Ainsworth

CIMMYT

CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO, A.C.
Londres 40, Apdo. Postal 6-641
Col. Juárez Deleg. Cuauhtémoc
06600 México, D.F.
Telex: 1772023 CIMTME

Primitive Maize

For Lecture

Dr. M. S. Swaminathan
Hotel Presidente Chapultepec
Room 2710
Mexico City.

PRESENTE

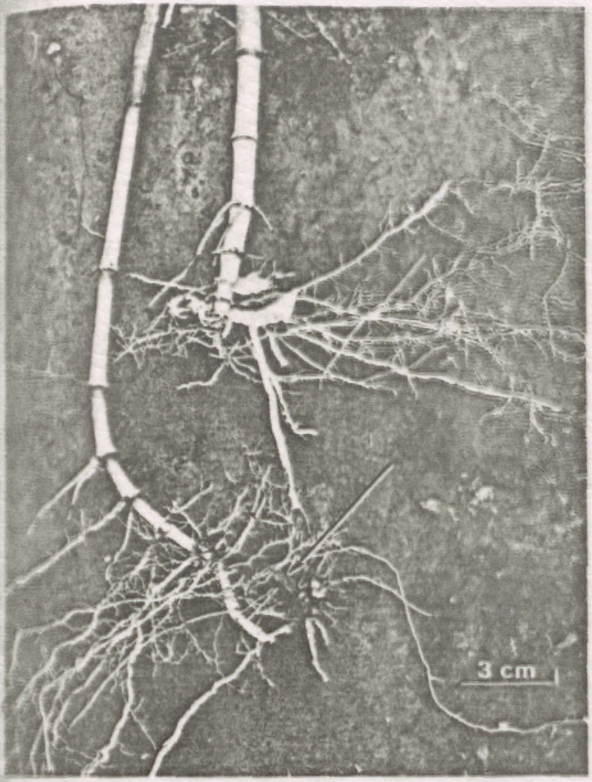

Fig. 1 (left). Root system of *Zea diploperennis*. Left plant showing a cordlike rhizome (note short internodes); right plant has two sectioned tuberous short rhizomes, which are covered with scale leaves; the arrow points to the stump of previous years' culm. Fig. 2 (right). Comparative growth of the two perennial teosinte species in a uniform environment (University of Guadalajara greenhouse), with *Zea perennis* on the left, *Z. diploperennis* on the right, and R. Guzmán M. in the middle. The plants were grown from rhizomes collected in the wild, and were 9 months in cultivation. Plants growing in the wild would be somewhat shorter.

tinged, strongly green-nerved, the nerves usually clustered marginally near the apically ciliate prominent lateral wings; outer glume strongly enclosing inner glume.

Female spikes sessile or often borne on long peduncles, frequently tipped by short male racemes; fruit cases 5 to 10 per spike, trapezoidal-cylindric, 6 to 8.2 mm on the long side, 2.5 to 4.5 mm on the short side, 4 to 5 mm in diameter; when mature light sepia to grayish brown speckled with dark brown or nearly black; weight of 100 mature fruit cases 7.12 g.

Chromosomes number: $2n = 20$; meiosis regular with ten bivalents (*4*).

MEXICO: JALISCO: many, often dense, colonies, mostly among tall grasses and herbs (*Dahlia coccinea*, *Thalictrum*), in deep soft soil, often on edge of (or in) small streams, and sometimes on edge of (but not in) maize fields or in grazed pastures, on what was formerly open *Pinus-Quercus (elliptica?)-Carpinus caroliniana* forest: at base of rocky north-northeast-facing uppermost slopes of Cerro de San Miguel (east end of Sierra de Manantlan), just north of and below saddle (crest) at La Ventana (104°13"W, 19°31'45"N), near an Indian hut surrounded by five gigantic *Yucca (elephantipes?)* trees, 20 km due south of El Chante, 7 km east-northeast of El Durazno (Municipio de Cuautitlán), altitude 2250 to 2400 m, 22 September 1978, H. H. Iltis, R. *Guzmán* M., J. Doebley, and A. Lasseigne No. 450.

The holotype is in the Herbario de la Universidad de Guadalajara (Zapopán); isotypes (to be distributed) in B, BH, BM, CHAPA, ENCB, F, GH, ILL, K, L, LIL, MEXU, MICH, MO, NA, P, TAES, TEX, UC, US, WIS, XAL (*5*).

Another collection from the same population was distributed as *Zea perennis* [the location data given on this label (see below) and by Guzmán (*1*) are not quite correct]:

> Campos cultivos de maíz cerca del bosque frio de pino, Cerro de la Ventana San Miguel, 15 km al E de la comunidad indigenia de Cuzalapa, Municipio de Cuautitlán, Jalisco, 1700 m alt., 15 December 1977, *R. Guzmán M. 777* [in ARIZ, Universidad Autonoma Guadalajara, Universidad Guadalajara, Zapopán, MICH (*5*)].

This collection included mature seeds which will be distributed with the type material.

Common name: "Chapule," "Maíz Chapule," or "Milpilla."

It is of interest that the local people report grinding up and mixing the kernels with maize for use as food in hard times.

Similar to *Zea perennis*, *Z. diploperennis* differs by its dimorphic rhizomes with much shorter internodes (Fig. 1), those of *Z. perennis* being usually 1 to 3 cm long; by its more open root system which is not densely sod-forming, by the larger number of, and longer and laxer tassel branches (Fig. 2); by wider and longer leaves; and by its considerably more robust habit (Fig. 2).

The implications of this discovery are considerable. (i) Being morphologically primitive, this diploid wild maize could give clues to the evolution of *Zea*, and specifically to the origin of the supposedly autotetraploid *Z. perennis* (*6*), its probable descendant. (ii) Since it is a diploid perennial, and interfertile with maize, as shown by F_1 hybrids, grown from field-collected seeds at the Universidad de Guadalajara, this new species should provide geneticists and maize breeders with a potentially valuable source of germ plasm, and may lead to the development of perennial maize.

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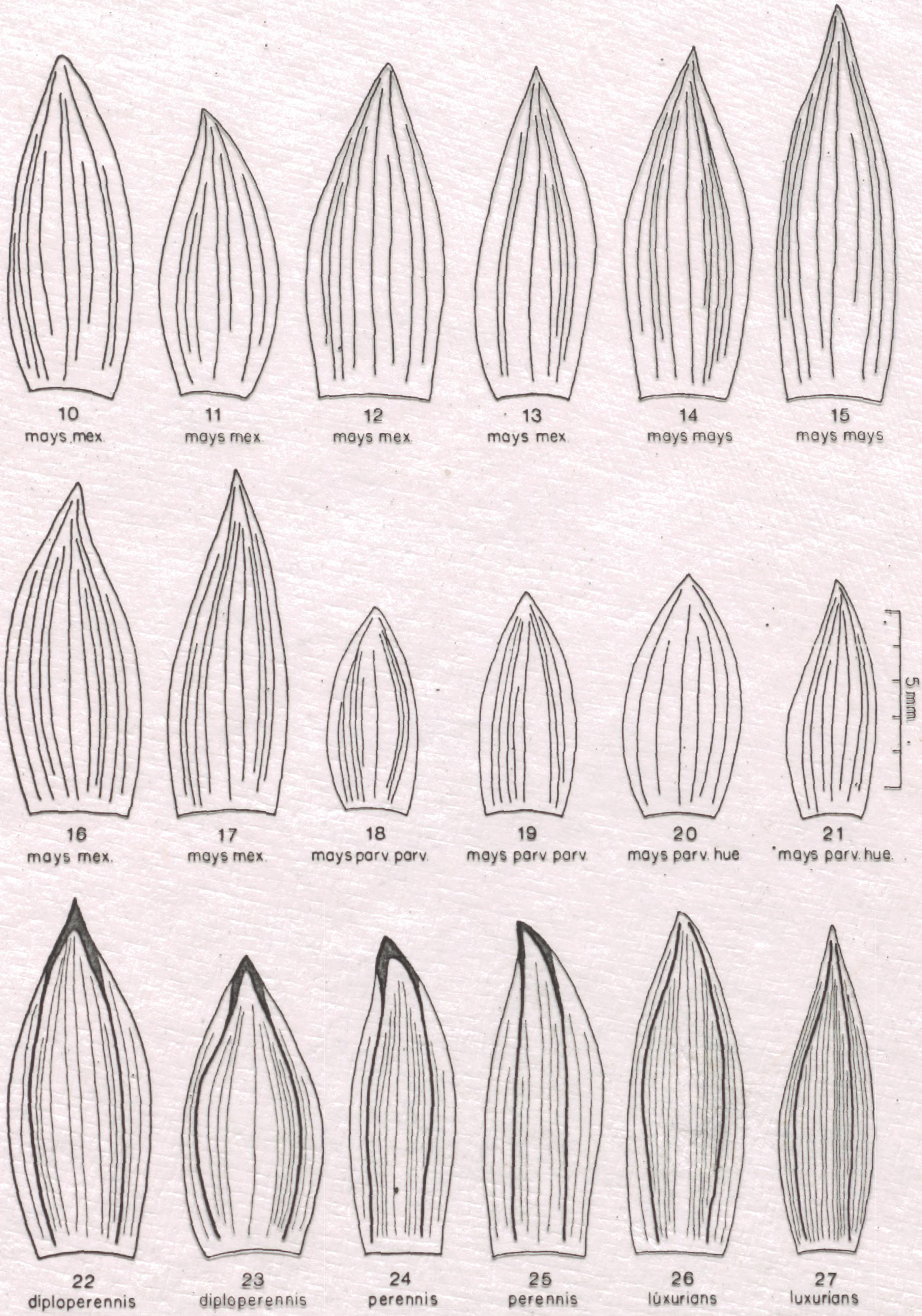
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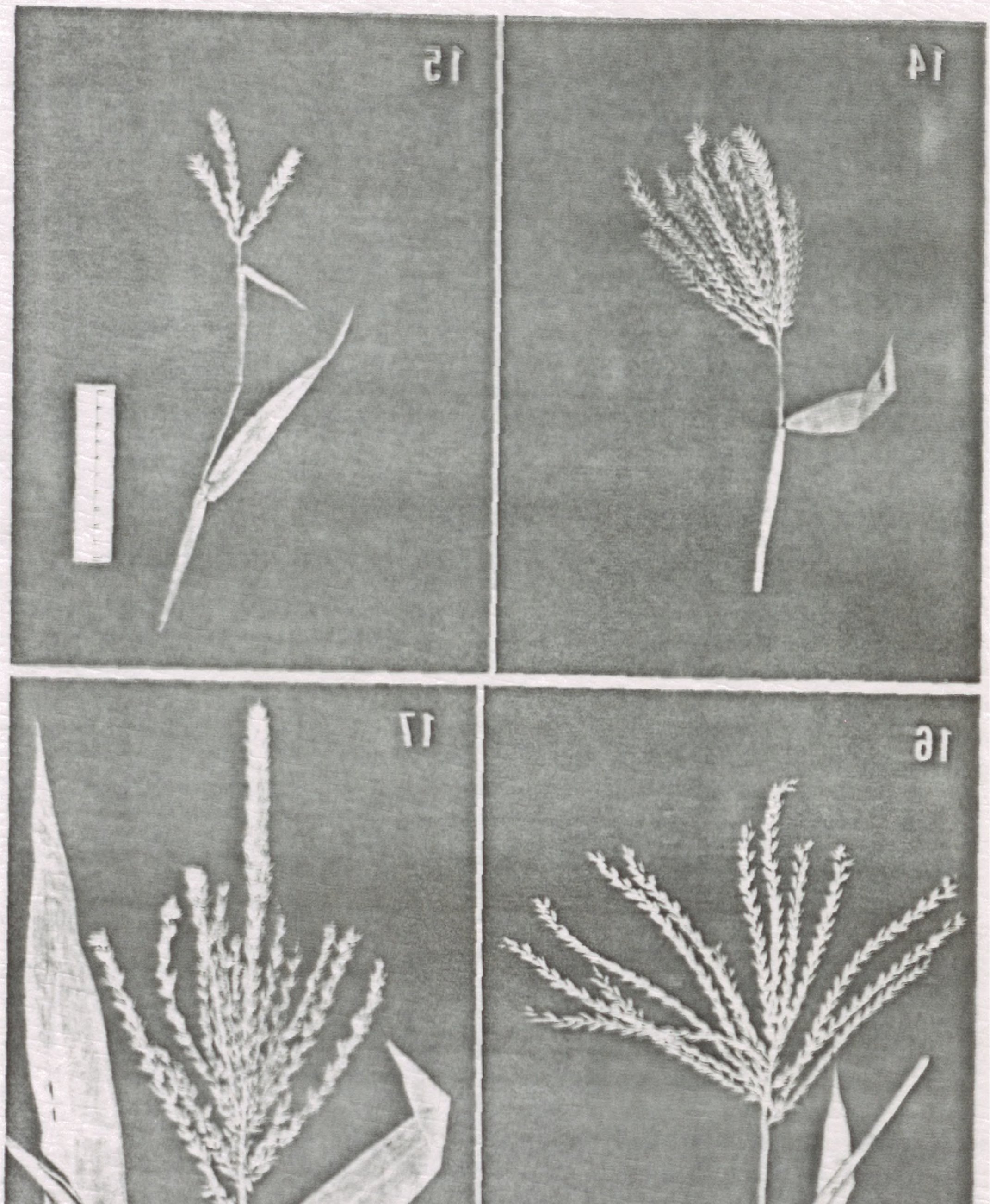

FIGURES 14–17. Pressed male inflorescences.—14. *Zea diploperennis*, *Iltis, Guzmán, Doebley and Lasseigne 450* (plant GG).—15. *Zea perennis*, *Guzmán s.n.* (plant I).—16. *Zea luxurians*, *K. Lind 421* (plant T).—17. *Zea mays* ssp. *mays* (Mexican Pyramidal), *Iltis and Doebley 403* (plant B). (Scale in cm.)

s of vegetative and fe-
logy that are essential
the taxa are also de-
ale inflorescence, and
mplex branching pat-
slighted here, and are
iled study. Similarly,
sintes and maize, al-
ld, are not described

antarum 971. 1753;
5, 419. 1754.

bley and Iltis, Amer.

Doebley, and Guz-
. 1979.

0–)3–13 ± divergent
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ame side (Figs. 22–
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short side, 4–5 mm
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erennial, with both
omes, both of these
des. Rare, endemic
lisco, Mexico, alt.

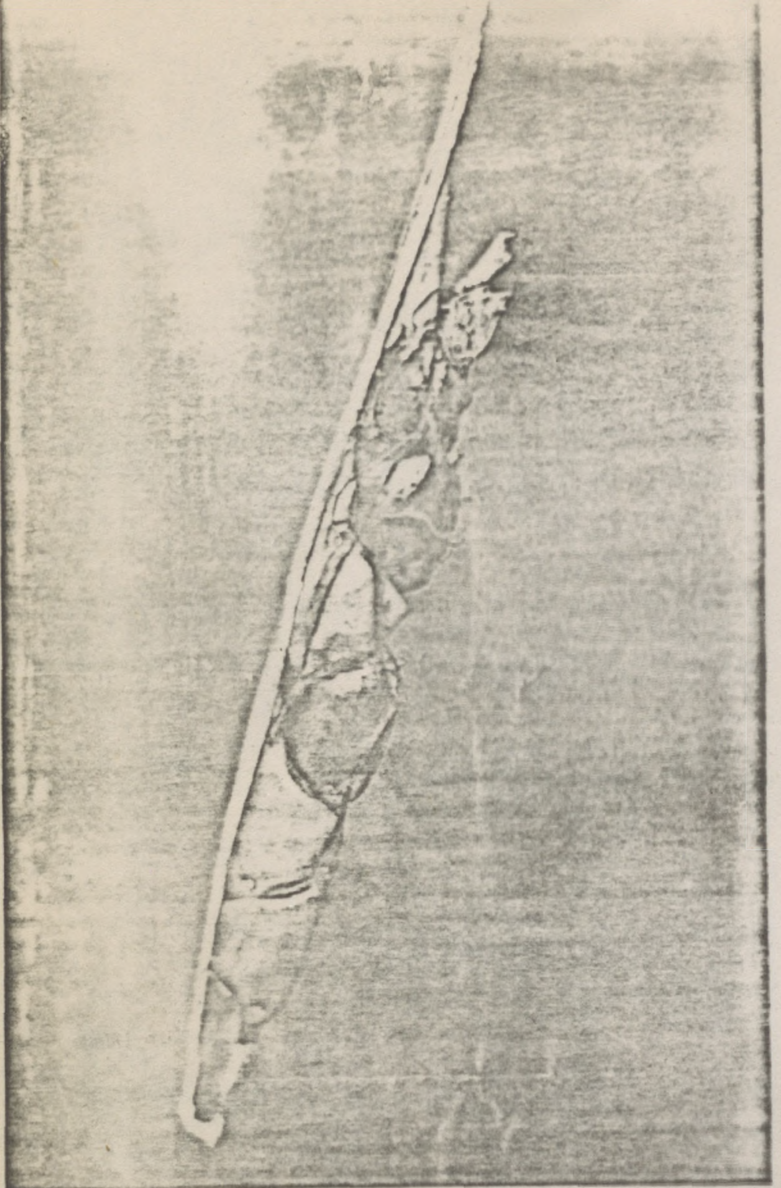
Fig. 29. Distribution of native populations of the genus *Zea*. In *Zea mays* ssp. *mexicana*, the two northern stations represent the NOBOGAME and DURANGO populations respectively, the two southern clusters CENTRAL PLATEAU (western) and CHALCO (eastern). In *Zea mays* ssp. *parviglumis*, the southern Mexican cluster represents var. *parviglumis*, and the Guatemalan one var. *huehuetenangensis*.

ssp. *mexicana* (including races CHALCO and DURANGO) were essentially normal in both respects. Similarly, Beadle (1932) found that cultivated maize formed cytologically normal hybrids with *Z. mays* ssp. *mexicana* but abnormal ones with *Z. luxurians*.

Cytogenetically, *Z. luxurians*, *Z. perennis* and *Z. diploperennis* are similar, all having terminal chromosome knobs or telomeres, while lacking internal ones. These knobs are most pronounced in *Z. luxurians* (Longley, 1941; Kato, 1975; W. Galinat, letter to H.H.I., April 6, 1979). On the other hand, all the subspecies of *Z. mays* have, in general, many internal knobs and few or no terminal ones (Kato, 1975).

Genetically, Levings, Timothy and associates (Levings et al., 1978; Timothy et al., 1979) have found electrophoretic banding patterns of chloroplast DNA (using two different restriction enzymes) of *Z. perennis* and *Z. luxurians* (both Sect. LUXURIANTES) to be identical to one another, and different from those of *Z. mays* ssp. *mays* and ssp. *mexicana*, the two latter (both Sect. ZEA) in turn similar to each other. Gray and Perkins (1973) found that leaf flavonoids of sspp. *mays* and *mexicana* are very similar but entirely different from those of *Z. perennis*. Similarly, studying proteins of *Zea* by gel electrophoresis, Smith and Lester (1979a) found *Z. mays* sspp. *mays* and *mexicana* to have banding patterns identical to each other but different from that of *Z. luxurians*.

Is Zea luxurians perennial?—Our conclusion, namely that *Z. luxurians* and the two perennial species are so closely related to each other that they must be placed into one and the same section of the genus, opens up the old question of the perennial propensities of *Z. luxurians*. Some authors (cf. Wilkes, 1967: 6–13) have reported GUATEMALA teosinte grown in Florida (hence the misleading name "Florida Teosinte") to be somewhat perennial in habit, and many earlier as well as several recent authors have repeatedly mentioned either this condition (Wilkes, 1967: pl. XXV; Galinat, 1973; Bird, 1978), or at least a "pro-



Zea diploperennis, with the right chromosome count, raises hopes of breeding a modern perennial corn crop.

Because it is so primitive, *Zea diploperennis* has much to teach us about corn genetics. "It could be a 'Rosetta stone' for understanding the evolution of corn," Iltis suggests. "With luck, we may well solve many a scientific mystery."

He is referring to the fact that corn's ancestry is uncertain. No other grass species bears multiple rows of seeds on a rigid axis, the cob; so there is no obvious ancestor. Yet, the cob is the key to corn. Where did it come from?

Teosinte is a close relative, but whether it is the parent, brother or nephew of corn is the subject of a great scientific controversy. Viewed from a distance the two are hard to distinguish, for both have similar leaves and they both possess separate male (tassels) and female (silk) flowers. A number of botanists argue zealously that teosinte is indeed the progenitor of corn, but this idea is disputed by others with equal fervor.

Iltis is among those who are convinced that teosinte is the parent of corn, and in 1978 he and John Doebley set out to see the new perennial form.

After four days of back-road driving they, together with Guzmán, arrived at the base of the precipitous escarpment of the Sierra de Manantlán. On four rented mules, two horses and a donkey, and with a supporting party of local Indians, they followed narrow footpaths up through cloud forests filled with mosses and lichens, and on up through open pine forest until they arrived at a fog-shrouded saddle on a rocky northeast slope at about 8,000 feet.

Below them was a quilt of tiny corn patches bordered by wild flowers in full bloom. Next to a stream Guzmán dismounted. Around him were dense thickets of teosinte plants—the *Zea diploperennis* they were seeking—as tall as a man and in full tassel.

"My heart was really beating," Iltis recalls, "when I saw this teosinte here at last . . . alive! Once off my mule I started to dig out a big clump on the edge of a deep cold rivulet to see its roots. It had fat short rhizomes, the like of which I had never seen. I said to Doebley in practically a whisper, 'This damn thing's got tubers, it's different, all right!' "

Over the next four hours the whole group fanned out collecting specimens "like crazy." "It was tremendously exciting," Iltis recalls. "Exhilarating!"

The new species appears more grasslike than corn does; its several stalks fan outward from the root crown. Many specimens were growing in stream beds, suggesting the possibility of using it to breed corn to withstand damp sites where the crop now easily becomes diseased.

A weed worth billions

Nearby was an old hut beneath six immense yucca trees. The Indian owner explained (with translation to Iltis by his guide) that he actually used the rock-hard teosinte grain, ground up and mixed with corn meal, in tortillas—but only in time of famine.

"So," says Iltis, "here was an almost useless plant that had tremendous economic and botanic importance. A weed sitting out there on the mountainside, barely used by anyone, yet you could estimate its potential value to our corn crop in billions of dollars!"

This is perhaps the most important implication of the new discoveries. To keep our crops continually evolving to meet the mutations of pests and other changes in the environment, as well as Man's needs, we need reserves from which to draw breeding stock.

A rich reserve of disease resistance, cold tolerance, protein, oil and a myriad of other properties is to be found in teosinte and in the primitive Indian corns of fellow student who told Guzmán that more of it was growing on his grandfather's land high in the Sierra de Manantlán. Guzmán hiked ten strenuous hours only to find that it was the annual teosinte. But as he was collecting seed, a man came by on a mule and told him that 12 kilometers farther back on the mountain he'd find a field of what he was seeking.

Again Guzmán set off, and dawn brought him the long-dreamed-of sight: hundreds of teosinte plants, each with the root rhizomes that make it perennial. But something even more spectacular was to follow.

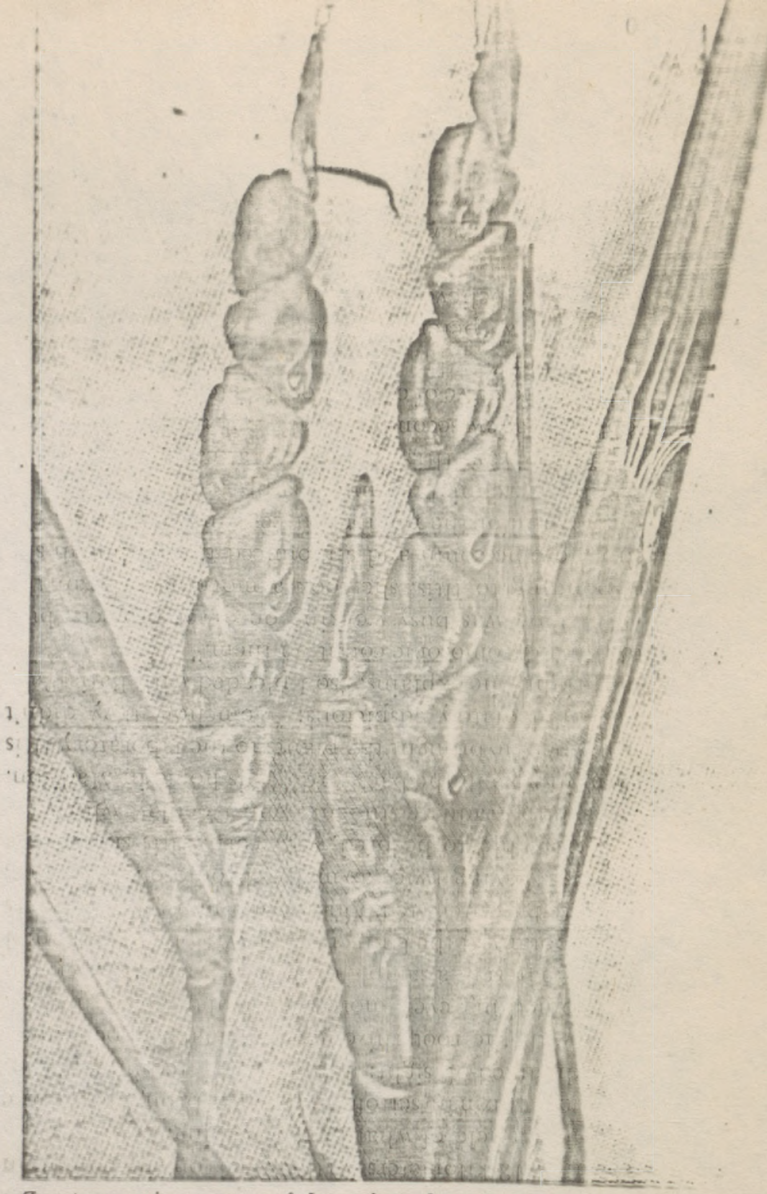
Guzmán sent a sample of seed to Hugh Iltis, professor of botany at the University of Wisconsin. Perennial teosinte has interested botanists far more than farmers because, having twice as many chromosomes as corn, it is not able to be bred with corn. Iltis shared the seeds with graduate student John Doebley, who grew them in pots in the backyard of his home in Madison. But when he brought the plants to the laboratory Iltis was immediately suspicious: "Somehow they didn't look right," he explains, "so I pleaded with Batia Pazy to run a chromosome count on them."

Dr. Pazy was busy working on other projects, but, responding to Iltis, she took a morning off, ran the chromosome count and announced that although she wasn't sure of the number, it certainly wasn't 40, the number perennial teosinte is supposed to have.

"Then," says Iltis, "we looked at each other, and it took only a few seconds to realize what we had. In that pot was a relative of corn whose existence we had never dreamed of."

The new perennial species, *Zea diploperennis,* which Iltis believes is the most primitive living relative of corn, proved to have 20 chromosomes, as does corn. The two crossbreed: the pollen from the tassels of one fertilizes the silk of the other to produce coblike fruits that seem to be fertile. This suddenly made the new discovery interesting to both botanists *and* farmers. Corn breeders all over the world quickly began requesting seed. Much of corn's cost goes to plowing under the old crop and sowing the new one; *Zea diploperennis* has awakened hopes for a perennial corn that farmers could harvest each year without replanting.

"It's a wonderful new plant. No doubt about it!" says Iltis. "It will probably be crossed with corn at least 10,000 times in the next ten years. It is immune to several major corn virus diseases, and it survives in cool mountains in Mexico so that, through crossbreeding, we might eventually be able to get perennial corn to grow in the Southern states."



Zea perennis, a perennial teosinte, has too many chromosomes to interbreed with modern annual corn.

Noel D. Vietmeyer, a specialist in tropical agriculture at National Academy of Sciences, wrote on Papua New Guinea butterfly ranching in the May 1979 issue.

All over the world—but especially in the tropics—the wild relatives of our crops are being destroyed. Iltis calls it plant genocide. Throughout Latin America, for example, hundreds of corn varieties and thousands of strains with potentially valuable attributes are on the verge of disappearing or have gone already. In Colombia and Mexico many ancient forms of corn are now hard to find, and along the western slope of Mexico and Guatemala, much of the annual teosinte has vanished as roads and farmers roll into the more remote areas to grow more food for an exploding population or even to grow strawberries for export to the United States.

Corn is particularly vulnerable because it can't support itself without our help. Corn's evolution has been

At University of Guadalajara greenhouse, Guzmán stands between species of perennial teosinte he found, *Zea perennis* (left), *Zea diploperennis* (right).

...to human needs that its fruiting ...ale ear with its permanently at... ...nger can reproduce the species. Not ...around an ear of corn block the ...n on a shucked ear the seeds germi... ...to the cob, producing plants that ...hey choke each other and fail to ...achine must remove the seeds from ...them over the soil before corn will ...progeny to keep itself from extinc... ...s the guardians of corn's future.

...d corn types widely used across the ...re World War II were essentially lost ...ere developed. And today, when a ...r a Hopi Indian abandons the crop ...raditionally fed his family, it may ...n a year—even less if he eats all the ...rmally saves for replanting. Says ...etic heritage of a millennium can dis... ...gle bowl of porridge!"

...n be stored only in the embryo of a ...el; once the seed is dead, its genes can ...ieved. Evolution, unlike history, can... ...pon to repeat itself.

...ge against starvation

...ersity is preserved in collections of ...and seeds. The biggest collection, at ...al Maize and Wheat Improvement ...n by an agency of the Mexican Min... ...ure some 30 years ago. In its refrig... ...hambers near Mexico City are stored ...tems, the majority of them *Zea mays*, ...not a lot. And the process is cumber... ...ds lose viability over a decade or two ...periodically replanted and the seeds ...eep the strains alive. Plant genetic ...ge is also vulnerable to power failures. ...e year's harvest of potato tubers was ...torage facility for potato germ plasm ...y, Wisconsin, in this way. Nonetheless, ...nds on such "banks." Seed collections ...us and catastrophic starvation on a ...t imagine," warns Jack Harlan of the ...llinois. "In a very real sense, the future ...ace rides on these materials." Yet, he ...ed collection in the world is adequate. ...f corn, the fields of Indian farmers in ...th America could be an alternative. ...e areas that preserve old strains and ...s.

...ent seed collections," says Iltis, "it is ...t particular remote areas of Mexico, ...d Peru that use primitive types of corn

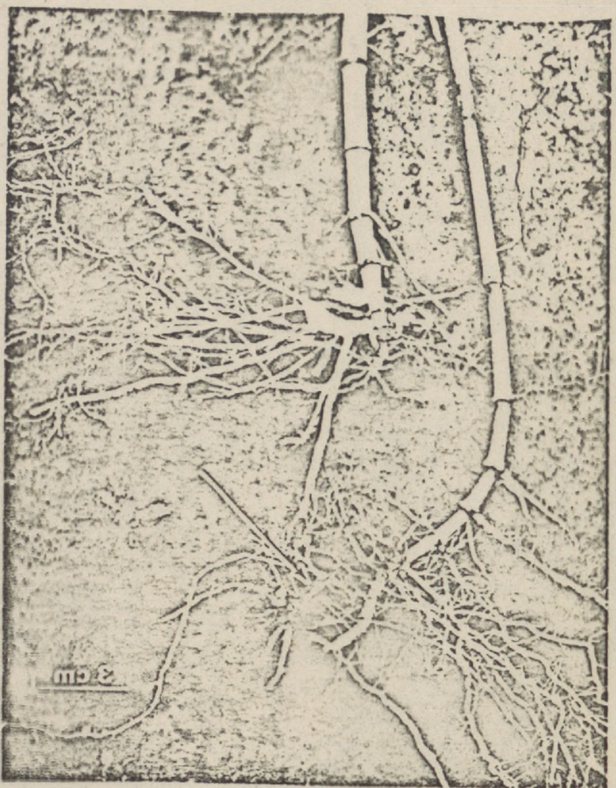


Fig. 1 (left). Root system of *Zea diploperennis*. Left plant showing a cordlike rhizome (note short internodes); right plant has two sectioned tuberous short rhizomes, which are covered with scale leaves; the arrow points to the stump of previous years' culm. Fig. 2 (right). Comparative growth of the two perennial teosinte species in a uniform environment (University of Guadalajara greenhouse), with *Zea perennis* on the left, *Z. diploperennis* on the right, and R. Guzmán M. in the middle. The plants were grown from rhizomes collected in the wild, and were 9 months in cultivation. Plants growing in the wild would be somewhat shorter.

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D. P. [illegible]
June 28, 89

Asian and Pacific Development Centre
Seminar on
Public Policy Implications of Biotechnology
for Asian Agriculture

1. Format of Seminar

The Seminar is intended for senior level decision makers and will be structured in a manner that an inter-active dialogue is promoted among the participants. For this purpose there will be a series of panel discussions, with carefully chosen Panel Members leading the discussion on each topic. The scientists chosen should have a high scientific reputation and credibility but with the capacity to articulate clearly issues and ideas in a non-technical language.

2. Duration

3 days.

3. Participants

(a) Political and administrative leaders connected with decision making on priorities in science and technology and on the allocation of resources for biotechnology research and development;

(b) Eminent Asian biotechnologists; and

(c) Eminent world leaders in developmental banking.

Chairman & Secretary General South Commission.

4. Scope

All aspects of Asian agriculture, namely, crop husbandry (both annual and perennial crops), animal husbandry, fisheries and forestry will be considered. Since mixed farming is a way of life in most parts of rural Asia, the implications of developments in biotechnology for improving the productivity, profitability, stability and sustainability of major farming systems, including crop-livestock, agriculture-aquaculture and agro-forestry systems of land and water use, will be discussed. The time frame for the topics to be considered will be up to the year 2000.

5. Topics for Discussion and Potential Panel Members

Topic I. Asian agriculture in the context of the emerging trends in global agriculture

The directions of change will be considered in the context of the dynamics of consumer preferences.

(a) Domestic Consumers

i) Household needs

ii) Commercial and industrial needs.

(b) International Trade

i) Household consumption

ii) Commercial and industrial uses.

The emerging trends in food consumption patterns, particularly with reference to the "Health Foods of the Future" will receive special attention. The role of technology, services (supply of inputs including credit) and public policies in accelerating agricultural advance will be considered. In the Asian context, "land saving crop husbandry" and "grain saving animal husbandry" will receive special stress, since the per capita availability of arable land is fast declining.

Panelists

(a) Population and Food and Nutrition Security

i) Prof. Nurul Islam (Bangladesh)
International Food Policy Research Institute
Washington

ii) Assistant Director General, FAO. — Agriculture At 2000. Input requirements Investment requirements

Both the quantitative and qualitative dimensions of the food security issues will be considered.

(b) Commercial and industrial aspects of agriculture

i) Dr. Sartaz Aziz
Minister of Agriculture, Pakistan
-- International Trade in Agricultural Commodities

ii) Dr. A.S. Ganguly
Chairman, Hindustan Lever Ltd., Bombay
-- Opportunities for Export of Agricultural Commodities

iii) Dr. Oshima, Japan
-- Viewpoint of ~~Development~~ Developed Countries

iv) Dr. Trindade
U.N. Office of Science and Technology for Development, New York

— Recent developments in S & T as related to agriculture.

v) Director General, UNIDO, Vienna — Role of biotechnology in agriculture

vi) Prof. Umberto Colombo, Rome
-- Integration of Biotechnology with Traditional Technologies

The speakers will deal with trade opportunities, tariff barriers and on methods of remaining competitive in a changing world. The comparative advantages and handicaps of Asian countries in the global market will be discussed.

Topic II. Positive Implications of Biotechnology for Asian Agriculture: The Era of Opportunities

The target groups will be small farmers and fishermen households from the point of view of assessing the potential benefits of biotechnology research. The topics will be dealt with using a matrix approach, as shown below.

Biotechnology Matrix

No.	Major Areas of Production	Implications				
		Economics	Ecology	Employment	Equity	Energy
1.	Crops					
2.	Animals					
3.	Fisheries					
4.	Forestry					
5.	Farming Systems					
6	Biomass Utilization					

The economic viability assessment will include the consideration of the cost, risk and return structure of new farming systems. In the case of employment, the major aim will be to achieve the diversification of labour use and to avoid the displacement of labour.

The issues will be considered with reference to both the production and post-harvest phases of technology development and adoption. The session will identify areas of hope for the rural poor working in agriculture.

Panelists

(a) Crops

Prof. V.L. Chopra, New Delhi

(b) Animals

i) Dr. J. McWilliam
Australian Centre for International Agricutural Research (ACIAR), Canberra

ii) Prof. Tiwari
Head, New Delhi Component of the International Center for Genetic Engineering and Biotechnology (ICGEB)

(c) Fisheries

ICLARM, Manila (Dr. Roger Pullin)

(d) Forestry

Dr. Saleh Mohammad, Kuala Lumpur

(e) Farming Systems

i) Prof. Charan, Bangkok

ii) Prof. Li Zhenzheng
Vice President, Academic Sinica, Beijing

iii) Dr. Rafael ~~Guevarra~~ Guerrero, Philippines

(f) Biomass Utilization and Post-harvest Technology

i) Dr. W. Padolina, Philippines

ii) Prof. Falasi
Head, Trieste Component of ICGEB, Trieste, Italy

iii) Prof. Lars Munck
Carlsberg Laboratory, Copenhagen, Denmark

They will be requested to prepare a joint paper, if possible.

Topic III. Areas of Concern: Potential Adverse Impact of New Technologies

Panelists

(a) Substitutes for Natural Products

i) Dr. H.K. Jain, ISNAR, The Hague

ii) Dr. C.R. Bhatia
Bhabha Atomic Research Center, Trombay, Bombay

(b) Patents and Intellectural Property Rights

i) Dr. John H. Barton, Stanford University

ii) Dr. Anand Chakraborty
Chairman, Panel of Scientific Advisors, ICGEB

iii) Dr. S. Varadarajan, New Delhi

(c) Biological Diversity: Conservation and Utilization

i) Dr. R.B. Singh, FAO, Bangkok
-- Breeders' Rights and Farmers' Rights

ii) Dr. Setijati Sastrapradja, Bogor, Indonesia

iii) Dr. Van Droste
Director, MAB Programme, UNESCO, Paris

iv) Dr. Don Marshall, Australia

v) Dr. Duvick Pioneer Hybrid Company

(d) Biosafety, Environmental Hazards and Ethical Issues

i) Dr. D. Ramirez
Dean of the Graduate School, UPLB
Los Banos, Philippines

ii) Hon. Mr. W.M. Catenhusen
Chairman of the Biosafety Committee of the German Parliament

iii) Prof. Arthur Kelman
Chairman, Biosafety Committee of the U.S. National Academy of Sciences

iv) Dr. John Evans
Chairman, Board of Trustees of the Rockefeller Foundation and
Chairman, Allelix Company, Canada

v) A senior expert from the Soviet Academy of Sciences.

IV. Institutional Framework for Biotechnology Development and Utilization

(a) Generation of Political Will and Political Action

Public policies to promote national capabilities in research, education and agricultural applications.

i) Prof. Habibie
Minister fo Science and Technology, Indonesia

ii) Mr. He Kang
Minister of Agriculture, Fisheries and Animal Husbandry, China

iii) Korean Minister of Science and Technology.

(b) Research

Promoting relevance and excellence in national, regional and international research and development of institutional mechanisms for setting priorities and implementing well defined tasks.

i) Dr. Lewis Branscomb, Harvard University
-- User-orientation to Research

ii) Dr. Gunsalus
Director, ICGEB, Trieste
-- Organization of Networks

iii) Rector, United Nations University, Tokyo

iv) Prof. Falsella
Director General
Science and Technology Department, EEC, Brussels

v) Dr. Nam Hai Chua
Rockefeller University, New York — Singapore -
-- R.F. Network in Rice

vi) Drs. B. Sigurbjornsson, IAEA, Vienna and
Dr. Mohammad Zehni, FAO

vii) Dr. Amir Muhammad
Chairman, PARC, Pakistan.

(c) Education and Training

1. Orientation of Political Leaders in Biotechnology Options

   i) Prime Minister of India

   ii) Prime Minister of Malaysia

   iii) Prime Minister of Sri Lanka

   iv) Mr. Abheyarama, Bangkok.

2. Human Resource Development -- Training of Professionals

Training at the national, regional and international levels -- existing opportunities and need for additional facilities.

   i) Prof. Dr. Omar b. Abdul Rahman
      Science Advisor to the Prime Minister
      Kuala Lumpur

   ii) Prof. Hirotsuke Okada
      Director, International Center for Cooperative Research in Biotechnology, Osaka University, Japan

   iii) Dr. Sassoon, UNESCO

   iv) Prof. Yongyuth Yuthavong, Bangkok.

3. Educating the Public and Generation of Awareness of the Potentials and Limitations of Biotechnological Options in Agriculture

The topics to be discussed will include (a) mobilizing the mass media and (b) development of educational resources including software for communication.

Panelists may be invited from BBC, London, Television Studios of Japan, Singapore and Australia, Mr. Mercado of ~~UNESCO~~, Dr. Anil Agarwal and Dr. Anil Sadgopal from India.

V. Financial Resources

   i) Dr. David Hopper
      Senior Vice-President, IBRDM

   ii) Mr. M. Fujioka
      President, ADB

iii) Mr. Riyochi Sasakawa
Sasakawa Foundation, Tokyo

iv) Mr. S. Okita, Tokyo

v) Mr. J.R.D. Tata, Bombay, India.

VI. Closing Session

~~Towards a Happy~~ Biofuture for Asian ~~Farmers and Fishermen~~ Agriculture

i) Prime Minister of India

ii) Prime Minister of Malaysia

iii) Prime Minister of Singapore

iv) Prime Minister of Italy

Prime Minister of China

Asia will have over 4 billion of the anticipated 6 billion human population by the year 2000. Over 50% of this population will be below the age of 21. Asian agriculture therefore faces the following challenges.

(1) How can more and more food be produced from less and less land to meet the needs of an expanding population under conditions of shrinking land resources for food production?

(2) How can the primary sector generate more jobs in the secondary and tertiary sectors, so that the farm and off-farm sectors together can provide greater opportunities for gainful employment in rural areas?

(3) How can farming become both intellectually stimulating and economically rewarding so that it is able to attract and retain youth in rural areas?

(4) How can the triple objectives of agriculture -- more food, more jobs and more income -- be accomplished in an ecologically sustainable manner so that today's progress is not in conflict with tomorrow's prospects? and

(5) How can Asia capitalize on its vast human resource and its immense diversity in climate, soils and genetic resources through the intelligent integration of traditional and emerging technologies?

These issues will be considered in the concluding session based on the implications of biotechnology for Asia's agricultural future.

Programme

Day 1

9.00 to 10.00 am Inauguration

10.30 to 12.30 pm Session I

Asian Agriculture ~~- Directions of Change~~ in the context of a changing world

2.00 to 5.00 pm Session II

~~Positive Implications~~

The era of opportunities – positive implications of Biotechnology

Day 2

8.30 to 10.30 am ~~Positive Implications (contd)~~ The Era of Opportunities (contd.

11.00 to 12.30 pm Session III

Areas of Concern~~s~~ – Anticipatory Action

2.00 to 3.30 pm Concerns (contd)

4.00 to 5.30 pm Session IV

Institutional Framework for Technology Development & Utilization

Day 3

8.30 to 10.30 pm Institutional Framework (contd)

11.00 to 12.30 pm Session V

Financial Resources for blending biotechnology with traditional technologies

2.00 to 5.00 pm Session VI

Closing Session: Biofuture for Asian Agriculture

Towards a Happy Biofuture for Asian Farmers and Fishermen

NEED FOR A NEW INTERNATIONAL
AGRICULTURAL ORDER

Statement made by Dr M.S. Swaminathan, Independent Chairman
FAO Council in Rome

on June 18, 1985

There is today an impressive sense of unity both in the diagnosis of major global agricultural maladies and in the prescription of remedies. It is clear that the time is ripe for introducing a new International Agricultural Order based on five major principles.

First, the global agricultural scenario reveals considerable diversity in per capita productivity. Some countries and some parts within large countries in all the continents have very little gap between potential and actual yields at currently available levels of technology. In contrast, the yield gap may be as high as 80% or more in others. The constraints responsible for the prevailing yield gap may be ecological, technological, educational, socio-economic and/or political. Socio-economic and political factors may be both internal and external and their relative importance may vary. National and international action is needed to identify and remove the constraints responsible for inadequate progress in improving the productivity, profitability, stability and sustainability of major terrestrial and aquatic farming systems.

Secondly, inspite of much patchiness in agricultural progress, more than enough food is already produced in the world to provide a balanced diet for all its inhabitants. Global, regional and national policies for equitable distribution and improved consumption by the rural and urban poor are therefore urgently needed.

.../...

Can a "humanitarian food reserve" become an integral part of a new international agricultural order with all nations contributing to the maximum of their capacity?

Thirdly, people with purchasing power seldom go hungry. Greater opportunities for both on-farm and off-farm employment are essential for higher household purchasing power. Continued food imports by predominantly agricultural countries possessing a large untapped food production potential will have the same impact as importing unemployment, since imports will lead to keeping local farmers and landless labour families at low levels of productivity and employment. Hence, a livelihood security plan based on opportunities for earning one's daily bread will have to be developed based on an appropriate blend of technologies, services and government policies.

Fourthly, small and subsistence farmers who constitute the majority of the farming population in many developing countries will not produce more than what they need for themselves, unless they are assured cash and/or goods acceptable in exchange for the surplus. Remunerative prices coupled with the timely and adequate supplies of agricultural inputs and of basic goods such as clothing, salt, soap, blankets, cooking oil, matches, sugar, paper, pencils, batteries, etc. will enable and stimulate small farmers to produce and earn more. Hence, it will be desirable to reserve a certain proportion of the funds available for aid and relief for purchasing at remunerative prices surplus produce from small farmers and for providing essential consumer goods. The grains thus purchased could be used in the same country for a "Food for Work" programme for promoting agricultural and ecological rehabilitation and a "Food for Nutrition" programme for insulating old and infirm persons, pregnant and nursing mothers and pre-school children from starvation.

Finally, current trade, aid and investment patterns need a thorough review. Shrinking commitment to multilateral and concessional assistance, expanding debts and debt servicing burdens, import restrictions and export subsidies, trade wars, an increasingly unfavourable cost, risk and return structure of farming to the world's small producers, inadequate availability of capital for the modernisation of agriculture and in some cases, the very model of agricultural modernisation adopted having built-in seeds of ecological and social biases, are all areas which deserve concerted attention and equitable solutions.

The urgent need for a new international agricultural order has been highlighted by the food situation in Africa. 1985 is the International Year of the Youth as well as the Year of the Forest. Soon there will be a world conference in Nairobi to review and appraise the achievements of the United Nations decade for Women. All these events are symbols of the continuing human quest for peace, equity and freedom from hunger. The famine of purchasing power among the world's poor is becoming a more important cause of hunger than the famine of food itself. An unfortunate consequence of poverty is added damage to our basic life support systems like land and water, flora and fauna. Ecology and equity are therefore the twin foundations for sustainable agricultural progress.

M.S. Swaminathan

INTERNATIONAL ECO-DEVELOPMENT CORPS FOR AFRICA

Basic Guidelines

1. Preparation of Action Plans:

The first step is the preparation in each country of a National Conservation for Development Programme consisting of detailed action plans at the local level for eco-development. Where such plans exist or can be prepared soon, the kinds of professional expertise needed for implementing the plan could be articulated in fairly precise terms. Where they do not exist, one of the early tasks of the Members of the Eco-Development corps will be the preparation of detailed action plans in consultation with the local population and authorities. Thus, the corps could help in the preparation of eco-development plans as well as in the conversion of plans into accomplishments.

2. Organisation of a global grid of back-up institutions

A very important pre-requisite for the successful implementation of this programme is the availability of a global grid of outstanding support institutions. Depending on the nature of the job to be done, as for example, anti-desertification measures, production of food, fodder, fuel and fertilizer (through biological or organic sources), control of animal and human diseases, irrigation and drinking water supply, biomass utilization, improved management, etc... the support of advanced institutions located in developed and developing countries should be enlisted for (a) providing technical help when needed throughout the duration of the project and (b) training of members of

.../...

the corps. The back-up institutions will serve as an umbillical cord supporting the project until the work reaches a self-reliant and self-proprelling state. The organization of such a consortium of scientific and technical institutions for supporting the Eco-development Corps in a meaningful manner will not only help in harnessing the best available know-how and do-how, but will also generate a sense of participation among large numbers of professional institutions and experts in a programme of great human significance.

3. Selection and Deployment of Members of Corps

This is the key element of this programme. Once the precise tasks to be performed under the National Eco-development plan are articulated, the nature of the expertise needed will be clear. There has to be a proper match between the nature of the expertise and skills needed for successful task implementation and the nature of the skills possessed by the candidate. Interest in do-how is more important than just interest in know-how.

Once the candidates have been chosen carefully according to the needs of each action plan, they should be given suitable pre-deployment training and orientation in an appropriate institution belonging to the back-up consortium as well as in a suitable institution in the country concerned.

Deployment of Members of the Corps will be in clusters. For example, for a project aiming at agricultural and ecological rehabilitation, there will be need for a group consisting of an agronomist, a forester, a Veterinary expert, and a home scientist. In addition, every cluster should have a Medical graduate who can attend to human health problems. Whenever the members of the corps are unable to find solutions to some of the field problems (such as new soil health and plant health problems), they should seek the assistance of the appropriate back-up institution. In the initial stages, Members of the Corps could help in optimising the benefits from the Food for Development programmes.

4. Duration of the Project

In order to achieve some tangible results, this Programme should be planned until 2000 AD. Obviously, many of the young professionals agreeing to give a part of their early life for this emotionally satisfying and intellectually challenging work, may not be prepared to stay for more than 3 years. Each person who is leaving the project should be replaced with a person with similar expertise so that the continuity of the work is maintained. In work designed to achieve ecological rehabilitation, a 15 year period is the minimum before visible and lasting impact is achieved.

5. Remuneration

The monthly honorarium paid to the volunteers should not exceed the amount which a national doing similar work may receive in his/her country. However, suitable dormitory and other arrangements which will help to provide free lodging and boarding and recreational facilities will be needed.

6. Tasks to be performed

Each country participating in this programme should have an integrated ecological and agricultural rehabilitation plan. Such a plan should consist of a portfolio of well defined tasks. Members of the Eco-Development Corps will be assigned specific tasks under such an integrated development plan. Funds for executing the tasks should be available from national, bilateral and multilateral sources.
