft, pliable spheres with thin shells, comprised of an outer pliable layer bounded on the inner surface by 2 shell membranes and with the pores formed at the intersection of 4 or more shell units. The eggs have a greater proportion of yolk than of white. The white and the yolk contain 98 and 52% moisture respectively. The protein content is significantly lower and higher in white and yolk respectively as compared with those for chicken eggs. The fat and cholesterol in turtle eggs were found to be significantly lower. The content of some amino acids, fatty acids and minerals differs significantly in the two types of eggs. Vitamin content showed no significant difference.

#### PS. B-26

##### EFFECTS OF LONGTERM FEEDING OF MAIZE-BEAN AND WHEY RATIONS ON THE GROWTH AND COMPOSITION OF BLOOD, LIVER, HEART AND PANCREAS OF ALBINO RATS

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The effect of longterm feeding of three diets containing a fixed amount of maizemeal, varying amounts of autoclaved kidney beanmeal and whey protein concentrate (WPC) at levels of 10, 12.5 and 15% respectively, on the growth and the composition of blood, liver, pancreas and heart of albino rats has been studied. The diets were supplemented with vitamins and minerals to the minimum levels recommended for growing rats. Preliminary results show that the mean gain in weight of rats over periods of 4 to 20 weeks increased with increasing amounts of WPC in the diets. Haemoglobin and PCV values which were monitored monthly did not vary much from month to month nor between the diets. Organs of all rats had a normal histological appearance after 20 weeks of feeding. Organ weights tended to increase with increasing WPC in the diets. Blood urea was lowest in rats consuming the diet with the highest amount of WPC. The results indicate that for long-term feeding, plant proteins need adequate supplementation with animal proteins to effect meaningful growth and development, an observation that may not be evident in short-term feeding studies.

#### PS. B-27

##### A NEW PROSPECTIVE STARCH SOURCE IN TAIWAN - THE SEED OF MIRABILIS JALAPA L.

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This investigation reports on the isolation and the characterization of the physicochemical properties of the starch component of the seed of Mirabilis jalapa L. The starch was isolated by a wet-milling process with 0.1% sodium hydroxide as

the steeping liquor. Its granule was spherical in shape and of extremely small size, 1.5-3.0 . It had a pasting temperature of 72.5°C, an iodine affinity of 3.6%, and an A-type X-ray diffraction pattern. The Brabender viscoamylogram showed no pasting peak and a continuous increase in viscosity during the process of cooking and cooling. The swelling pattern indicated a restricted type. The percentage of solubles paralleled the swelling power. The phosphate content of the starch was only a trace, and the solubility in dimethyl sulfoxide was low. The degree of syneresis of the starch gel was high and the stability to freeze-thawing was low. These results indicated characteristics of this small-granule starch somewhat different from the small-granule starches reported in the literature.

#### PS. B-28

### DETECTION OF VEGETABLE OIL ADULTERATION BY HPLC ANALYSIS OF TRIGLYCERIDES

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A simple and rapid high-performance liquid chromatographic (HPLC) method of detecting vegetable oil adulteration was developed. It involved direct injection of the oil sample dissolved in chloroform into the HPLC equipped with a  $\mu$ -Bondapak C<sub>18</sub> column and a differential refractometer. The sample was eluted with methanol/acetone (3/2, v/v) at 2 ml/min. Plotting the ratios of peak heights of equivalent carbon number (ECN) shows drastic change with different vegetable oils such as soybean oil, sesame oil, peanut oil, rice bran oil and liquid palm oil. Qualitative and quantitative determination of adulterants in these vegetable oils in mixtures can readily be made by such plots.

#### PS. B-29

### THE EFFECTS OF FOOD PROCESSING ON THE PROTEIN QUALITY OF SOME CEREAL PRODUCTS

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The effect of home and industrial processing on the protein quality of products prepared from wheat, rice and corn was measured in nitrogen balance experiments with growing rats. The samples were also analysed for amino acids. The levels of lysine, threonine and tryptophan were, in some cases, negatively affected by baking and caused significant decrease in the biological value (BV) and net protein utilization (NPU) of corn bread. Industrial processing reduced lysine (35-76%) and arginine (10-41%) and resulted in poor protein quality of vermicelli, rice crunchies, cornflakes and puffcorn. There is an urgent need to improve industrial processing to prevent protein damage in foods.

## Poster Session B

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1715 - 1915

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PS. B-30

### A NEW METHOD OF TAPPING PALM TREES FOR NON-ALCOHOLIC JUICE

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A new method of tapping and collection has been developed for Elaeis guineensis and Raphia hookeri. The method excludes yeasts and bacteria from the sap almost completely in contrast to the traditional method of obtaining palm wine. The product is a clear juice if collected at intervals of not more than six hours. It contains a higher percentage of sugar than palm wine and no ethanol. An accelerated rate of tapping gave a greater yield than the normal tapping of two times a day. The non-alcoholic juice has a shelf life of at least four months when sodium meta-bisulphite is added (60 ppm) and it is heated at 75°C for 30 minutes. By this method palm wine could be produced during the night and juice during the day from the same tree. Non-alcoholic beverages and liqueur could be made from the juice.

PS. B-31

### NEW NATURAL ANTIOXIDANTS FROM SPICES: STRUCTURAL DETERMINATION AND ANTIOXIDATIVE ACTIVITY

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Among the efforts to prevent a delay on deterioration of foods, antioxidants, commonly BHT and BHA, have been used widely to retard oxidative rancidity. However, these synthetic antioxidants have been reported to cause damage in the liver and other organs. The objective of this study is to isolate new and safe antioxidants from natural sources, especially from edible plants. Attention has focused on spices, mainly on those belonging to the family, Labiatae.

Dried leaves of rosemary (Rosmarinus officinalis L.) were extracted with n-hexane and the extract was steam-distilled to separate volatile and non-volatile fractions. The latter was fractionated chemically. The weakly acidic fraction showed strong antioxidative activity, which was measured by the AOM, TBA and ferric thiocyanate methods. Repeated column chromatography on silica gel afforded active compounds, whose structures were determined by IR, UV, <sup>1</sup>H-NMR, <sup>13</sup>C-NMR and MS to be carnosol (I), rosmanol (II, 7 $\beta$ ,11,12-trihydroxy-6,10-(epoxymethano) abieta-8,11,13-trien-20-one), rosmadial (III, 12-hydroxy-6,7-seco-11, 10-epoxy-methano-20-oxo-abieta-8,11,13-trien-6,7-seco-11,10-epoxymethano-20-oxo-abieta-8,11,13-trien-6,7-dial) and a quinoidal diterpene and three flavones. Compound II was odorless and tasteless and showed the highest antioxidative activity among the isolated components, approximately four times that of BHT (by AOM). The derivatives of these diterpene lactones were synthesized and their activities compared. The leaves of sage (Salvia officinalis L.) were also extracted with dichloromethane, followed by purification as above. Compounds I, II and III as isolated showed antioxidative constituents.

**PS. B-32**

**EXTRACTION AND IDENTIFICATION OF AGAR FROM  
GRACILARIA FORTISSIMA DAWSON (RHODOFICEAE)**

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The cultivation of economically important tropical algae is feasible. A preliminary survey has been carried out on the polysaccharide recovery from marine seaweed, gracilaria fortissima, a possible endemic plant, as collected from the reef of Cahuita, Limon, in the rainy season. The material was decoloured, dried and milled. After extraction with water and successive concentration, and then solvent extraction, the agar obtained (50% M.S.) was compared qualitatively with agarose (Merck-electrophoresis) and agar BDH (fine powder) by infrared spectroscopy.

**PS. B-33**

**SMALL-SCALE PROCESSING OF FISH PROTEIN CONCENTRATES  
(FPC Type B) USING ORGANIC AND INORGANIC SOLVENT EXTRACTION**

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Fish protein concentrates (FPC Type B) were prepared from local species of fish by ethanol, isopropanol, citrate buffer and brine extraction, using appropriate technology. The FPC (Type B) products were analysed for protein, fat and ash content. The freshwater species studied include Tilapia mossambica, Chanos chanos (milkfish), Ophicephalus striatus (lalag), and Clarias batrachus (catfish). FPC was also prepared from marine species, including Decapterus (round scad), Nemipterus (bisugo), Sardinella (tamban), Trichiurus haumela (esp ada) and Sillago (asohos). Protein content ranged from 75 to 89%, fat from 1.5 to 15% and moisture from 6 to 12%. Storage life of FPC from Decapterus was evaluated using peroxide value as an index of fat rancidity. Samples vacuum packed in polyethylene bags and stored at 0°C exhibited the slowest rate of oxidation compared to those stored at room temperature (27-30°C). Similar results were obtained using FPC Type B from Chanos chanos extracted with 0.1 M citrate buffer solution. Sensory evaluation was made on formulated products (such as kropeck, polvoron and molido) fortified with FPC Type B, and statistical treatment of data showed high acceptability of the products.

PS. B-34

INCREASED PRODUCTION AND UTILIZATION OF SOME LESSER  
KNOWN PROTEIN SOURCES FOR NIGERIAN DIETS.

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Augmenting protein in the diets of a large section of the population is a very pressing need in all developing countries. In Nigeria, various protein sources exist which are either unknown, little known, or known but less exploited nutritionally. Nutritional studies by the authors on such lesser known protein sources as periwinkle (Littorina littorea), snails (Vivapara Sp.), crabs, crayfish (Palamonetes Varians), and smoked fish (Tilapia Sp) as well as on other small aquatic and terrestrial foodstuffs in the Nigerian diet have shown that these stuffs have very high nutritional values. This paper stresses the roles these foodstuffs could play as protein supplements in school lunch in place of milk powder, and as substitutes for meat, eggs and even milk in boarding-house meals and in other institutional feeding programmes. These materials could also be introduced in the menus of the various restaurants in the country and dishes prepared from them could be served in the National Museum restaurants as delicacies. This paper also emphasizes the need for the Federal Government to encourage increased production of these lesser known but nutritionally rich foodstuffs.

PS. B-35

STUDIES ON INDIGENOUS SEED OILS

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Seed oils from five species (Bauhinia malabarica, Celosia argentea, Centauria moschata, Delphinium ajacis, and Sesbania sesban) were analyzed for their component fatty acids mainly by gas chromatographic and spectroscopic techniques. Four of the five species reported here (viz. B. malabarica, C. moschata, D. ajacis and S. sesban) have not had their oil composition reported before. Oil content of the seeds was quite variable and ranged from 4.0% for V. malabarica to 32.0% for D. ajacis. Iodine values of the oils range from 98.0 - 120.7.

Contents of saturated and unsaturated acids are reported and comparisons made. It is suggested that two species (C. moschata and D. ajacis) deserve agronomic evaluation as the C. moschata resembled safflower (especially grown in the tropics) and the D. ajacis yielded oleic-rich (46.5%) seed oil accompanied by eicos-cis-11-enoic acid in major proportion (27.1%). The eicos-cis-11-enoic acid content in D. ajacis was the maximum among Delphinium species reported.



**PS. B-36**

**GRAIN QUALITY OF SORGHUM (SORGHUM BICOLOR [L.] MOENCH), PEARL MILLET  
(PENNISETUM AMERICANUM [L.]), PIGEONPEA (CAJANUS CAJAN [L.] MILLSP.)  
AND CHICKPEA (CICER ARIETINUM [L.])**

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There are several components to grain quality, such as visual quality; nutritional quality, including digestibility and bioavailability of nutrients; antinutritional factors; milling characteristics; cooking quality; consumer acceptability; and storage stability. Analyses of sorghum, pearl millet, pigeonpea and chickpea for their chemical composition, including amino acid composition, revealed that the following are the limiting essential amino acids- sorghum: lysine (amino acid score 38), methionine and cystine (67), and threonine (87); pearl millet: lysine (52), and methionine and cystine (77); pigeonpea dhal: methionine and cystine (58), tryptophan (74), valine (92), threonine (95), and isoleucine (97); chickpea dhal: methionine and cystine (67), valine (89), threonine (90), and tryptophan (115) was not observed to be the limiting amino acid. Polyphenolic compounds, inhibitors of enzymes such as trypsin, chymotrypsin, and amylase, and flatulence-causing oligosaccharides such as stachyose, raffinose and verbascose were estimated in pigeonpea and chickpea. A survey was carried out in major producing areas of these crops in India and detailed information were obtained on milling characteristics of pigeonpea and chickpea, traditional food preparations from sorghum and pearl millet, and consumer preferences for these products. The relationships between certain physicochemical characteristics and cooking qualities as evaluated by a panel of tasters were obtained.

**PS. B-27**

**HUMAN FOOD FROM CHEAP PROTEIN**

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Alkaline digestion with consequent solvent extraction has been applied to obtain protein from fish wastes and sunflower meal. A simple experimental procedure is presented for extracting from vegetable or animal material, a high grade protein which can be used for human consumption. While each raw material requires specific conditions, the procedure proposed can, with short experimentation, be adapted to any such material. The industrial success of the method is reflected in the production of texturized proteins, Sugarman patent (1956), and the present pilot plant for oleaginous seeds extraction using aqueous solutions as developed by chemists of the Argentinian National Institute of Industrial Technology.

PS. B-38

BIOCHEMICAL COMPOSITION AND NUTRITIVE VALUE OF UNFRACTIONATED  
AND FRACTIONATED CHLOROPLASTIC AND CYTOPLASMIC  
LEAF PROTEINS FROM SESBANIA GRANDIFLORA (AUGUST TREE)

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Biochemical constituents (e.g. protein; ether extractives; ash; total and bound carbohydrates; minerals such as P, Fe and Ca; free, bound and total polyphenols; and pigments such as carotenes and xanthophylls) and the nutritive value including amino acids (total and available methionine and tryptophan), in vitro digestibility and the calorific value of the unfractionated and fractionated chloroplastic and cytoplasmic LPCs (Leaf Protein Concentrates) from Sesbania grandiflora (August tree) were studied.

The unfractionated LPC contained maximum total carbohydrates of 21.42% and maximum Fe and Ca values of 94 and 735 mg/100 g LPC, respectively. The chloroplastic LPC showed maximum contents of ether extractives (26.17%), ash (14.08%), bound carbohydrates (2.97%), carotenes (94 mg/100 g LPC) and xanthophylls (170 mg/100 g LPC). The cytoplasmic LPC contained slightly higher total polyphenols (10.63%) than the chloroplastic (9.66%) and unfractionated LPC (9.10%). The cytoplasmic LPC had maximum content of total and available methionine and tryptophan (1.89, 1.72 and 1.45 g/100 g protein) closely followed by the unfractionated and the chloroplastic LPC, the values being 1.68, 1.17 and 1.43 g/100 g protein and 1.45, 0.90 and 1.39 g/100 g protein, respectively. The cytoplasmic LPC showed maximum in vitro digestibility of 95.94% while the unfractionated and chloroplastic LPC showed 71.40 and 62.43% digestibility, respectively. The calorific value was maximum in the chloroplastic LPC (474.53 calories/100 g LPC) followed by the unfractionated and cytoplasmic LPCs exhibiting the values of 465.20 and 423.30 calories/100 g LPC, respectively.

Considering all the parameters related to the biochemical constituents and nutritive value, we concluded that the cytoplasmic LPC from Sesbania grandiflora tree leaves appeared to have better nutritional qualities than the chloroplastic and the unfractionated LPCs.

PS. B-39

LEAF PROTEIN CONCENTRATE FROM THE HAULMS OF  
DIFFERENT POTATO VARIETIES

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A field experiment was conducted at the university research farm, during the year 1980-81, designed to explore the possibility of using potato haulms, a waste



by-product of potato crop, for the production of leaf protein concentrate (LPC). Eight early maturing potato varieties were grown in a randomised block design with four replications. The crop was harvested at 60,70,80 and 90 days after sowing. The tuber yield data were recorded and the haulms were studied for protein extractability and LPC yields with a view to finding the most suitable variety and its optimum time of digging in order to obtain maximum yield of both tuber and LPC. Variety JF 27 gave the maximum tuber yields of 164.93 and 195.31 q/ha at 80 and 90 days after sowing, respectively. This variety also performed best with respect to potato haulm yield at all the four crop growth stages and yielded a maximum of 138.19 q/ha at 80 days after sowing. The dry matter content of the haulm pulp from the eight varieties including all the four crop growth stages ranged from 10.05 to 13.98%. Maximum extractability of total N (60.96%) and protein N(38.69%) calculated as percentage of total pulp N was shown by the varieties Kufri Chandramukhi and JF 27 at 90 days after sowing. Variety JF 27 gave the highest LPC and protein yields of 371 and 149 kg/ha respectively, at 80 days after sowing. We concluded that variety JF 27 when harvested 80 days after sowing appeared to be the best with respect to both tuber and LPC yields. We are currently studying the protein quality and solanine content of this LPC in order to assess its use as a supplementary protein source in food and feed.

#### PS. B-40

### A BIOCHEMICAL APPROACH TO THE PROCESSING AND PRESERVATION OF THE AFRICAN YAM TUBER

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African yam tubers (*Dioscorea* species) undergo rapid deterioration during storage, and efforts to develop new methods for their storage have not been successful. Biochemical investigation has demonstrated that the poor storability results from endogenous enzymic reactions of the tubers, principally those responsible for proteolysis, carbohydrate degradation during sprouting. This proteolysis is activated by glutathione, of which yam tubers contain a high level of both free and protein-bound forms. Glutathione initiates proteolysis by causing the proteins to undergo conformational changes thereby exposing their hydrophobic regions to proteolytic attack. This conformational change has been studied with the intention of applying it to the largescale processing and preservation of yam tubers as pounded yam, a delicacy among African consumers of yam tubers. Pounded yam undergoes adverse degradative changes after its preparation, and if it is not eaten within two hours it is discarded, leading to food wastage. We found that incorporation of the right quantities of glutathione into pounded yam not only stabilizes and improves fufu texture, but it also gives fufu a brilliant white colour which enhances its acceptability. The full biochemistry of the glutathione-protein interaction in pounded yam and its industrial potential is discussed.

PS. B-41

#### PROTEIN AND SUGAR CONTENT OF LATEX PRODUCING PLANTS FROM RWANDA

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The main barrier to large scale production of hydrocarbons from latex producing plants is the high cost compared to fossil material. To lower this cost it has been previously shown on Euphorbia Lathyris that fermentable sugars can be extracted as well. In the same respect, a reported study on Asclepias Speciosa as source of hydrocarbons showed that the protein content of this plant was comparable to alfalfa and corn grain. This same kind of work on some species of potential hydrocarbon plants (latex plants) that grow in Rwanda has been initiated. This paper presents the results obtained thus far on obtaining chemical raw material from Rwanda plants.

PS. B-42

#### UTILIZATION OF SHALLOT AS A FLAVORING SOURCE

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Shallot (Allium cepa L., Var. aggregatum), an onion-like herb of the Allium species, gives a characteristic flavor in Chinese food. Approximately 0.021%, 0.012% and 0.009% (v/w), of essential oils were obtained by steam-distillation from bulbs, white part and green part of the leaves respectively. By means of GC-MS, 25 sulfur components were characterized. Dipropyl disulfide is the principal constituent of the essential oil of the bulbs, followed in descending order of percentage by dipropyl trisulfide, methyl propyl trisulfide, propyl trans-propenyl disulfide, propyl cis-propenyl disulfide and methyl propyl disulfide. Dipropyl trisulfide is the principal constituent of the essential oil of the white part, followed by methyl propyl trisulfide, propyl trans-propenyl trisulfide, dipropyl disulfide, propyl trans-propenyl disulfide and propyl cis-propenyl trisulfide. Dipropyl disulfide is the principal constituent of the essential oil of the green part, followed by methyl propyl disulfide, methyl propyl trisulfide, propyl trans-propenyl trisulfide, dipropyl trisulfide and 1-methylthiopropyl propyl disulfide. Volatile sulfur compounds play an important role in the flavor of food because of their strong, often characteristic odor. All the bulbs, white part and green part of the shallot leaves are edible and commonly used as a food relish.

**PS. B-43**

**RICE BRAN AS A SOURCE OF HUMAN FOOD**

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Rice bran is a potential human food, although only a small part is used as such or as a source of edible oils. Improvement of the food value of bran deserves attention. It is essential to prevent deterioration of the oils, to remove phytic acid (ca. 10%) which is tightly bound to proteins and has been reported to interfere with the dietary mineral absorption of mammals, and to reduce fiber and ash (ca. 20% each). A low cost method involving heat-extrusion and pelletization inactivates the enzymes and stabilizes the rice bran making it easier to solvent-extract the oil. Studies of the pH-dependent extractability of phytate and proteins of defatted rice bran revealed that, although the majority of phytate was soluble in aqueous solution at pH 3.5 + 0.2, 90% of the protein remained insoluble. This unusual difference in solubility provided an efficient way for the removal of phytate from bran proteins. The supernatant phytic acid was recovered by precipitation at neutral or slightly alkaline pH followed by ion exchange chromatography.

**PS. B-44**

**DIGESTIBILITY OF LEGUMES**

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Two groups of 21-day old rats were subdivided into four lots, and fed with the following diets: stock diet, bean diet, bean diet plus cow parsnip powder, bean diet plus cow parsnip flavor. Group one, after 10 days, and group two, after 30 days, were killed and the following parameters studied: (1) digestibility of diets, (2) estimation of hepatic DNA and RNA, (3) extent of intestinal flatulence, (4) animal weight gain and (5) changes of weight of animals' organs (liver, pancreas, intestine, heart, kidneys, spleen). The results showed that cow parsnip had some effect on these parameters.

**PS. B-45**

**DEVELOPMENT OF SOY-SUPPLEMENTED EXTRUDED SNACK PRODUCTS  
I. RICE-SOY CURLS**

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Using an extrusion cooking process, rice-soy curls have been prepared from rice-soybean mixture as a high energy protein snack food. The product has been

fortified with nutrients, packaged and stored. Comparative nutrient analysis of the product and commercial counterparts has been made. The effect of packaging material and storage on product acceptability has been studied. Process description and results are presented.

**PS. B-46**

**PROTEIN EVALUATION OF RICE-BEAN COMBINATIONS**

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The nutritional quality of rice-bean combinations and the effect of cooking on their protein quality has been assessed. A four week rat feeding experiment using protein efficiency ratio (PER) as the criterion was conducted to determine the protein quality of 15 different combinations of rice and beans (50:50 protein ratio) both raw and cooked. The destruction of anti-nutritional factors upon cooking significantly improved the PER of kidney beans, pigeon peas, winged beans, lima beans and soybeans. Compared with the standard protein-casein, cowpea (red and white), kidney beans (red and white), pigeon peas (white and black), winged beans, lima beans, soybeans and meara peas exceeded the PER of casein. However, all fifteen (15) rice-bean combinations met the Protein Advisory Group (PAG) PER requirement of not less than 2.1 and preferably above 2.3 for a food mixture to qualify as supplementary weaning food. Results point to the potential of rice-bean mixtures for helping to solve malnutrition problems.

**PS. B-47**

**SEED PROTEIN PROCESSING FROM LEGUMES (PEA, FABABEAN) AND  
OILSEEDS (SUNFLOWER, RAPESEED)**

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Cooperative research on the processing of pea, fababean, sunflower and rapeseed proteins has progressed to the pilot plant stage (flow rate capacity: 0,7 to 1,5 m<sup>3</sup>/h). It aims to solve problems of flavor, color, functionality, antinutritional factors, processing technology and economics. Processing costs and product characteristics are being compared to those of the soybean protein processing industry. Rapeseed and sunflower concentrates are obtained by leaching soluble materials from the flour (ground dehulled and delipided kernels) with aqueous alcohol. Concentrates are clear and light in flavor; protein content (N x 6.25% dry basis) ranges from 63 to 67. The main difficulty encountered in processing sunflower was the presence of chlorogenic acid and mucilaginous materials in the flour. Therefore, specific purification steps were developed. Optimum conditions (yield and protein content) for processing pea and fababean flours into isolates have been defined. Two flowsheets appeared to be satisfactory: (A) protein extraction (pH 9) and precipitation at pH 4.5; (B) protein extraction (pH 7) and precipitation at pH 5.3. Respectively, yield and protein content are 60-65% and

92-93% (flowsheet A) and 55% and 94-95% (flowsheet B). In every case the level of antinutritional factors was minimized.

#### PS. B-48

#### NUTRITIVE VALUE OF SOME PHILIPPINE SEAWEEDS

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Data on edible seaweeds can serve as a basis for using seaweeds in the diet of normal persons and those suffering from nutritional deficiency. As sources of iron and iodine in particular, seaweeds can help correct iron-deficiency anemia and endemic goiter. Local seaweeds have been analysed for essential elements, electrolytes, vitamins and essential amino acids. The methods used were atomic absorption spectrophotometry for copper, magnesium, manganese and zinc; flame photometry for sodium and potassium; colorimetry for iodine, iron and phosphorus; titration methods for calcium and protein; gravimetric methods for moisture, fat, crude fiber and ash; chromatographi-colorimetric methods for carotene and amino acids; fluoremetry for thiamine and riboflavin; and a microbiological method for niacin. Results showed that 100 g of the following fresh edible seaweeds meet the RDA for one or several nutrients:

Hydroclathrus chlatratus (balbalulang), Acanthopora spicifera (culot) Laurencia papillosa (culot), Gracilaria arcuata and Sargassum fulvellum (kulafu) for calcium, iron and iodine; Enteromorpha intestinales (lumot ti baybay), Gracilaria eucheumioides (canut-canut), Halymenia durvillaei (gayong-gayong) and Hypnea charoides (culot ti pusa) for iron and iodine; Caulerpa racemosa (lato or ararosp) and Gracilaria verrucosa (caocaoayan) for iron, iodine and manganese; Codium tenue (pocpocelo), Sargassum hemiphyllum (kulafu), Enteromorpha compressa (lumot) and Ulva pertusa for iron; Ulva lactuca (gangamet or lab-labig) for magnesium, and Sargassum fulvellum (kulafu), Hormophysa triquetra, Sargassum crispifolium (kulafu), Sargassum nigriifolium (kulafu), Sargassum giganteifolium (kulafu) Caulerpa peltata, Eucheuma gelatinae (guso), Eucheuma spinosum (guso), Gracilaria coronipifolia (caocaoayan), Gracilaria salicornia (canut-canut), Laurencia okamurai (culot) and Scinaia moniliformis (ar-aritas) for iodine.

#### PS. B-49

#### DEVELOPMENTS IN POSTHARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

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Several methods such as control of environmental conditions surrounding the products, ionizing radiation, use of solar energy, canning, preservation by food additives/preservatives and freezing are employed to prevent postharvest losses of fruits and vegetables. Recent developments in these areas of research and the

feasibility of employing these methods in developing countries such as India are discussed.

**PS. B-50**

**IMPROVED TECHNOLOGY FOR TRADITIONAL PHILIPPINE  
ALCOHOLIC BEVERAGES**

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Through use of an improved fermentation process and selection of efficient strains of microorganisms the yield and quality of four traditional alcoholic beverages, namely, sugarcane wine ("basi"), rice wine ("tapuy"), coconut wine ("tuba") and distilled coconut wine ("lambanog") were greatly improved. "Basi" fermentation using selected strains for alcohol and flavor production such as Saccharomyces cerevisiae DFST 156, Pediococcus pentosaseus DFST 58 and Lactobacillus casei DFST 302 has increased the alcohol content by 2 to 3% and yield by 15% as compared with the traditional method. Sensory evaluation of the product showed that the "basi" produced from the improved process received a significantly higher acceptability than "basi" produced by the traditional method. Selected strains for "tapuy" were Rhizopus oryzae DFST 32, Mucor rouxii DFST 45, Saccharomycopsis fibuligera DFST 70 and Saccharomyces cerevisiae DFST 614. These strains have good activity in producing amylase, aroma, flavor and alcohol hence increasing the yield of high quality product. "Tuba" fermentation consisted of a wide variety of both useful and spoilage microorganisms, particularly Saccharomyces chievalieri and S.baili var baili. Addition of 3% Ceriops tagal Perr bark in the collecting container did not inhibit these microorganisms and killed the spoilage microorganisms, increased alcohol content by 3 to 4%, minimizing the astringent taste of the product. Improvement in the quality of "lambanog" was achieved by an improved fermentation process and controlled temperature of distillation.

**PS. B-51**

**REMOVAL OF AFLATOXINS IN PADDY BY PARBOILING AND MILLING**

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Aflatoxins, the naturally occurring mould metabolites, have been unequivocally demonstrated to be responsible for causing disease outbreaks in India and Kenya. Maize and rice have been found to be two of the high risk commodities for aflatoxin contamination. Paddy harvested under abnormal weather conditions, such as cyclones and floods in India, has been found to be contaminated with aflatoxins up to 130 ppb. A study of the reduction of aflatoxin by various rice processing steps is reported. Popular varieties of paddy, after autoclaving, were artificially infected



with toxigenic strain of Aspergillus parasiticus. The aflatoxin produced in these samples was determined. Aliquots of sample were subjected to polishing, and to parboiling followed by dehulling and polishing. The process of hulling removed 50 to 70% of the aflatoxin present in the original contaminated paddy. The process of milling further reduced it by 10%. Parboiling per se brought down the aflatoxin content in paddy by about 50%, and after hulling and milling the aflatoxin content was reduced to 7 and 17% of that originally present. Any aflatoxins present in paddy can thus be removed to a considerable extent by the normal methods of processing.

**PS. B-52**

**DEVELOPMENT AND SUITABILITY OF LOCAL MILK COAGULANTS  
FOR MAKING HARD AND SEMIHARD CHEESES**

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Abomasa of adult carabao and cattle have been tapped as indigenous sources of potential milk coagulants as substitutes for the costly imported calf rennet in local manufacture of ripened hard and semihard cheeses. Among several formulations developed, IFS-6 crude extract from cattle gave the best characteristics. One ml extract can clot 100 ml normal milk at 30 C in 3-6 minutes, retaining its clotting activity at 25-44 C and pH 5.5-7.0. Optimum temperature for coagulation, however, varies from 36 to 40 C. This is not highly proteolytic but its clotting activity and microbiological quality is lower than that of the imported rennet. Tests on technological suitability of the local coagulant in the manufacture of Cheddar, Blue, Gouda, Edam and other ripened cheeses showed that yield, composition and sensory qualities of the cheeses after 4-5 months storage are not significantly different from those made with the imported rennet. During early ripening, however, the rennet-substituted cheeses gave slightly inferior flavor, aroma, body and texture. Hard and semi-hard cheeses can thus be manufactured in the Philippines using a locally prepared milk coagulant thereby reducing rennet and cheese imports.

**PS. B-53**

**THE EFFECTS OF PROCESSING ON THE PROTEIN QUALITY OF MUNGBEAN**

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A biological testing using rats was carried out to study the effects on the protein quality of mungbeans of dehulling, germination, roasting, boiling, and supplementing with cereals fortified with vitamins and minerals. True Digestibility Coefficient (DC), Biological Value (BV), and Net Protein Utilization (NPU) were the parameters used. A total of 35 male weanling rats of Sprague-Dawley strain were

randomly assigned to six mungbean-based diets (undehulled, dehulled, sprouted, roasted, boiled and baby food product) formulated to contain 10% protein. Skim milk served as control protein. Results are presented that show that processing markedly improved the digestibility of mungbean protein. In terms of NPU, dehulled, sprouted, roasted and boiled mungbean were significantly comparable. The NPU of baby food mungbean-based diet (81.18) was the highest among all mungbean diets, which is indicative of a balanced amino acid pattern as a result of cereal-legume protein supplementing, fortified with vitamins and minerals.

#### PS. B-54

### HIGH ENERGY TOFU FROM SOYBEAN MILK AND COCONUT MILK MIXTURE

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Tofu with increased caloric density was prepared from mixtures of coconut milk and soymilk by coagulation with calcium sulfate. The protein content of the tofu decreased slightly while the fat content increased significantly with increasing levels of added coconut milk. Hardness, springiness, cohesiveness and gumminess exhibited similar trends, increasing from 0% to 9% or 16.6% added coconut milk and then decreasing with further addition of coconut milk to soymilk. The yield, and sensory qualities were not affected by added coconut milk. Thus tofu manufacture with coconut milk enrichment warrants consideration especially in developing countries where lack of calories is the most prevalent form of malnutrition.

#### PS. B-55

### VASCULAR STREAKING OF CASSAVE (Manihot esculenta Crantz) AS AFFECTED BY DETOPPING, O<sub>2</sub>, CO<sub>2</sub> AND RELATIVE HUMIDITY

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Cassava stems were detopped at varying lengths before and after harvest; roots were stored at varying levels of O<sub>2</sub>, CO<sub>2</sub> and at different relative humidities to determine their effects on the appearance of vascular streaking, rots, and changes in physio-chemical characteristics of the roots during storage. Detopping at 50-100% and stripping of all the leaves before and after harvest significantly delayed vascular streaking but reduced the dry matter content of the roots though not the starch content. Detopping after harvest did not affect the dry matter, starch and HCN content. Detopping 40 days before harvest was more effective in minimizing vascular streaking than at 20 days. Storage in an atmosphere with 5, 10 and 15% O<sub>2</sub> and 0.03% CO<sub>2</sub> did not affect vascular streaking significantly, however storage in 5 and 10% CO<sub>2</sub> at 16% O<sub>2</sub> minimized vascular streaking. CO<sub>2</sub> at 5 and 15% aggravated it. A relative humidity of 80-90 also suppressed streaking but resulted in a greater percentage of rotted roots.



**PS. B-56**

**ALTERNATIVE CARRIER FOR POTASSIUM PERMANGANATE AS  
ETHYLENE ABSORBER DURING TRANSPORT AND STORAGE OF BANANAS**

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A laboratory trial using perlite, vermiculite, pumice and clay as permanganate carrier; purafil and a Japanese sachet (both commercial preparations) was carried out on 'Cavendish' bananas shipped from Davao to Manila. Shipment duration was 5 days inside an unrefrigerated container van at ambient conditions (27-35°C). Assessment of the effects of ethylene absorbents was done 15 days after, to maximize benefits from the treatments. Ranking of the absorbents is reported based on ethylene concentrations inside the pack on the 13th day, on CO<sub>2</sub> concentrations, and on O<sub>2</sub> content. In addition, rankings are given for yellowing of the peel and firmness. Clay and perlite which are both available locally have been determined to be suitable alternative carriers for potassium permanganate. Both were effective in maintaining low levels of ethylene, suitable O<sub>2</sub> and CO<sub>2</sub> concentration, color and firmness for medium term keeping at ambient conditions.

**PS. B-57**

**DETERMINATION OF AMINO ACID AND PROXIMATE ANALYSIS OF  
UNCONVENTIONAL FEEDSTUFF FOR BROILER CHICKEN  
GALLUS GALLUS (LINNEUS) STRAIN COBBS**

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A study on an unconventional foodstuff with commercial feeds as a control for comparison has been carried out on 40 broiler chicks (20-day old) fed for 45 days. The formulated unconventional feedstuff was given proximate analysis (moisture, fat, fiber, protein, ash and nitrogen-free extract) and its amino acid content determined. On these indices of nutritive value, the formulated ration was superior.

**EFFECT OF DEGREE OF MILLING OF RICE ON PROTEIN AND ENERGY  
UTILIZATION BY PRESCHOOL CHILDREN**

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Brown rice has relatively more protein with slightly higher lysine content, B vitamins and oil than milled rice, but it also has more dietary fiber and phytate content. Brown and milled IR32 rice had similar NPU in growing rats. Confirmatory balance studies were undertaken on preschool (1.5-2 years old) children to compare protein and energy utilization in brown, undermilled (5% bran removal) and milled (9% bran-polish removal) rice. Because of bulk, only 2/3 of N was from rice and 1/3 from casein. Control diets had casein as N source. Coconut:corn oil (9:1) blend contributed 25% of energy intake with the remaining carbohydrate from sucrose and mung bean noodles. The subjects received vitamin and mineral supplement. Energy intake was at 100 kcal/kg body wt daily. At a daily intake of 250 mg N/kg body wt, six children showed similar apparent N absorption and retention and energy absorption values on the three diets. The casein diets I and II were better absorbed but N retention and energy absorption were similar to those of the rice diets. Repetition of the balance study on four children at 200 mg N/kg body wt daily gave essentially similar results. Further data using 200 mg N (rice:powdered milk 2:1 N basis)/kg body wt are presented since powdered milk is more commonly used than casein. Results suggest that the nutritional advantage of brown rice over milled rice is its higher content of B vitamins in the bran layers and embryo.

## Poster Session C

December 7 & 8, 1982

1715 - 1915

Delegation Building, Third Floor, Lobby

PS. C-1

### VEGETABLE RENNET FROM WITHANIA COAGULANS

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Rennet was extracted with 10% aqueous solution of NaCl from the fruit of Withania coagulans. The crude enzyme(s) was purified by dissolving it in 5% NaCl solution and centrifuging. The supernatant liquid was treated with NaCl and the precipitated enzyme(s) was removed by centrifuging and dried at room temperature. 100 g of dried fruit yielded 7.0 g. One half mg of this rennet is capable of coagulating 1000 ml of milk. The vegetable rennet is stable at room temperature and the loss of activity after one year is negligible. Cultivation of Withania coagulans yielded 1500 - 1800 kg/ha of fruit. Gel filtration of the enzyme(s) on Sephadex G-25, C-100 and DEAE- Cellulose gave a single highly active band. Disc electrophoresis of the eluted enzyme(s) indicated a mixture of at least three bands. Behavior of this vegetable rennet on column and disc electrophoresis is quite different from that of calf rennet. The quality of the taste of the cheese prepared with vegetable rennet compares well with that from calf rennet.

PS. C-2

### INFLUENCE OF NITROGEN SOURCE AND CONTENT, OXYGEN AND pH ON THE METABOLISM OF PSEUDOMONAS OVALIS CULTIVATED ON PETROLEUM

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Pseudomonas ovalis was cultivated on different media containing urea, ammonium nitrate or sodium nitrate as nitrogen source and a petroleum wax distillate (boiling range 300 - 400°F) as carbon source. The assimilation of these nitrogen sources was studied under conditions of limited aerobic and of sufficient supply of oxygen. The metabolic activities were studied under pH adjustment and non-adjustment.

The highest accumulation of biomass occurred when urea was the sole source of nitrogen. Oxygen has a substantial influence on the biomass accumulation, the cellular protein content and the change in the character of the hydrocarbon. A higher cellular protein content and biomass were obtained in the presence of 2.5% urea and a continuous vigorous air supply (30 l/hr/flask), than in the presence of a limited air supply (shaking flasks). pH adjustment during cultivation was important to maximizing the yield. The most efficient use of the wax distillate occurred in the presence of sodium nitrate or a high amount of urea.

### PS. C-3

#### NEW, NATURALLY-OCCURRING PLANT GROWTH REGULATORS

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The isolation and identification of naturally-occurring plant growth regulating agents has become of major agricultural importance. Two such compounds recently reported are 1-triacontanol and brassinolide. Reported here are a series of naturally occurring plant components which have been found by the author to exhibit plant growth stimulating activity surpassing all known plant growth regulators to date. The new compounds are effective at sub-nanomolar concentrations when applied to crops as a foliar spray, and have shown increases in the dry weight of seedlings in preliminary greenhouse trials of up to about 99% a few days after application. Further, the compounds are effective only when in solution with selected non-toxic electrolytes. All crops tested have responded markedly. Field trials for the 1982 growing season are being conducted on a variety of crops; corn, soybeans, tomatoes, radishes, carrots, peas, beans, and others. The results of these trials are reported.

### PS. C-4

#### THE SEARCH FOR POTENTIAL SOURCES OF PROTEINS THROUGH TAXONOMICALLY ORIENTATED STUDIES

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Successful cereal and pasture crops have many essential characteristics in addition to their protein content and amino acid composition. Nevertheless, the nutritional status of the protein is presumably relevant to the search for potential new crops. Data on seed/leaf protein and amino acid composition allied with taxonomy might help in locating potential donors of useful genes for existing crops. In this context, we have examined the protein and amino acid content of seeds and leaves of grasses chosen to represent fairly the family as a whole. Seed protein content from 121 species (72 genera) ranged from 4.0 g% fr. wt. in *Oryza sativa* cv Calrose to 27.5 g% fr. wt. in *Festuca hockera*. The existence of a taxonomic pattern in the amino acid composition was confirmed. Nutritional chemical scores of the seed proteins, but not total protein content, correlate with taxonomic groupings, lysine being the limiting essential amino acid in several of the tribes (e.g. chloridoideae and panicoideae). Leaves from 88 species (58 genera) are low in protein content, with an average of  $2.2 \pm 1.0$  g% fr. wt. Analyses of the total leaf amino acid patterns also show consistent differences between major taxonomic groups, and identify isoleucine, valine, methionine and cysteine as the nutritionally limiting essential amino acids. Seeds of several non-cereals (eg *Bromus* spp.,

Stipa spp., Nasella sp., Anisopogon sp., Ehrharta spp. and Microlaena sp.), some of which grow in arid regions unsuitable for existing cereal crops, and which have not been subjected to human selection and genetic improvement, have a protein content, amino acid composition and chemical scores similar to, or better than, many of the cultivated cereals.

#### PS. C-5

### NEW WAYS IN THE DEVELOPMENT OF FOOD PRODUCTION: TITANIUM-CHELATE

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The insolubility of natural compounds of titanium makes it practically unavailable to plant roots. We have applied the watersoluble and pH-stable chelate of titanium with ascorbic acid as a very effective agent in plant nutrition. By using a very low concentration (3-10 g. Ti/ha) the yield of wheat, corn, alfalfa, sugar-beet, apple, wine-grape etc. can be increased on an average by 10-15%, and at the same time the quality of product (carbohydrate and protein content) can also be improved. The foliar application of titanium-chelate increases the activity of some enzymes and can promote the uptake of other nutritional elements from the soil. This compound is not toxic but favourable for living systems, and no problems of environmental contamination occur. We also have very promising results in animal nutrition.

#### PS. C-6

### PRODUCTION OF SINGLE-CELL PROTEIN FROM GREEN PLANTAIN SKIN

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Pichia spartinae was grown on the skin of green plantain (Musa paradisiaca). The green plantain skin constitutes an agroindustrial waste with a high level of total carbohydrates, 3% simple sugars, 50% starch, 9% cellulose, and 12.4% hemicellulose. The hydrolysate of the filtrate of plantain skin (4% W/V) was used as a substrate. Acid hydrolysis with 1.5% (W/V) sulfuric acid, at a temperature of 110°F, for 15 minutes, showed optimum growth of the yeast in the acid-hydrolyzed filtrate at a pH of 4 and a temperature of 30°C. After the addition of 0.2% (W/V) yeast extract (optimum concentration to the medium), the biomass obtained was 7.8 mg/ml with a yield of 37-40%. The biomass contained 52% protein, 10% RNA, and 0.05% DNA. Microbial hydrolysis was done with the yeast Endomycopsis fibuliger grown on unfiltered, nonhydrolysis substrate. After microbial hydrolysis, the medium was filtered and used as a substrate for the growth of Pichia spartinae. The optimum pretreatment time of the substrate with E.fibuliger was 24 h. Final biomass production was lower compared with that obtained by acid hydrolysis. The results

obtained demonstrate that the skin of plantain could serve as a low-cost substrate for the production of microbial proteins.

## PS. C-7

### ALTERNATE FOODS FOR THE GROWING POPULATION

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"Alternate foods", defined as indigenous plant and animal food resources consumed by some minority groups but not traditionally or conventionally used as food by the general populace, can substitute for or complement conventional protein, calorie, mineral and vitamin sources and thus alleviate malnutrition. A study on alternate foods has been conducted by which 33 provinces have been surveyed and 938 samples identified (566 plants and 372 animals). Of these, 16 animal samples and 141 plant samples have been scientifically identified. Examples of these alternate foods are the acacia (Samanea saman) fruit; anahao (Livistoma rotundifolia) bud; dutsarita (Alternanthera versicolor) tops and leaves; lingat (Begonia nigritarum) tops, leaves and stem; dagang palay (Rattus mindanensis mindanensis) meat; and salagubang (Leucopholis irrorata). Activities still to be undertaken are proximal, nutritional and toxicological analyses, systematic identification of other alternate foods and dissemination of information to the consuming public. Although people will require time to be convinced to consume alternate foods, it is believed that these foods will both help solve problems of food insufficiency and also help increase the total income of the rural and urban poor by small and large scale production of such alternate foods.

## PS. C-8

### PROTEIN PRODUCTION AND LIGNIN BIODEGRADATION BY MYCELIAL LACCASES

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It may be possible to obtain protein-rich biomass for animal and/or humal nutrition from lignocellulosic waste materials. The transformation of such material into proteins starts with degradation of cellulose and lignin by cellulase and laccase produced by bacteria (Pseudomonas spp., Flavobacterium spp., Hormodendron spp., etc.) and Enycoetes (Coriolus spp., Fomes spp., Poluporus spp., Pleurotus spp., Trametes spp., Agaricus spp., etc.). Mushrooms, in particular, through the metabolization of lignins and cellulose, produce large amounts of protein-rich material (mycelium and carpophores) with high content of essential amino acids. A close relationship between laccase activity, growth rate and protein content of A. bisporus mycelium has been found. Experiments carried out "in vitro" (with purified enzyme from A. bisporus) and "in vitro" (mycelium of the same mushroom grown on a compost medium) show the possibility of improving laccase activity by activators (simple phenols) in order to improve protein production.

## PS. C-9

### MICROBIAL AND ENZYMATIC UTILIZATION OF STEAM-PRETREATED FORESTRY AND AGRICULTURAL WASTES

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In recent years world-wide research on more extensive utilization of renewable resources for the production of chemicals, energy, fodder and foodstuff has been intensified. We have investigated the enzymatic hydrolysis of wood chips and maize stalks pretreated with high-pressure steam followed by expansion. The enzyme was produced from Trichoderma reesei QM 9414 grown on the pretreated waste. Maximum cellulose waste concentration used in the fermentation was 30 g/l resulting in a final enzyme concentration of 1.8-2.0 filter paper units /cm<sup>3</sup>. The enzyme-containing fermentation broth was used directly without enzyme concentration. A 10-15% substrate concentration was used for enzymatic hydrolysis. A two-step hydrolysis improved conversion. Utilizing the favourable adsorption properties of the enzyme, only fresh buffer was added in the second hydrolysis step. With the use of 13% substrate concentration at an enzyme:substrate ratio of 13.3 IU/g and 24 hour hydrolysis time, a 91% conversion (25% higher than with the one-step process) was achieved. The broth, containing 25-30 mg/cm<sup>3</sup> of reducing sugar, was utilized, after the addition of nutrients, by three different species of Candida yeast. Sugar utilization was 92-94% both in the case of Candida guilliermondii and Candida tropicalis. Yeast was obtained at a rate of 0.5 g/g sugar, with a protein content of 35-40%.

## PS. C-10

### EFFECT OF DITHIOCARBAMATES ON THE PRODUCTION OF CITRIC ACID, KOJIC ACID AND CELLULASES BY FUNGI

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In the presence of tetramethylthiuram disulphide (TMTD) (0.2 ppm), sodium dimethyl dithiocarbamate (NaDDC) (0.1 ppm) and zinc dimethyl dithiocarbamate (ZnDDC) (1.0 ppm), a significant increase of the order of 103, 103, and 11% respectively, in citric acid production by A.niger was observed. With these compounds about 100% increase in kojic acid production by A.flavus-oryzae was also observed. Different concentrations of TMTD, NaDDC and ZnDDC, affected the amount of cellulase activity in the culture filtrates of Trichoderma reesei. After eight days' incubation at 28°C the greatest increase in Avicelase CMCase and B-glucosidase over the controls were observed at 0.1 ppm (TMTD), and 0.4 ppm (NaDDC and ZnDDC). There was a decrease in growth in the presence of these compounds. However, at 12 days incubation, Avicelase and CMCase production increased greatly over the controls for 0.2 ppm TMTD, 0.1 ppm NaDDC and 0.2 ppm ZnDDC, but B-glucosidase activity was reduced considerably. Total protein in the culture filtrates increased with increase in cellulase activity. No change in pH was observed at eight days incubation but pH increased (not exceeding 5.9) at 12 days incubation.

**PS. C-11**

**TRANSFORMATION OF MUNICIPAL WASTE TO CHEMICAL FERTILIZERS**

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The advantages of solid waste disposal are gaining the attention of municipal authorities, especially in the developing countries. To dispose of municipal waste, to clean the environment and to protect the health of the community are some of the aims of an adequate municipal waste disposal program. The transformation of solid municipal waste to fertilizers is a process with the dual advantage of disposing of the waste and producing a fertilizer to increase soil productivity. Aerobic or anerobic bacterial processing of waste can be used to produce the fertilizer. The value of the fertilizer for agriculture depends on its chemical content, and requires proper application in different soils and for different crops. The process, production and management details, and the quality of the fertilizer produced from solid waste, as carried out in a developing country, is described.

**PS. C-30**

**PHEROMONE TRAPS - AN ADDITIONAL METHOD IN THE  
PLANT PROTECTION WARNING SYSTEM**

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The monitoring of pest populations has long been an important part, worldwide, of crop protection measures. Using a wide variety of different methods, such as visual observations, beating method, trap bands, soil samples, light traps etc., there have been many attempts to anticipate the arrival of pests so as to allow appropriate control measures to be carried out in good time, systematically and hence more efficiently. This highly labour-intensive monitoring work has hitherto been undertaken mainly by official bodies in conjunction with their warning service. To show the ranking accorded to the use of pheromone traps, the Federal Republic of Germany is taken as an example. For the growers, the use of pheromone traps as a method for prognostic purposes is found to be economically justifiable.

**PS. C-31**

**CHITIN SYNTHESIS INHIBITORS - SAFE AND NOVEL INSECTICIDES**

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Chitin synthesis inhibitors are moult - inhibiting chemicals which upon



ingestion selectively disrupt chitin biosynthesis in larval insects. These new insecticides are non-persistent in soils and have very low biological magnification. They do not appear to have any adverse effect on non-target species such as fish, birds and mammals. These novel insecticides act as reversible inhibitors of chitin synthesis by blocking chitin synthetase. Diflurobenzuron and Bay Sir 8514, two chitin synthesis inhibitors, were evaluated as bioicides against crop pests such as the rice swarming caterpillar, *Spodoptera mauritia*, bhindi leaf roller, *Sylepta derogata*, sweet potato weevil, *Cylas formicarius*, cucurbit leaf caterpillar, *Plusia peponis* and hairy caterpillar, *Pericallia ricini*. The data on the insect mortality are presented. These pesticides also induced various morphogenetic changes such as blackening and shrivelling of the cuticle, oozing out of the body fluid, inability to shed the larval molt, etc. The use of these safe insecticides may progressively reduce our dependence on broad-spectrum neurotoxic insecticides leading to more ecologically sound methods of insect management.

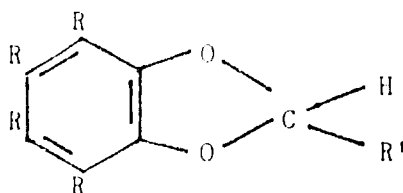
### PS. C-32

#### TETRACHLORO-o-PHENYLENEDIOXYACETIC ACID AND ITS EFFECT ON GERMINATION OF SEEDS. SYNTHESIS OF HALOGENATED BENZODIOXOLE CARBOXYLIC ACIDS AND DERIVATIVES

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Since certain halogenated aryloxyalkanoic acids acquire plant growth regulating activities, we have synthesized a series of tetrahalo-o-phenylenedioxyacetic acid derivatives and tested their effect on germination of seeds.

Tetrachloro- and tetrabromo-o-benzoquinone react with ethyl diazoacetate yielding ethyl-4,5,6,7-tetrachloro- (Ia) and ethyl-4,5,6,7-tetrabromobenzodioxole-2-carboxylate (Ib), respectively. When (Ia) is subjected to alkali-hydrolysis, the corresponding phenylenedioxyacetic acid (Ic) is obtained. The hydrolysis of the bromo-analogue (Ib) follows the same course, yielding the corresponding tetrabromophenylenedioxyacetic acid derivative (Id).



Ia; R = Cl, R' = COOC<sub>2</sub>H<sub>5</sub>  
 b; R = Br, R' = COOC<sub>2</sub>H<sub>5</sub>  
 c; R = Cl, R' = COOH  
 d; R = Br, R' = COOH  
 e; R = Cl, R' = CONHNH<sub>2</sub>

If; R = Br, R' = CONHNH<sub>2</sub>  
 g; R = Cl, R' = CONHC(CH<sub>3</sub>)<sub>2</sub>  
 h; R = Cl, R' = COCl  
 i; R = Cl, R' = CONHC<sub>6</sub>H<sub>4</sub>Cl -p  
 j; R = Cl, R' = CONHC<sub>7</sub>H<sub>6</sub>NO<sub>2</sub>

Hydrazine hydrate reacts with (Ia) as well as with (Ib) yielding the corresponding hydrazides (Ie) and (If), respectively. (Ie) Condenses readily with acetone yielding (Ig). In order to prepare the anilide derivatives of (Ic), the acid chloride (Ih) was prepared through the reaction of (Ic) with thionyl chloride.

(Ih) reacts readily with p- chloro-aniline as well as with 2-amino-5-nitrotoluene yielding the corresponding anilides (Ii) and (Ij), respectively.

We tested the effect of tetrachloro-o-phenylenedioxyacetic acid (Ic) on the germination of seeds. The acid shows significant selective activity on the germination of seeds of common wheat (*Triticum vulgare*), broad bean (*Vicia faba*) and Egyptian cotton (*Gossypium barbadense*). In contrast to the acid, the sodium salt lacks this activity. Thus, the acid shows an inhibitory effect on the germination of monocotyledonous wheat seeds in low concentration. A much higher concentration is required to give a similar effect on the germination of the dicotyledonous cotton or bean seeds. These results suggest that the acid (Ic) possibly acts in a manner which is different from "2,4-D" since the latter is known to be mainly effective against dicotyledonous plants. The bromo-analogue (Id), as well as the prepared functional derivatives, were more or less inactive which might be due to their insolubility in water.

### PS. C-33

#### IMMOBILIZATION OF $\alpha$ -AMYLASE

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Commercial hydrolysis of starch is done economically using immobilized  $\alpha$ -amylase and glucamylase. This study was undertaken to learn more about the details of immobilization and hydrolysis. The activity of  $\alpha$ -amylase was measured at room temperature using dinitrosalicylic acid as reagent. The percent activity of  $\alpha$ -amylase coupled to cyanogen bromide-activated Sepharose 4B (100 mg) at pH 8.3 decreased from 72% to 1.2% when the concentration of  $\alpha$ -amylase was increased from 1 to 1000  $\mu$ g. In this range, the log of percent activity of the immobilized  $\alpha$ -amylase was inversely proportional to the log of concentration of  $\alpha$ -amylase added. Immobilized  $\alpha$ -amylase stored at 45°C for four days was not only more stable, but also exhibited 50% more activity than the immobilized  $\alpha$ -amylase stored at 0°C. Immobilized  $\alpha$ -amylase showed optimal activity in 0.02 M phosphate buffer (pH 7.0). The optimal substrate concentration for the activity of immobilized  $\alpha$ -amylase was 1.65% starch.

### PS. C-34

#### APPLICATIONS OF RECOMBINANT DNA RESEARCH TO THE STUDY OF PLANT VIROIDS

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Viroids are infectious agents composed entirely of closed circular single-stranded RNA of low molecular weight ( $1.1-1.3 \times 10^5$  daltons). They replicate in a wide variety of plants, and are often associated with specific disease symptoms.

The disease caused by the potato spindle tuber viroid (PSTV) presents a potential obstacle to the adaptation and expansion of the potato as a food crop in tropical and subtropical climates. Recombinant cDNA clones of PSTV have been constructed and used to develop a highly sensitive and reliable method for the detection of PSTV. This method is based on hybridization between radioactive PSTV cDNA and viroid RNA extracted from infected tissue and attached to a solid support such as nitrocellulose. Current experiments are underway to determine if these recombinant DNAs are themselves infectious. If so, directed in vitro mutagenesis will provide a new and powerful approach to identify regions of the viroid molecule that are involved in viroid-host interaction.

#### PS. C-35

### HETEROSIS AND GENETICAL RECOMBINATIONS FOR ROOT NUCLEIC ACID CONTENTS AND SELECTION OF WATER STRESS ADAPTED WHEAT (T.AESTIVUM) VARIETIES

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Understanding the pattern of inheritance and the identification of positive heterosis in respect of some root morphological characters of bread wheat, *T.aestivum* (L.) Thell. in certain hybrid combinations has already been accomplished. During the 1976-7 season a one way diallelic crossing was done amongst six wheat varieties showing contrasting root nucleic acid contents (total- and synthesised- DNA and RNA). During 1977-8 the root N-acid contents of  $F_1$  and parents were determined following Kirby's method at the anthesis stage after  $^{32}P$  labelling of N-acid by feeding with the isotope. From the study two hybrid combinations showing positive heterosis for root N-acid contents could be identified. Both selections and trials for superior vegetative and grain yield characteristics from these lines under 1/4th normal irrigation yielded six recombinants showing 8-14% improved grain yield in the  $F_2$  generation over the parents. It was concluded that (i) higher values for root N-acid contents in wheat  $F_1$ 's indicated better adaptability under water stress and (ii) there is scope for selecting recombinants on the basis of biochemical parameters which may show better yield under water stress than parents.

#### PS. C-36

### NEW SOURCES OF EDIBLE VEGETABLE OILS IN KENYA

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One way to meet acute fat-deficiency in diets is to intensify the cultivation of the conventional oil seeds. Climatic conditions and cultural habits may hinder the cultivation of these oil seed crops in new regions. A second approach is to identify new oil seeds which are indigenous to various regions and from which edible oils can be obtained. Thus we have been screening and identifying indigenous oil seeds which may be alternative sources of edible vegetable oils in Kenya. The oil content of over forty indigenous seed species, and the physical and chemical

properties of some of these oils have been determined. In addition, the seed meals left after oil extraction have been analysed for protein, carbohydrates, fibre and ash content in order to determine their possible use as animal feedstuffs. The viability of commercializing some of these oils has been determined using a rating classification which takes into account oil content, seed meal value, estimated seed availability, domestication potential, etc. Tables and figure summarizing the above data, and our preliminary conclusions so far are discussed.

#### PS. C-37

### CONTROL OF DRECHSLERA GRAMINEA STRIPE DISEASE OF BARLEY BY A STRAIN OF STREPTOMYCES ALBUS

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During preliminary screening of the soil samples collected from various Indian localities for obtaining the antibiotic producing actinomycetes, an actinomycete culture (NGO-148) was isolated in pure form which was strongly antagonistic to Escherichia coli, Bacillus subtilis, Candida albicans and Briehslera graminea. On the basis of morphological, cultural and some physiological characteristics as well as antibiotic sensitivity, this was identified as a strain of Streptomyces albus. The antibiotic substance produced by this strain is of non-polyenic nature and is different from that produced by all the known existing strains of S.albus. The antibiotic substance produced by the present isolate when tested by the agar diffusion method inhibits the growth of a number of plant pathogenic micro-organisms such as Fusarium moniliformis, Penicillium chrysogenum, Curvularia lunata, Alternaria brassicicola, A.alternata, Pseudomonas mori, Xanthomonas vignicole, X.synopeidis, thus indicating the wide scope of the control of the plant diseases caused by these micro-organisms. This antibiotic substance also brought about a reduction in the development of stripe disease of barley caused by D.graminea of 65.26%, 70.31% and 47.62% when the culture filtrate was sprayed over the barley plants simultaneously with, a week before or a week after the spraying the spore suspension of D.graminea, respectively. A reduction in disease development to the extent of 32%, 31% and 73% was also achieved when S.albus culture was mixed as such in the soil, before the infestation of the pathogen, simultaneously with or after the infestation, respectively.

#### PS. C-38

### FORMIC ACID WOOD PROCESSING: A KEY TO FOOD, CHEMICALS AND FUELS.

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Densely grown legumous trees provide foliage for ruminants, nitrogenated soil for high crop yields, and wood (and bark) for digestion by 80% formic acid at 105°C/atmospheric pressure. The cellulose pulp may be used for confined ruminant

feeding (increased meat-dairy products yields), for enzymatic hydrolysis to glucose (microbials and microbial processes, e.g. ethanol), or directly for microbial production (mushrooms, Thermoactinomyces). The liquor is distilled to recover formic acid and acetic acid (hemicellulose hydrolysis). The undistilled portion containing lignin and sugars (hemicellulose hydrolysis) is useful as feed or substrate for microbials (e.g. Spirulina) after water extraction. The unique residual lignin is of low (1,000) molecular weight, soluble in organics, and essentially a poly-alkyl-aryl ether which by acid catalyzed hydrolysis evolves methanol from depolymerized polyhydric propylphenols. In turn, these can be converted by hydrogenolysis (dehydroxylation and/or hydrodealkylation) to chemicals (phenol, benzene) and propylbenzene which serve as a liquid fuel. This process based on delignifying wood is described in detail and advanced as an economic source of food, chemicals and fuel.

#### **PS. C-39**

##### **CONTINUOUS-FLOW YEAST PRODUCTION IN NUTRIENT-SUPPLEMENTED COCONUT WATER**

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Continuous-flow culture of Candida tropicalis UPLB 1 in coconut water, which was supplemented with ammonium sulfate and phosphoric acid, was conducted in a one- or two-stage 9-liter airlift fermenter at several dilution rates. The effects of some fermentation parameters on biomass production and carbohydrate utilization of coconut water were studied. Preliminary results of continuous-flow experiments using a 72-liter fermenter are presented.

#### **PS. C-40**

##### **AGROFORESTRY IN FOOD AND WOOD PRODUCTION**

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Agroforestry is a cropping system, more appropriately applied to the uplands, which combines two or more agricultural and forest crops in the same area simultaneously with the ultimate purpose of having a combination of permanent crops growing on the land later on. Agroforestry when properly practised has the potential of producing substantial amounts of food crops and livestock together with wood products from the large areas of degraded/open uplands in the Philippines which are now minimally productive. Application of our recent findings on the production and use of inoculants which could make agroforestry even more promising as a cropping system for marginal and semi-marginal uplands for the production of more food is noted.