Improved Seed for the Small Farmer Conference Proceedings

CIAT, Cali - Colombia, August 9-13, 1982

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Foreword

New and improved varieties are being developed by national and international crop research programs at an accelerated rate. However the use of these varieties in farmers' fields is not happening at the same pace. The availability of good seed of improved varieties continues to be a constraint to agricultural development in many countries.

CIAT is attempting to overcome this constraint in Latin America and the Caribbean through the Seed Unit Program by:

1. *Increasing the number and competence of seed technologists.*
2. *Strengthening seed programs and enterprises countries within the target area, through technical collaboration.*
3. *Stimulating seed production and accelerating production of the most promising varieties and hybrids.*
4. *Contributing to the solution of problems limiting seed production and distribution, through research activities.*
5. *Disseminating information on seed activities, advances in seed technology, and availability of promising materials.*

Varios workshops have been sponsored by the Unit to deal with specific topics of concern in the region. The workshop on Improved Varieties for the Small farmer was held to promote information exchange, propose technology transfer activities and develop basic principles and concepts in production, management, and marketing, with the objective of increasing the use of improved seed by the small farmer.

We expect these proceedings to be useful to government decision-makers, leaders in seed activities, and seed technologists concerned with improving seed programs and industries in the region.

J.L. Nickel

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Contents

Introduction

Improved Seed for the Small Farmer

These proceedings document the highlights and summarize the discussions of an international conference on Improved Seed for the Small Farmer held at CIAT, Palmira, Colombia, August 9-14, 1982.

Focus of the Conference

Since seed is used almost universally in agriculture, it has been one of the predominant mechanisms for improving agricultural production and productivity. This mechanism has been effective because it is possible to embed, within the seed embryo, genetic characteristics that directly affect the quality and quantity of crop production. Seed not only has a direct effect on production, but, being of natural interest to farmers, it also serves as a mechanism through which to introduce other technologies such as the use of fertilizer, weed control, etc.

However, as more emphasis is given to the small, limited resource farmer, not only as a means of contributing to national food supplies, but also to improve the plight of the peasant population, questions are being asked about why small farmers do not use more seed of improved varieties and how seed can be made a more effective mechanism in the transfer of technology. Much of the doubt about the effectiveness of seed arises from the fact that seed evaluated by scientists as superior to traditional farmer varieties frequently nas not been readily adopted by the farmer. This low adoption rate of seed offering improved value to the producer is being questioned. Therefore, this conference looked at seed from many different viewpoints: Are improved varieties perceived as additional risk? Are the

varieties unacceptable to farmers because of quality or because of incompatibility with their production systems? How can the acceptability to small farmers be evaluated? What are the important socioeconomic considerations in the use of improved seed? Have geneticists used the proper criteria for selection of materials in the development of new varieties? How good is the farmer's seed? Is the transfer system weak? These and many more aspects of seed were discussed.

"Seed" in this conference was used in the generic sense. Participants explored not only the production, processing, and distribution of seed but also the development of new varieties along with the generation and transfer of companion technologies, such as fertilizer, weed control, insect control, etc. Seed saved and stored by the farmer himself and farmer participation in seed selection, storage, processing, and distribution were among other topics discussed.

This conference, then, was not the usual kind of seed meeting where seed specialists confer among themselves, but one which looked at seed as a strategy to improve small, limited resource farming.

Those attending the conference represented different disciplines and experiences: plant breeders, seed specialists, economists, bankers, and administrators. Most came from Latin America, and many had experience in different kinds of development programs.

The Conference Program

The conference consisted of three principal activities: (a) presentation of invited papers on specific subjects, (b) roundtables or panels in which panel members commented on assigned subjects, and (c) workshop sessions which developed guidelines and proposals for future action for improving varieties and seed planted by small farmers.

Summaries of invited papers. Considerable license has been taken in summarizing the invited papers. In most cases the papers were too lengthy to be included in their entirety in these proceedings. In cases where no complete manuscript was presented, a summary was made from the speaker's notes and visuals. Care has been taken to express the author's meaning. Very likely there are some errors, for which we accept responsibility if the author did not review the summary. It is suggested that the summaries presented here not be cited as literature references, but that copies of the original manuscripts be obtained from the CIAT Seed Unit for such purpose.

Panels. Three panels or round tables during the conference were related to different aspects of improved seed for the small, limited resource farmer:

Panel A. Practical recommendations of selection and production for the farmer who saves his own seed.

Panel B. Factors that affect decision making on the use of improved seed of different crops.

Panel C. Experiences in marketing seed to the small farmer.

In the first two panels, specialists in different crops made brief presentations. The third round table featured presentations by representatives from different geographical areas.

Workshop groups. The three workshop sessions during the conference had themes parallelling those of the panels and closely related to subjects of the technical papers presented in the plenary sessions. Also, as in the case of the panels, two of the sessions grouped participants by crop and one (Workshop B) by geographic areas. This resulted in a total of 14 different groups that worked together to make conclusions and recommendations.

The subjects, or themes, of the three sessions were:

Workshop A. Methods for the production, selection, handling, and storage of seed by the farmer.

Worshop B. The role of research and extension in promoting the use of seed of improved varieties.

Worshop C. Strategies for improving the production and marketing of seed for the small farmer.

Each workshop was given a specific set of guidelines for its discussion. These proceedings give both the workshop theme and the guidelines in the introductions to the recommendations made by each workshop. While the groups were asked to make recommendations and conclusions related to the guidelines, they were not restricted to them but could make additional comments.

Each group, by commodity or by geographic area, presented its conclusions and recommendations in plenary session during the last day of the conference.

Conference Objectives

The general theme of the conference was: Better seed of the best varieties for the small, limited resource farmer.

Specific objectives were:

1. To exchange information on mechanisms for improving the quality of seed used by the small farmer.

2. To propose methods of promoting and stimulating the use of improved varieties through the generation and transfer of technology.

3. To develop basic principles and concepts for seed production, handling, and marketing in order to increase the use of improved seed of the best varieties by the small farmer.

Implications of the Objectives

It was clear throughout the conference that the above objectives were interpreted as asking: How can improved seed, whether improved by the farmer himself or through agricultural services supported by the government or by private industry, contribute to the production, productivity, and well-being of the small, limited resource farmer?

Some Conference Highlights

This was probably a first for an international conference held specifically to study many aspects of seed technology as a mechanism to improve production, productivity, and the well-being of small, limited resource farmers.

While the majority of participants represented agronomic professions, the conference was multidisciplinary, with attendance by geneticists, production agronomists, administrators, economists, and, of course, seed specialists. Based on the number of countries (15), of institutions (44), and of professional experience such as world banking, administration, development projects, and uniquely focused research, the conference was not only multidisciplinary but also covered a broad spectrum of experiences.

It is not surprising, therefore, that many different suggestions and recommendations were made to improve the use of seed by the small farmer. What is surprising are the similarity and compatibility among the concepts, strategies, and methodologies put forth.

In addition to general strategies that might be employed in the best interests of small farmers, there were specific, concrete recommendations for the development of technologies, some detailed comments about research and extension, some unique ideas for project development, and some criticism of governmental policies.

A New Technological Approach for Seed?

Much more technological attention is being given to the small farmer today than just a few years ago. Much literature, although relatively new, can now be found proposing that research be oriented more specifically toward the client, that new technologies be evaluated under farmers'

conditions, and that the client for technology be a participant in evaluations. Although there are documented cases of first-hand experience in projects, institutions, and methodologies directed specifically to bring more relevant technology to the small farmer (Zandstra *et al.* 1981; Waugh 1975, 1978, 1982; Hildebrand 1981), much of the literature is conceptual, and there is still only limited experience with this new, client-oriented research.

However, it was evident that many of this group had considerable experience in working with small farmers, had directed their scientific efforts toward them, and were in a position to relate meaningful experiences and ideas about the use of improved seed by small farmers.

Some of the frequently mentioned specific ideas, about which there seemed to be a consensus, were:

1. The farmer's basis for evaluating varieties is frequently different from that of the plant breeder (Poey, page 18).

2. The scientist should develop technologies specifically for the small farmer and in order to do so will have to understand his conditions through study, dialogue, and direct experience (Velasquez, page 116). Nevertheless, farmer-oriented goals and criteria in the development of new varieties will not be sufficient; new technologies will need to be evaluated under conditions of the small farmer, and with his participation.

3. Since the beginning of crop cultivation, small farmers have been successful in saving their own seed, but their technology can be improved (Douglas, page 21, Delouche, page 26).

4. The small farmer should probably receive different assistance in improving his varieties and seed quality, depending upon whether: (a) he saves his own seed, or (b) he purchases seed.

5. Seed as a small farmer business, either on a group or individual basis, might be established within communities (Poey, page 110, Velásquez, page 116, Lewerenz, page 112).

6 .Private initiative has been more efficient and effective in many cases of seed production, handling, storage, and distribution than government programs, but extra effort is needed in reaching small farmers.

7. Seed quality standards of developed countries should not be

applied so strictly in developing countries, especially in the case of small farmers.

Available Technology

There is a myriad of technology now available. Some offers promise of the kinds of technologies needed by small farmers. The quite complete outline of technology for producing, preparing, and handling reproductive material for cassava is an outstanding example of having technology available but little of it being applied (Leihner, presented by Cock). The techology for potatoes is another example.

The farmer already has much good technology, but its use is not universal; in fact, technology must be changed, depending upon the conditions of the farmer and the area in which he lives. However, scientists have been slow to understand this. It is evident from the number of cases of farmer technology cited, that production agronomists, plant breeders, and seed specialists have begun to understand small farmer technology.

Successful Experiences

There are examples of success, but these seemingly have not been studied sufficiently (Martinez, page 74, and others).

Role of Government

Action taken by governments to promote improve seed has not always been effective. Several reasons are mentioned in these proceedings. Failing to have seed easily available to the farmer at the right time for planting was one of the most frequently mentioned problems in governmental programs.

Research and Extension

Technology generation is effective only when the technology is used by farmers. Today much technology is not being used. Sometimes, the technology is not appropriate. In other cases, the transfer mechanism is weak. Close coordination of efforts by research and extension is of primary importance. Extension agents can participate in the evaluation of new technologies with farmers (Waugh page 62). In this manner, they can learn about new technology, criticize it objectively, provide information to researchers, and be better prepared to help farmers.

Marketing and Distribution

Regardless of whether the organization is public or private, distribution

is frequently a bottleneck, especially in the delivery of seed in areas with limited infrastructure.

Much of the problem is a logistical one of transportation and storage in order to have the right amount of seed in the right place at the right time. Especially in government programs, however, bureaucracy and the resulting ineficiency are major causes for the lack of good distribution.

However, marketing and distribution *per se* are not always responsible for the low marketing results because: (a) too frequently the variety is not what the farmer wants, and (b) seed regulations are too strict and limiting.

Summaries of Invited Papers

Selection and Production of Seed by the Small Farmer

Quality and Varietal Characteristics of Seed Saved by the Small Farmer

Federico Poey

Small farmers commonly save part of their grain harvest to use as seed the following season. An analysis of the practices followed and the reasons for them might well serve as a point of reference for those people and institutions involved in improving the production and productiviy of small farmers who do not use much modern technology.

There are three categories of farmers who save their own seed: the subsistence farmer, the limited resource farmer, and the highly conservative farmer. The first two have major financial and cultural limitations, while the third saves his own seed for more specific reasons.

In any event, the reasons for this practice are not difficult to determine. Some of them are:

1. Tradition. Within communities of small farmers, deep-seated customs become established as measures of protection and survival, and these are difficult to modify. For example, the practice of saving seed offers some guarantee of yield and quality, while new varieties may be a risk.

   The custom of saving seed, in some instances, is based on personal pride, or on pride within the community. In the Highlands of Guatemala, for example, it is common to find families who consider it prestigious to save their own seed and maintain their own varieties which have the characteristics they desire and which are relatively stable in yield and quality.

2. The amount of seed is small. The amount of seed needed for planting another crop is important to the farmer. For example, beans or upland rice requiere more seed per unit of land area than maize. In some cases, only a small amount of seed is required and it is easily handled, such as ears of maize which do not require much space. Furthermore, the ear can be hung under the roof above the stove where smoke and movement of dry air protect the grain from mold and insects. For other seeds the task might be more difficult under farm conditions.

3. Experience and custom. Lack of knowledge about other alternatives for storing seed is common in such communities. An inefective extension service, illiteracy, or even an unfortunate experience with other sources of seed may lead the farmer to save his own seed.

In some cases the farmer knows about improved seed but his economic resources make it difficult to obtain the seed, and thus it is more practical to save his own seed. This farmer probably does not seek seed in the marketplace until he needs it and at that time it is scarce. Also the farmer may have some doubt about availability of seed at planting time. He prefers a system entirely under his control and not subject to outside factors. An effective seed distribution system established by the Kenya Seed Company in Africa has been able to change this traditional practice of small farmers. (Increasing Seed Sales Especially to Farmers with Small Holdings. Seed Enterprise Management and Marketing Workshop, CIAT, May 18-22, 1981.

Varietal Characteristics

Comparing the seed characteristics considered important by the small farmer with those considered important by geneticists will explain, at least in part, why farmers do not purchase seed of improved varieties.

Regardless of the crop, some differences can be found in the criteria used by small farmers and plant breeders to identify important seed characteristics:

1. Yield. While the plant breeder seeks maximum yields, the small farmer seeks a good, but stable, yield. Normally the geneticist works under controlled conditions that are favorable to yield, which contrast markedly with the agronomic, ecological, and economic conditions of the small farmer. Such factors are now being taken into consideration in some plant improvement programs.

2. Grain quality. For the plant breeder, the concept of grain quality

can be very different from that of the small farmer. Small farmers usually desire special characteristics such as a specific culinary quality or resistance to insects during storage that are not important in marketing commercial grain.

3. Plant architecture. The geneticist considers maximum physiological efficiency in the formation of grain important, while the small farmer may be interested in stalks and leaves for livestock feed, construction, or other traditional uses.

4. Production system. Generally, the plant breeder develops varieties for monoculture, while the small farmer usually practices mixed planting and therefore is interested in very specific agronomic characteristics, such as maturation. Also, the plant breeder usually thinks in terms of mechanization while the small farmer plants and harvests manually.

5. Seed quality. In saving his own seed, the farmer does use seed quality criteria similar to those used for commercial seed, although he does not use the same methods to assure quality of germination, purity, and soundness. The small farmer takes great care in seed selection, and his selection for color, shape, sheen, size, texture, and soundness is more exacting than any mechanized equipment used to process commercial seed.

Although these concepts are important in the farmer's decision to save his own seed and although they are deeply ingrained in his beliefs, he will change when he finds adequate reason to do so. If plant breeders are successful in screening for disease and insect resistance, yield, stability, and other factors of traditional interest to the farmer, then the farmer will accept new varieties.

Practices Used by Small Farmers in Selecting and Maintaining Their own Seed

Johnson E. Douglas

Two basic questions need to be asked: What do we really know about the small farmer and his seed? Are we sure that the seed which we have is definitely better for him?

Small farmers, or their wives, have successfully saved seed from the beginning of crop cultivation. They normally do not rogue their fields to make the crop more uniform although diseased plants are sometimes removed. Most seed is hand-harvested when the general crop is gathered; thus, mechanical damage and weed seeds usually are not serious problems. The seed is normally threshed by hand or animal power, sun dried, and cleaned by hand. Farmers have solved their insect control and storage problems in many ways, depending on the area, materials available, and the length of time the seed has to be stored. Their storage methods are often successful because they are dealing with small quantities of seed. Seed surveys have tended to show that the seed is not tested for viability before planting and that no seed treatment is used. the seed frequently has a nice appearance. Anyone offering seed to the small farmer must have seed that looks as good as or better than what he already has.

Information is limited on the quality of seed planted by small farmers. The few seed surveys made tend to show that the seed saved is not of bad quality althoug improvements can be made. Frequently, programs to introduce new varieties have failed because the seed supply was poor and the seed was of lower quality than the seed the farmer had saved. Thus, not only does a variety have to be better but the seed itself must be equal to or

better than the farmer's own seed if seed of a new variety is to be introduced successfully.

The quality of seed of improved varieties is an essential factor in determining the success of any new crop improvement program. Efforts are needed to help the farmer do a better job of saving his own seed as well as to assure that the seed supplied from outside the farm is of good quality.

Recommendations for the Farmer to Dry and Store his own Seed

L. G. Villa

The following is a brief review and discussion of different systems for drying and storing grain in order to conserve seed quality. These systems are applicable to the small farmer's situation.

The Problem

Once harvested, seed continues "to live," and resulting biochemical reactions lead to deterioration in seed quality. Also, seed has many enemies, such as birds, fungi, insects, and rats, which cause damage.

Following harvest, seed quality is affected by the amount of moisture, the temperature, and other conditions of the grain and its environment, along with the time it is exposed to a given set of conditions.

When saving his own seed, then, the farmer should use practices that control the damaging conditions as much as possible.

Drying

The purpose of drying seed is to reduce its moisture content, which reduces the action of insects and fungi, and biochemical reactions within the seed. When the moisture content is down to 12 to 13 percent, the action of fungi is practically stopped; at 9 percent, attack by insects is minimal.

Among drying systems applicable to conditions of the small farmer are:

1. Drying on the plant in the field. The sun's heat causes drying; this low-cost method exposes the grain to damage by birds and insects.

2. Drying platforms. This is another system using solar energy. Placing the seed by hand on the platform or patio reduces damage from birds. Stirring the material while on the platform accelerates drying.

3. Covered drying platforms. The seed, once on the platform, may be covered with plastic which causes a "greenhouse effect" with higher temperatures and faster drying. It is important to stir the material and allow air to circulate. The moisture must have a means of escape.

4. Covered structure, at air temperatures. Cribs are structures in which ears of maize are placed. The outer walls are not solid, but have spaces small enough to retain the ear but allow air circulation.

5. Dryers with artificial heat, without forced air (natural convection). These are special structures designed so that heated air passes through a tube placed in the center of a plenum or empty space. This heated air then passes through a perforated floor on which the grain is placed.

6. Dryers, with solar heating, natural convection. In this type of dryer, the greenhouse effect heats the air. It can be combined with system 5

7. Forced air dryers, with air at ambient temperature. Fan-forced air passes through a perforated floor, on which the grain is stored.

8. Forced air dryers, with solar heated air.

9. Forced air dryers, with artificially heated air.

Drying system selection should be based on relative advantages in a given situation, which will vary according to the environment, the farmer's economic situation, and his location.

Storage

The principal requierements for storage are to keep the seed cool and dry and to protect it from insects and rats. The following seven recommendations for storage can also serve as a checklist for evaluating systems:

1. Dry the grain well before storage (to 13 percent or less moisture).

2. Clean the grain before storing. The storage area and containers also should be clean and free from old grain, dust, straw, and insects.

3. Keep the grain cool through proper selection of materials.

4. Protect the grain from insects by cleaning and drying it and by using insecticides.

5. Construct the storage area so that it is ratproof.

6. Keep the grain dry. The root must not leak. Sacks of grain should not be stored directly on the floor or against wall.

7. Check the stored grain periodically.

Seed Quality Guidelines for the Small Farmer

James C. Delouche

There are two different aspects to seed quality guidelines for the small farmer: (a) guidelines for the small farmer who saves his own seed, and (b) those for a seed program or industry that produces and markets seed for the small farmer.

For the Small Farmer Who Saves His Own Seed

Much thought, effort, and investment are being focused on the development of programs and/or industries for the production and supply of seed for small farmers. However, virtually no attention has been given to the "seed saving" practices of farmers, which are the source of at least 80 percent of the planted seed of the main crops. Seemingly there is reluctance, if not aversion, to consider these practices as an important resource in agricultural development.

There is a perception among some key personnel that farmer-saved seed is "bad" seed and that replacements of this "bad" seed with seed produced by a program/industry will automatically elevate production. The replacement of farmer's seed with **improved** seed can increase production, but the increase will result from superior genetic potential rather than because it was obtained from a modern seed industry. There are exceptions, of course, but the exceptions would be far fewer than the case in which this scenario would be valid. The point is that the benefit of a seed program/industry derive primarily from the inherent superiority of the varieties rather than the fact that the seed is produced and marketed under

regulated conditions. The implication is that a seed program/industry must be based on varieties that accrue advantages to the farmer.

There are at least three common misconceptions that should be corrected so that we view the farmer's practice of saving seed in the right light: (a) farmers in countries with advanced technology buy all the seed they plant, (b) in planning for seed supply, total resupply each year is the goal, and (c) seed that does not meet the quality standards of advanced-technology countries is not good seed. These misconceptions hinder the development of a commercial seed industry for the greatest benefit of the farmer in developing countries, and they impede action that might be taken to improve the farmer's practice of saving his own seed.

Improvement of seed saving practices

Seed saving has sustained agriculture for thousands of years because farmers have worked out procedures for saving seed of the traditional crops grown in their region. Nevertheless, improvements can be made.

Maintenance of varietal purity. This is not difficult with self-pollinated crops. Precautions have to be taken to prevent mechanical mixing during harvest, on drying floors, and in storage. In the case of cross-pollinated crops, farmers can be taught to isolate small seed plots and rogue off-type plants.

Maintenance of germination. Farmers have some knowledge about the viability and vigor of seed and understand that there is a difference between seed and grain for consumption. There are many things a farmer can do to maintain seed germination. Harvesting early and drying rapidly to reduce damage from exposure to the weather are examples. In some climates, it may be a good practice to plant a small seed plot so that the seed matures after the rains have stopped. Subsequent storage is also important (Villa, page 23).

Seed-borne diseases

Farmers need to be trained in how to protect their crops from seed-borne diseases. They should be trained to recognize disease, to discard diseased grains, and when and how to obtain clean seed from outside sources.

Non-traditional crops

Farmers often fail when saving seed from introduced crops since there is no accumulated community experience with the seed of the new crop. For

example, the practices for saving rice seed do not work well for soybean or sunflower seed in terms of maintaining germinability.

Quality guidelines

Seed with high quality in all attributes cannot be expected from farmers who save their own seed. The three main quality aspects that should be given most attention are: (a) varietal purity, (b) germination, and (c) freedom from seed-borne diseases.

It is not implied that other quality features should not receive attention, but even in developed countries, good crops may be produced with 95 percent purity and with germination as low as 60 percent.

Quantities

The key to the farmers' success in saving seed is the small amounts that need to be handled in a special way. It is much easier to maintain quality on 50 or 100 kg of seed than on many tons. This is the reason why large farmers tend to buy rather than save seed.

Seed Supplied to Small Farmers

The premise on which to establish quality guidelines for seed supplied to small farmers—or to any farmer—should be: Seed supplied to farmers ought to be higher in quality than the seed they save for their own planting.

A farmer who purchases seed expects the seed to have a good appearance and to perform well when planted. If it does not meet these reasonable expectations, the farmer will rely on his own seed if he can.

Initial seed program/industry development efforts have been set back because the seed suplied was not as good as that which the farmer saved.

Quality standards

Quality standards are, and should be, a concern in the production, handling, and marketing of seed. But the standards of Europe or North America are not necessarily what are needed in developing countries. These standards are not just those of an experienced and well-financed seed industry, but are also standards for **temperate climate** seed industries.

Not only are climatic conditions and management different, but the requirements of developing countries also differ from those of developed countries. Let's take peanuts as an example. The farmer in the United States buys shelled peanut seed for planting because he might need a ton or

more, which is more than he, his wife, and children can shell. This seed, stored under refrigeration, is expensive, but there is little alternative. Seed programs in developing countries often believe that the peanut seed they handle should also be shelled. Shelling would reduce bulk in handling, storage, and transportation, but will greatly shorten the seed's viable life, especially in the humid tropics. In most developing countries, peanut seed can be supplied in pods and shelled by the farmer and his family. Thus there is little justification for "shelled" being part of the quality standards.

Quality standars should be realistic and achievable. Standards should be rigid for the most important factors, over which the seed producer has good control. They should be less rigid for those factors not under his control. Standards must be reasonable. The might be low at first and then raised as the industry gains experience.

Action needed

There is a dearth of information on which to base realistic standards. As an example, the duration of a germination test needs to be based on the response time of different kinds of seed under various storage conditions. But storage responses over time have not been charted, or no one has taken the time to summarize the data. Other examples can be cited. There is a need to compile, interpret, and use the data base that is accumulating in many countries.

Guidelines for the Production and Selection of Cassava Reproductive Material

Dietrich Leihner
(Presented by James Cock)

The use of cassava "stakes" (pieces of main stems and branches) as "seed" has been so very common in the production process, and apparently so easily carried out, that the possible application of improved technology has been almost totally neglected. However, in this preliminary report, it is now forseen that the production, selection, and handling of the stakes can be a determining factor for improving cassava production.

Poor quality stakes can cause losses in the plant population during the initial growth phase, to the detriment of production. Also, diseases and insects can be transmitted by the stakes.

The following conclusions are drawn from work conducted by CIAT. First, it should be mentioned that the variety and agronomic practices used for the seed source affect the results.

1. Vigorous plants, with erect growth characteristics, have greater potential for the production of stakes, since such varieties have more main stem and secondary branches from which to take stakes of adequate size.

2. The older the plant, the grater the potential for producing stakes. However, the optimum age for production of the highest quality stakes is not known.

3. Stems of intermediate age, that is, the middle or higher parts of the

plant, are more appropriate for seed than the older parts of the plant, even though the older parts produce stakes that germinate more vigorously.

4. The higher the population of mother plants, the greater the number of cuttings per land area, although they may weight less.

5. Adquate soil fertility is important for the production of a good number of cuttings per unit of land.

6. Protecting the mother plants against disease, insects, and weeds is highly important in assuring satisfactory production of seed material and avoiding disease transmission to the new crop. Advisable practices include the visual selection of healthy stakes. Meristem culture is another method that might be used to produce healthy mother plants.

Once the stakes have been cut, selection should be based on recognizing symptoms of defects such as disease, or physiological defects which may be caused by insects. This selection is based on visual criteria.

1. The presence of systemic pathogens might be detected visually as a localized infection, in which case the stake should be discarded.

2. Likewise, stakes with insect damage should not be used.

Finally, adequate management of the stakes themselves is important, such as making a rectangular cut rather than a slanted one, and making the stakes at least 20 cm in length, and then protecting them from phisical damage. If it is necessary to store the stakes, it should be done appropriately, and the stakes should be treated chemically to protect against insects and pathogens before plating.

Guidelines for Producing and Selecting Seed Potatoes

Anibal Monares

There are two procedures that can be adopted by small farmers for producing potatoes for seed:

1. Planting small lots especially for seed, and

2. Using low-cost, on-farm storage.

Planting Small Parcels for Seed Production

This process starts with the farmer identifying and marking his best plants in the field. These are harvested and stored separately. At the next seeding, the farmer establishes a small parcel specifically to produce seed. Some seed from this plot is harvested to repeat the seed plot the following year, and the remainder is used as seed for the normal planting for consumption or sale. This process is repeated for each crop.

Low-cost On-farm Storage

Potatoes stored in the dark use their energy reserves to produce sprouts, resulting in wrinkled potatoes. The sprouts grow more from the end of the potato and inhibit sprouting from the other "eyes". Desprouting, which is usually done before seeding, cause small lesions that allow bacteria and fungi to enter upong planting. Germination is poor, and plant population and yield are reduced.

Simple, inexpensive storage houses with adequate ventilation and

indirect light have been designed. This diffused light inhibits excessive sprouting, but allows short and vigorous sprouts. These potatoes are better for seed than potatoes stored in the dark.

Panel A

Theme
Practical Recommendations of Selection and Production for the Farmer who Saves his Own Seed

Rice

Dorancé Muñoz

Under Irrigated Conditions

1. The government selects the recommended varieties and produces and sells pure, high-quality seed to farmers.

2. The small farmer:

   a. Should select the best area possible for producing seed (good fertility, freedom from weeds, etc.).

   b. Should practice transplanting for the production of his own seed.

   c. In some cases, should thin the planting 20 days after transplanting.

   d. Should rogue plants that are not typical of the variety seeded.

   e. Should clean seed to eliminate impurities and trash.

   f. Should break the dormant period before seeding.

3. It is recommended that small farmers organize cooperatives or associations.

Advantages of Transplanting

1. Preparation of the land for transplanting is done under flooded conditions, which reduces the population of weeds, volunteer rice, and red rice.

2. Weak and abnormal plants can be eliminated in the seed beds and not transplanted.

3. It is easier to eliminate off-type plants after transplanting because it is easier to identify each individual plant.

4. Transplanting produces higher yields and reduces the cost of production per unit weight of seed.

5. A kilogram of rice seed produces more seed by transplanting than by other methods of seeding. The ratio of seed planted to seed harvested when planting directly in dry soil is 1 to 33, whereas with transplanting is it is about 1 to 290.

Disadvantages of Transplanting

1. Transplanting is not feasible without adequate labor.

2. *Under upland conditions:*

   a. Transplanting is not possible under all conditions where upland rice is grown.

   b. *It is important to select the lowlands with the best moisture.*

Specific Recommendations

1. Any equipment used for harvesting seed should be clean and free from other seed in order to avoid contamination.

2. The harvest should be done when the grain has approximately 14 percent moisture.

3. Seed that will be stored for more than two months should be treated with insecticide. This seed would not be suitable for human consumption.

4. Germination should be at least 80 percent before seeding.

5. Seeding should be done on time, with adequate fertilization and control of insects and disease.

6. For transplanting, it is necessary to make 10 seed beds of 1 m wide by 20 m long for each hectare to be planted. Each seedbed will need 2 kg of seed, using 10 grains for each row of 1 m in length with 10 cm between rows.

7. The recommended distances when transplanting are 20 cm between plants and 30 cm between rows.

8. When it is not possible to transplant, a grain drill should be used; seeding should be at a rate of 60-70 kg/ha. The distance between rows can vary between 15 and 30 cm.

Beans

Oswaldo Voysest

Basic Premises

1. Beans are grown predominately by small farmers.

2. A large portion of the production is for family comsumption. It is estimated that 30 percent of the production in Latin America is consumed by the producer and his family.

3. Seed represents 30 to 40 percent of the production costs.

4. Since beans are self-pollinating, there is no great degree of genetic contamination resulting from the farmer saving his own seed.

5. There is great diversity in the types of beans produced in different localities, which makes it unattractive for private seed companies to produce and distribute seed for the small farmer.

6. There are many bean production systems; the majority of small farmers grow beans in association with another crop, frequently maize, and a large number of the varieties are climbing types.

7. Diseases are on of the most important limiting factors to bean production, and the most important common diseases are transmitted through seed.

Conclusions Based on the Above Premises

1. The small farmer generally produces his own seed.

2. There is a broad range of seed quality, which reflects the different types of farmers who produce beans.

Steps in Producing Seed by the Small Farmer

1. Obtaining the basic seed to start his own seed production:

   a. Commercial seed sources, which usually do not exist.

   b. Neighboring farmer of known reputation; this is usually the best option.

   c. The farmer's own production.

2. The first seed increase from an original seed source:

   a. Select a plot of land specifically for the seed increase.

   b. Protect this plot against diseases transmitted through seed:

      — Common mosaic: Control aphids.

      — Common "bacteriosis": Eliminate any infected spots within the area; use chemical treatment (such as Koccide)

      — *Anthracnosis:* Use chemical treatment such as Benlate.

   c. Harvest the best plants.

   d. Select the best formed grain without spots which might indicate infection.

3. For further seed increases:

   a. Divide the field into two parts, one for grain for consumption and the other for seed.

   b. For each hectare planned for production the next year, establish a seed plot of .01 ha. It is assumed that 5 kg seed, seeded in 1000 m^2, will produce 100 kg seed. Allowing for any

germination problems because of poor storage, this would be enough to seed 1 ha.

c. Seed for a lower plant population for seed production than for commercial production:

   — Bush type: For commercial production, plan for 200,000 plants/ha, using distances of .5 to 6 m between rows. For seed production plan for 100,000 plants/ha, using distances of 1.0 to 1.2 m between rows.

   — Climbing type: For commercial production, use 120,000 plants/ha in association with maize in rows 1.0 to 1.2 m apart. For seed production, use same plant population and distances but use wooden stakes rather than seeding with maize.

d. Cultural practices.

   — Apply insecticides to both commercial and seed production areas.

   — Use fungicide on the seed plot.

   — Insofar as practical, use the best possible agronomic practices such as fertilization, weed control, irrigation, etc.

e. Eliminate any off-type or diseased plants, preferably before flowering.

f. Harvest the best plants for seed, eliminating pods that are spotted or deformed.

g Eliminate small grains by screening; eliminate both small and spotted seeds.

h Store the seed in a cool, dry location after treating with insecticide.

There are other consideratins but these may not be within the control of the small farmer:

   — An isolated plot in an area having a dry climate is recommended for seed production.

   — Seeding is done preferably during their drier season.

— Isolation of the plot for seed production is desirable.

— Irrigation should be by gravity rather than by sprinkler.

Maize

J. Barnett

Small farmers have been selecting their own maize seed for thousands of years. The problem now is to find how to improve this time-tested system.

Farmers practicing mass selection usually make the selections after the harvest and thus the plant type is not observed. They sometimes select seed at harvest but usually select large ears with large grain. The larger ears tend to come from late-maturing plants. Farmers frequently state that they would like a shorter plant type. The mass selection they practice, however, undoubtedly selects for tall, late maturing plants.

The farmer should estimate the amount of seed required for the following year. The amount required is related to selection criteria: if large amounts are needed, he has less opportunity to apply selection pressure.

Following are suggestions to the farmer for saving his own maize seed:

1. Make the selection in the field before harvest in order to take plant type into account.

2. Select ears only from plants of his ideal plant type. The objective at this point is not to harvest all the seed needed for the following year, but to obtain seed of the desired plant and gran qualities. In this case he can apply heavy selection pressure.

3. In order to have seed for the following year, a second selection is made in the field.

4. The seed selected in limited quantities for ideal type is then seeded in an isolated plot—isolated either by distance or by time of seeding so that it will not be contaminated with pollen from other plots.

5. This isolated plot then becomes the seed source, following steps 2 and 3 in consecutive years.

Sorghum

Vartan Guiragossian

Technology relevant to the conditions of the client can be generated only by a multidisciplinary approach to agricultural research. It is important to know the client and understand his needs in order to orient research. New technology should be validated on farms, and both biological and socioeconomic aspects should be considered. Some specific points that should be given close attention follow.

1. Production potential of the variety should be as high as possible but it should also be stable. Potential farm production and stability can be determined only by testing under farmers' conditions.

2. Culinary quality should be tested.

   a. Ask the farmer

   b. Laboratory testing

      — Seed color: endosperm red/white, yellow (alkali test)

      — Grain texture: soft or hard endosperm

      — Amount of tanin (low level is important for human consumption)

      — Amount of phenol: phenol content should be low to avoid discoloration of tortillas

— Keeping qualities of the tortillas

3. Agronomic characteristics

   a. Maturity

      — Early-maturing varieties are sometimes important to fit a rotation or to escape drought, insects, or birds.

      — Later-maturing varieties are needed for seeding in association with maize.

   b. Plant height can be important for small farmers when they wish to use leaves and stalk.

   c. Some types opf sorghum make a regrowth, which allows a second harvest at low cost.

   d. In some varieties all panicles mature at the same time, which is important for mecanized harvest but is not necessarily important for the small farmer.

   e. Some types of sorghum have open panicles and others closed. Open panicles dry more rapidly but are more susceptible to bird damage.

   f. Resistance to insects, disease, and birds is important.

   g. If some grain will be sold, acceptance in the market is important.

Workshop A

Theme

The production, Selection, Handling, and Storage of the Farmer's Own Seed.

Guidelines

A. Do you think it is possible, through the use of improved technology in seed production, selection, handling, and storage, to improve the quality of the seed saved by the farmer? Why?

B. Present your ideas about methods the small farmer can use to assure good production, selection in the field, handling, harvesting, cleaning, drying, treating, packaging, and storage.

C. Suggest action that goverments, through their institutions, might take to improve the seed produced by the farmer. Indicate what kinds of institutions would play a role, as well as their specific responsibilities to meet this objective.

Rice

Dorance Muñoz, Coordinator

This workshop group reported under three categories: (a) seed quality, (b) methods and procedures the small farmer can use to improve seed quality, and (c) the role of government.

Seed Quality

The group felt that the quality of the seed presently used by the farmer can be improved.

The majority of small farmers use seed of improved varieties, but not certified; others use native varieties.

Small farmers use seed of unknown origing and apply few or no practices to improve it.

Methods and Procedures for the Small Farmer

1. Produce seed in new land free of weeds that are difficult to control.

    — Land for seed production can be rotated with other crops in which he can use herbicides to control weeds.

    — When the farmer wishes to change varieties, he should produce seed on land that has not been sown to rice for two seasons.

— It is recommended that progressive farmers be selected to produce rice seed in their best fields. These farmers can then distribute seed to other farmers of the region.

2. Cultivation.

— Use the regular practices of the region in producing seed.

— Seed that will be used to produce more seed should be selected for density by putting it in a container of water and elimianting those that float.

3. Selection in the field

— Eliminate off-type plants, weeds, and red rice from the seed plot.

— When the farmer's land is too limited to plant a separate area for seed production, he should save the best plants from his regular production, selecting the number or panicles he estimates will furnish the quantity of seed needed for the next crop. It would be desirable to eliminate off-type plants.

— The extension agent should help the farmer make the selections.

4. Harvest

— The customary practices of the region can be used for harvesting.

— Harvesting should be done when the grain has 16 to 20 percent moisture. Since the farmer will not have equipment to determine moisture content, he will have to rely on his experience and the experience of others in the region.

5. Handling the seed

— The customary threshing by hand should be done in clean areas in order to avoid mixing the seed with other rices or grains.

— The seed can be cleaned by using a screen and winnowing.

— When it is necessary to dry the seed further, this can be done on a cement platform, canvas, or plastic.

6. Storage

— Seed to be stored for more than two months should be treated with insecticide. Once treated, it will not be suitable for human consumption.

— The seed should be stored in clean bags.

— The seed should be stored in a clean, dry, cool place which is as well ventilated as possible. The sacks of grain should be stored on a wooden platform and not placed directly on the floor or against walls.

The Role of Government

1. The extension agent should have equipment and personnel to help the farmer in the selection and treatment of seed.

2. In order to initiate a seed production program for the small farmer, or when it is important to change varieties, the seed should be placed with a farmer who is supported through subsidy or credit.

3. The government should stimulate good seed by awarding prizes to the best small farmers.

4. Research programs should produce improved varieties opportunely, keeping in mind that the objective is to solve problems of farmers in each region.

Beans

Oswaldo Voysest, Coordinator

This workshop group believed that the quality of seed used by the small farmer could be improved, because the principal problems are diseases, which can be resolved by using pesticides and resistant varieties. Another problem is that farmers plant beans on the same land year after year, which favors an increase in root diseases. A third problem is the commonly used method of threshing by pounding with a stick, which physically damages the beans.

Recommendations for the production, selection, and handling of bean seed follow.

1. The small farmer preferably should plant an area just for seed that is separate from his regular production. One advantage is that he could give the separate parcel better agronomic treatment. The separate parcel serves a psychological purpose in that it emphasizes to the farmer that seed needs special attention and care. If the farmer cannot plant a separate area for seed production because of insufficient land, he should select the best areas in his regular seeding for selecting seed.

2. Since the amounts of seed required are small, it is recommended that the plants be selected individually and that the threshing be done by hand so the seed is not damaged.

3. A simple screen can be used to eliminate small seed and fine trash.

4. Spotted grains indicating disease and damaged grain should be separated by hand.

5. If the seed is to be stored in sealed containers, it can be treated with oil or "phostoxin" to protect against insect damage.

6. Advantages of using metal containers or small silos (cylinders) for storing bean seed should be studied.

7. Farmers should be trained to conduct germination tests.

This group suggested placing more emphasis on training extension agents in the production, selection, and handling of seed. Frequently, technical assistance personnel give attention to the production and handling of commercial grain but not seed.

Simple and practical experiences of Latin American farmers in producing, storing and handling bean seed should be compiled; CIAT should publish and distribute the information.

Potatoes and Cassava

Armando Rodriguez, Coordinator

1. It is possible to improve the quality of the seed used by the small farmer. Experience indicates that selecting plants that appear vigorous and healthy leads to good yields.

   On the farmer level, selection can be done by planting small plots with high quality seed. The most vigorous and healthy plants can be marked. The tubers produced by each plant should be harvested individually and saved for seed for the following year.

   Adequate control of insects and disease, especially insects that transmit viruses, is indispensable.

   Recent experiences in Asia, Africa, and Latin America show that it is possible to improve the storage of seed potatoes by using low-cost rustic structures that allow the tubers to receive indirect, incident light. Seed stored under these conditions produce better yields than seed storage under traditional conditions found on most small farms.

2. Active participation by extension and rural development programs could be a prime element in getting the small farmer to employ the above ideas.

3. Research programs and seed production programs should maintain close cooperation with extension agents in order to keep up to date on the production and handling of seed for the small farmer.

Cassava

Good cassava stakes for new planting depend on the variety, agronomic practices, and sanitation.

1. In general, vigorous plants will yield a larger number of stakes of satisfactory weight.

2. The older the plant, the more stakes that can be cut, but the optimum age of a plant for making stakes is not known.

3. Branches of intermediate age, i.e., the middle and higher parts of the plant, are more appropriate than the older parts for cutting stakes for planting, even though the older parts seemingly germinate more vigorously and have more nutrient reserves.

4. High plant populations (greater plant density) yield more stakes, but they are smaller.

5. Adequate plant nutrition is important for the production of a good number of stakes of good weight. Excessive fertilization, on the other hand, had negative effects on the new planting.

6. Protecting the mother plants against disease, weeds, and insects is important, not only to assure a good yield of stakes but also to avoid disease transmitted through the stakes. Such practices as visual selection, chemical treatments, and meristem cultures are measures that can help in the production of better quality planting material.

One the stakes are cut, careful visual selection to detect defects is critical. Those with any symptoms of disease or insects should be discarded.

7. The stakes should be 20 cm long. The cut should be made at a right angle to the stem, and not on a slant. Once the stakes have been cut, they should be handled carefully so they will not be damaged. Stakes should be stored only when absolutely necessary. Protecting them against diseases and insects is indispensable.

Conclusions

1. The quality of the stakes undoubtedly affects subsequent cassava yields.

2. The quality of the material for new cassava plantings is determined by factors related to the genotype (behavior in the ecosystem), to physiological conditions (maturity or lignification, thickness of material to be cut, nutrient reserves, size, and number of internodes), and to sanitary conditions (presence or absence of disease and insects). Furthermore, storage affects stake quality.

3. The farmer should always use high quality stakes which he can produce himself if he is taught how to do it.

4. Before seeding or storage, the material to be planted should be treated with the appropriate fungicide to avoid damage by pathogens in the soil.

5. Selection of the field and agronomic practices for the purpose of producing good quality planting material could be of great value to the farmer. If some farmers in a region could specialize in the production of stakes, national and international organizations could furnish disease-free material (through meristem culture).

Sorghum

Vartan Guiragossian, Coordinator

For farmers with limited resources, there are two principal systems of sorghum production: monoculture and mixed cropping.

In the first case farmers use seed of improved genotypes, both hybrids and varieties, and most farmers purchase seed.

In the case of sorghum grown in association with other crops, such as occurs in Central America, the farmer uses native varieties and saves his own seed. This type of farmer generally gives very little attention to selection of seed.

Recommendations

1. The farmer should select the best panicles of sorghum for seed. Only the best panicles that appear vigorous and healthy should be selected; they should be of the phenotype desired.

2. The harvest should begin after physiological maturity, but the seed should not remain in the field longer than necessary in order to reduce bird damage and other problems caused by lack of shelter. The harvest should begin when the plants start to dry and the grain starts to show a black layer.

3. The harvest usually takes place during the dry season and can usually be sundried. Sorghum should be dried to 13 percent moisture before storage.

4. Threshing may be done by putting the panicles in jute sacks and pounding them lightly.

5. Some simple, practical methods of cleaning will have to be used, such as hand screening and winnowing.

6. Small and broken grain, as well as foreign material, should be removed.

7. The seed should be treated against insect and fungus damage before storage.

8. Sacks of cotton, jute, paper, or woven plastic fiber can be used for storage. Tightly closed containers are not recommended in tropical areas unless moisture levels can be maintained at 9 to 10 percent. High temperatures should be avoided for seed storage.

9. Germination of the seed should be tested before seeding.

10. Seed should always be handled separately from commercial grain or that stored for home consumption.

11. It is recommended that research programs produce genotypes having the grain characteristics and qualities appropriate to the production systems used by the farmers.

Maize

James Barnett, Coordinator

In discussing the assigned guidelines, this group assumed that: (a) there are no varieties available that have been proven superior to those materials the farmer is already using, and (b) the small farmer has his own system for the production, selection, and handing of seed for each subsequent planting season. The following are the conclusions of the group:

Conclusions

1. Yes, it is possible to improve the seed that is currently used by the small farmer.

2. Rather than selecting ears of maize for seed after harvesting all of his crop, the farmer should make the selection in the field.

3. As part of the field selection process, plants that are diseased should be eliminated or detasseled before the production of pollen.

4. The farmer should consider producing seed in a parcel that is separated from his commercial planting, either by distance or by time of planting.

5. Excepted from the above conclusions would be those regions with high relative humidity, where it is practically impossible, or very costly, to store seed for up to six months.

6. The farmer can make the selection visually in the field, collect from

the best plants, and then sort the first selection again, saving only the best ears.

7. Satisfactory moisture content for storage is highly important. Therefore, the farmer should try to harvest during dry periods and use sun drying to adequately reduce moisture content.

8. It is usggested that governments develop an integrated policy for research, extension, credit, and marketing for production of the most common crops.

9. Governments should emphasize extension activities and the training of extension personnel. In order for the extension effort to have a multiplier effect, rural leaders should be trained.

Increasing the Use of Improved Seed by the Small Farmer

Seed in the Transfer of Technology to Small Farmers

R. K. Waugh

Seed, as used in a broad generic sense, has been a highly successful mechanism to improve agricultural production and productivity. Seed not only has a direct effect on production but is of natural interest to farmers and has served to introduce companion technologies such as fertilizer, plant population, insect control, etc.

Small farmers of the developing world are one of the major concerns of the moment. In these areas, seed and other technologies have not been as successful as desired. One of the major challenges of the future is how to improve the production and productivity of the small farmer. Seed can play an important role but it is necessary to consider several aspects of this very complex situation. The following are basic points important for seed and other technological programs.

1. Technology alone will not be enough to solve the plight of the small farmer. In many instances there is no agricultural solution.

2. Governments must support technological programs, such as seed. Many times, the input by government is inadequate to allow growth of technical programs in order to meet expanding needs.

3. Technology generation, transfer, and services must all be coordinated and directed toward common objectives. Seed is involved in all three of these aspects.

4. The situation of the small farmer must be understood. The

generation of technology must be client-oriented. Therefore, it is important to integrate the technology into the farmer's system, to evaluate the technology under representative farming conditions, and to be certain that the technology is acceptable to farmers before attempting to transfer it to the masses. This will require consideration of cultural and economic conditions along with the biological aspects of technology. Involvement of the farmer in the process of generating and transferring technology is one way to assure that all these aspects are considered.

Developing a Technological System

It is proposed that a system be organized and integrated that would orient and coordinate the activities of research, extension, and technological services such as seed production and processing so that the participating units function with common objectives.

There are several reasons why some systematic approach for promoting small, limited resource farming through the adoption of improved technologies is needed:

1. There is now considerable evidence that technology generation, transfer, and services should be **client-oriented**. However, if **all** the groups involved do not focus on the same objectives and the same clients, the total effort will be fragmented and diluted resulting in higher costs, additional bureaucracy, and multiple efforts that confuse the client.

2. Activities of the groups (research, extension, services) need to be **coordinated**. A common orientation of these groups will help, but a unified policy and focus are not enough. The **action** of these different groups must be coordinated so that each activity enhances the others. This requires that specific objectives be identified and specific responsibilities be assigned in order for technology to be generated and transferred to previously identified clientele. Seed, research, and extension programs must be certain that the technology or the seed offered in acceptable to the farmer. To accomplish this, technology generation, its transfer, and its technological servicing must be conducted by phases, with one phase depending upon another. This necessitates coordinated action that can be done only if responsibilities and objectives are understood. Each group must have confidence in the others. Each must support the others. Adoption will not be successful if the seed promoted by extension is not available at the time the farmer needs it. A conceptual outline of an integrated system for technology generation and transfer by phases is illustrated in Figure 1.

3. **Planning** is important. Technology generation and transfer cannot be given direction and managed if each group makes unilateral decisions. In order for the groups to act dynamically and in a coordinated manner, considerable planning must be done. This necessitates defining a system and arriving at a concensus of how it operates, what its objectives are, and the assignment of responsibilities to the participating groups. These groups do not have to be in the same organization to be successful.

Adding Agronomic Steps to the Model

Figure 2 illustrates the same model as Figure 1, but also shows the steps that might be followed in agronomic research and extension. The scheme presented in Figure 2 calls for three principal groups of participants: (a) commodity, discipline, and service groups, such as seed, (b) on-farm research, and (c) extension.

Locating Seed Within the Model

A seed program can function either as an integrated part of the commodity and discipline research or as a separate but coordinated unit. A seed program with responsibility for basic seed, commercial seed, and its processing and distribution would be interested in all phases of Figure 3, especially the last four.

Operating the System

In operating such a system, many questions will have to be resolved. For example, who will identify the varieties or lines to be tested in researcher-managed trials by the on-farm research teams? Who will produce the seed for these trials? Who will produce the basic seed? When should commercial seed be produced and in what quantities? Should small amounts of commercial seed be produced during phase IV (Figure 3) of those varieties being tested by farmers? Or should there be a delay of one year? This delay should be avoided because if a farmer tests a variety one year and cannot obtain seed the following year, he will lose confidence in the system. The demand for seed the year following phase IV will not be great since only a limited number of farmers have tested it. Therefore, it should be possible to provide adequate amounts of seed for those who tested it the previous year. However, it may be necessary to produce some commercial seed of some varieties that is not sold. If, for example, there are three varieties in farmer-managed tests, all three should be available to farmers the following year. These questions may appear to require only minor decisions, but they are critical ones.

Figure 1. Conceptual outline of an integrated system for generation and transfer of technology.

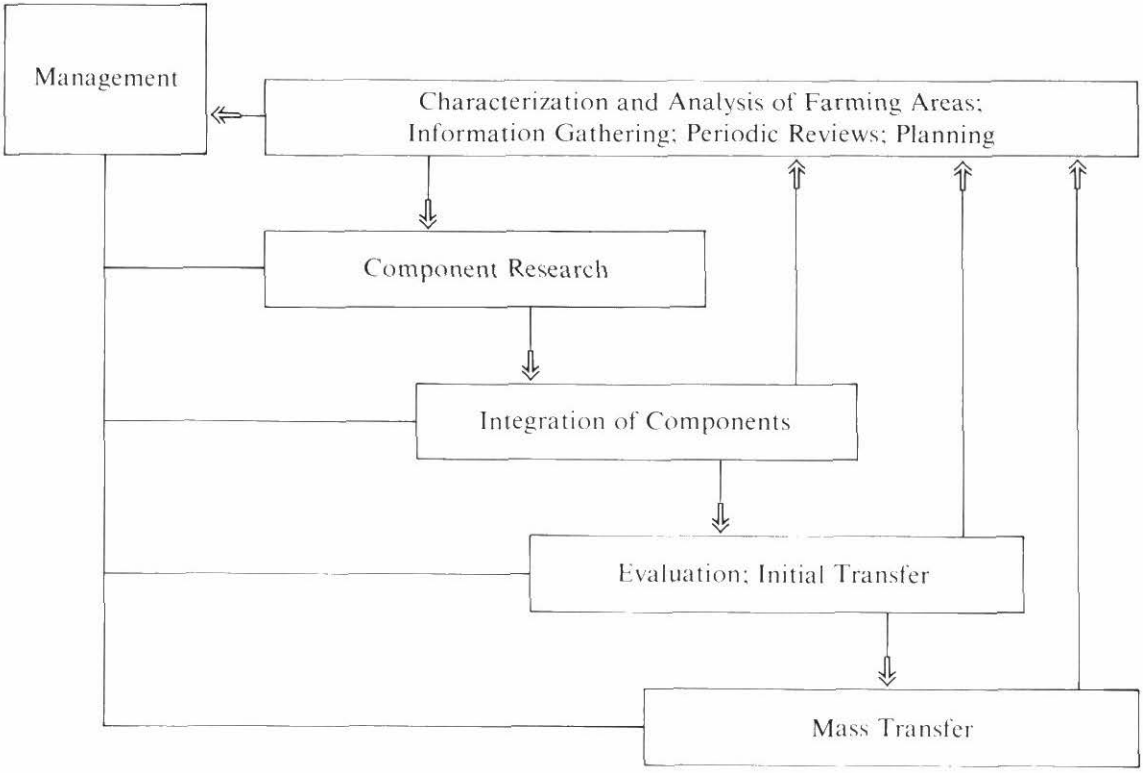


Figure 2. Outline of an integrated system for the generation and transfer of technology, with the participation of commodity and discipline personnel; on-farm research teams and extension.

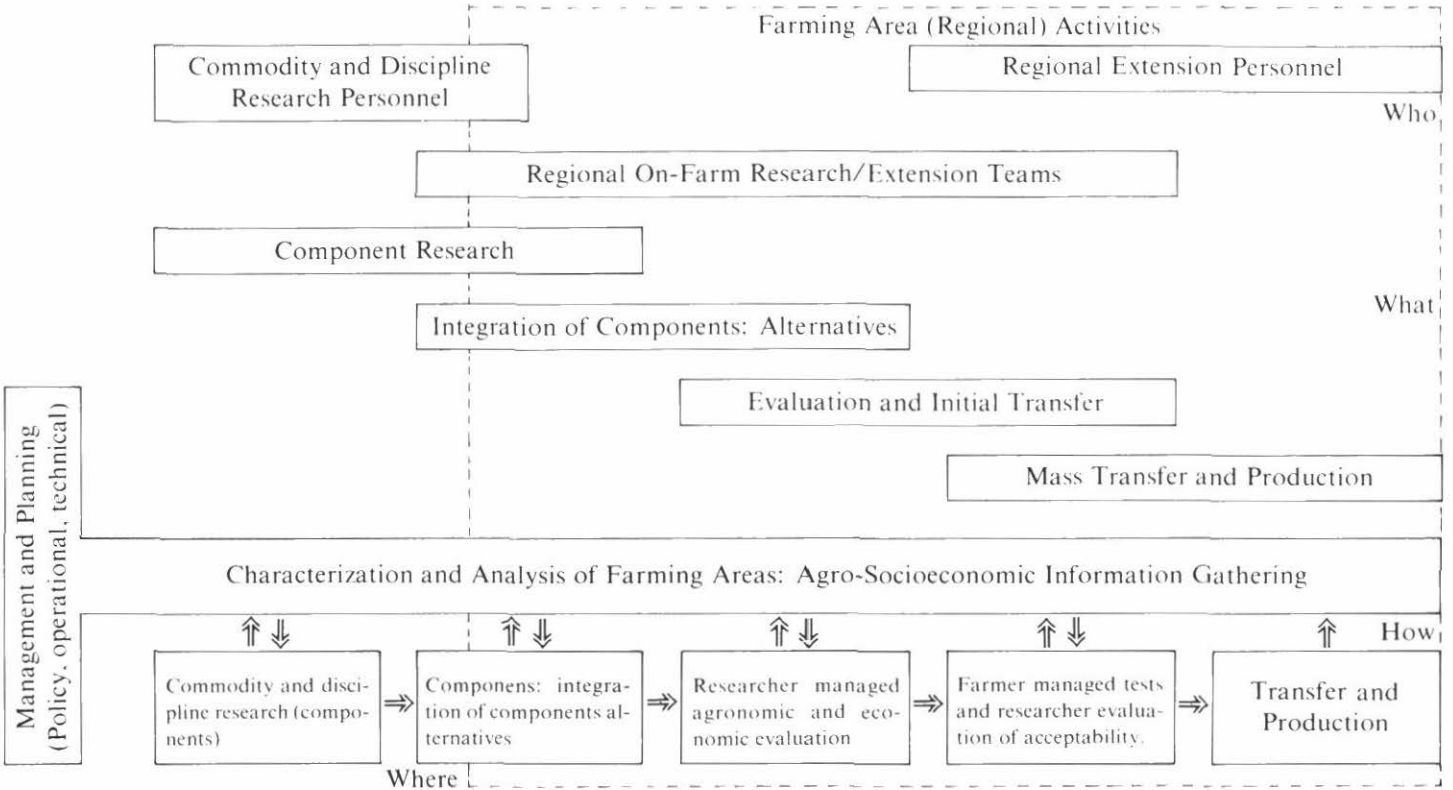
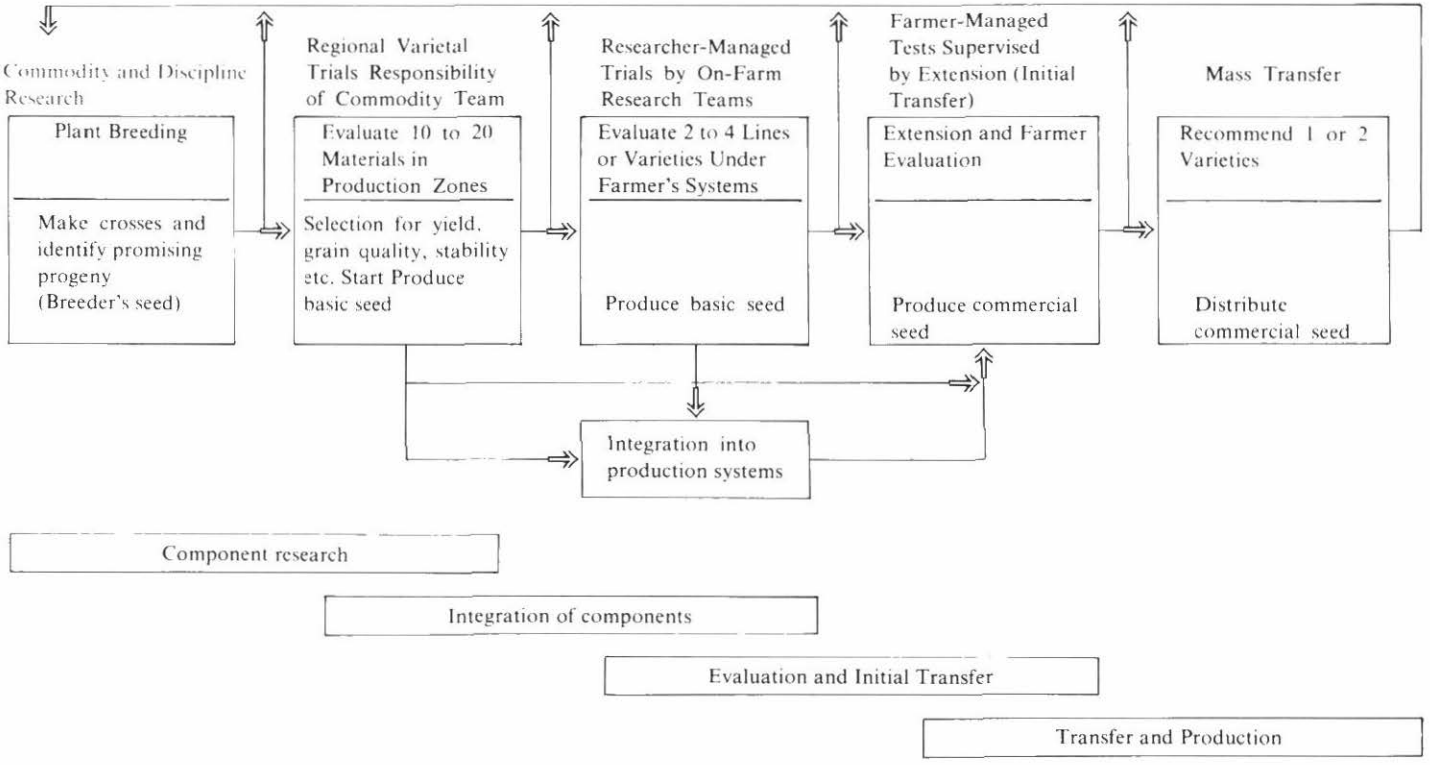


Figure 3. The integrated system for generation and transfer of thechnology, outtined in Figure 2, as it relates to plant imprrovement, seed productiond and transfer.



Meeting Local Conditions

The system suggested herein is not proposed as a rigid, fixed system but as a guide for evolving systems according to the conditions in each country, or in different areas of the same country.

Selection and Identification of Appropriate Varieties for Small Farmers

Jonathan Woolley

Important Characteristics

In order to obtain appropriate varieties for farmers with limited resources, it is insufficient merely to test under their conditions "finished" varieties produced for other types of agriculture. Instead, there should be breeding programs oriented to their needs. The CIAT Bean Program is an example. Important varietal characteristics for small farmers include: (a) adequacy for use in multiple cropping systems and mixed animal/crop production systems; (b) adaptation to marginal lands (poor soils, sometimes without fertilization, and with problems of toxicity, drought, or slopes (c) genetic resistance to diseases and insect pests; (d) acceptability for home consumption and/or marketing (some farmers have wide preferences for their own use but market requirements are less flexible; (e) adjustment to the farmers' goals which may vary among productivity per hectare, per unit invested, or per unit of labor; and (f) stability in response to environment over time. It is emphasized, however, that not all small farms are in conditions of high stress.

Selection Strategies

Breeding programs for stress resistance (characteristics 1 to 3) oriented to the small farmer are sometimes criticized for not selecting under his conditions. However, a compromise is necessary between conditions sufficiently uniform to allow reliable single plant selections in large segregating populations and conditions of high stress (where plants are not uniform even in small plots) similar to those of farmers.

In the Eberhart and Russell (1966) model for varietal adaptability across environments, the x-axis (environmental index) is derived from the mean yield of all varieties tested in a particular environment. Using the slope and mid-point of the regression line for each variety, the breeder can deduce its general and specific adaptation. In Figure 1, the x-axis is modified to describe stress due to temperature, water balance, diseases, pests, fertility, toxicity, management or multiple cropping, or a combination of these. The low stress conditions indicated would be inadequate when selecting for the range of small farmer conditions hypothecally represented in Figure 1. Selection need not be carried out, however, under exact small farmer conditions. In the example given, the order of performance of the three genotypes is the same as under small farm conditions, provided stress is greater than the minimum shown. In practice, when testing many single plants or lines, the challenge is to find a screening environment where yield rank is sufficiently correlated with performances on farmers' fields so that a relatively small proportion of suitable lines will be rejected. An environment should be checked against farmers' conditions for minimum effective selection stress by evaluating a genetically and phenotypically diverse sample of lines in both.

Flow of Varieties from Breeding Programs to the Small Farmer

Breeding efforts in various crops carried out in collaboration by international centers and national research programs generally have these stages: screening of germplasm, crossing, various generations of selection, progeny trials in more than one country, formation or identification of experimental varieties, international variety trials in many countries, regional trials in each country, on-farm agronomic research, and technology transfer in each region. Depending on their resources and priorities, national programs make their own crosses, begin the selection process in segregating generations, evaluate advanced progenies, or evaluate experimental varieties.

On-farm agronomic research and technology transfer is of particular importance to small farmers. A strategy will be described here (Fig. 2) which is being tested in a collaborative project between ICA and CIAT in different bean cropping systems and climatic zones of Colombia. This strategy is based on models developed previously by CIMMYT and ICTA, among others.

The key to the process is the technician's knowledge of the farmers' situation, based on the collection of information using both informal and formal techniques. From this, production constraints are identified in the agrosystem being studied and are used to design farm trials, based on results of component research at experiment stations and solutions obtained in other regions.

Figure 1. **Selection for small farmer conditions.**

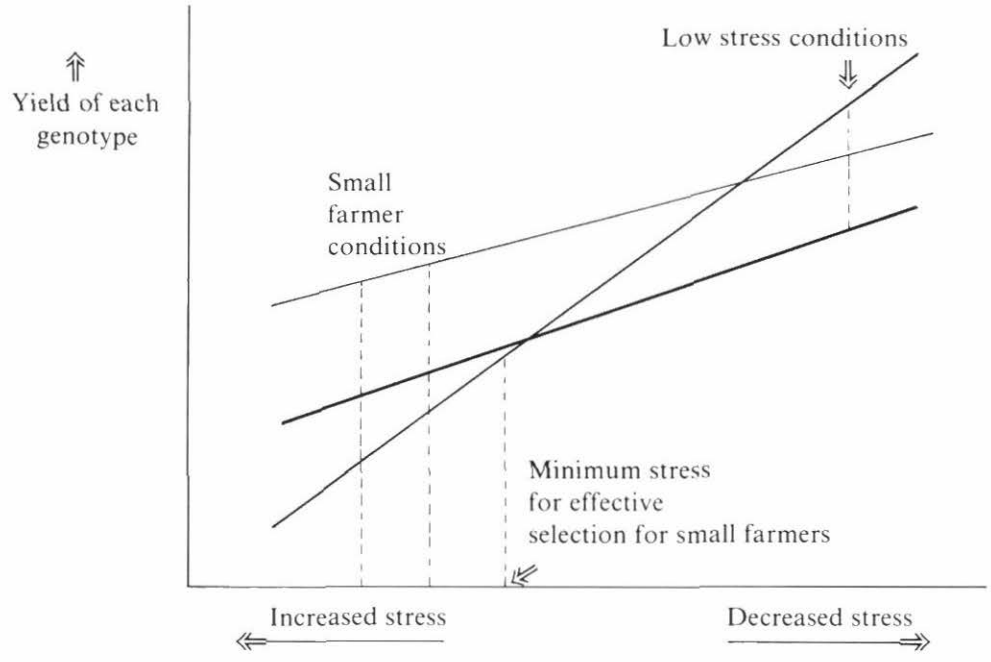
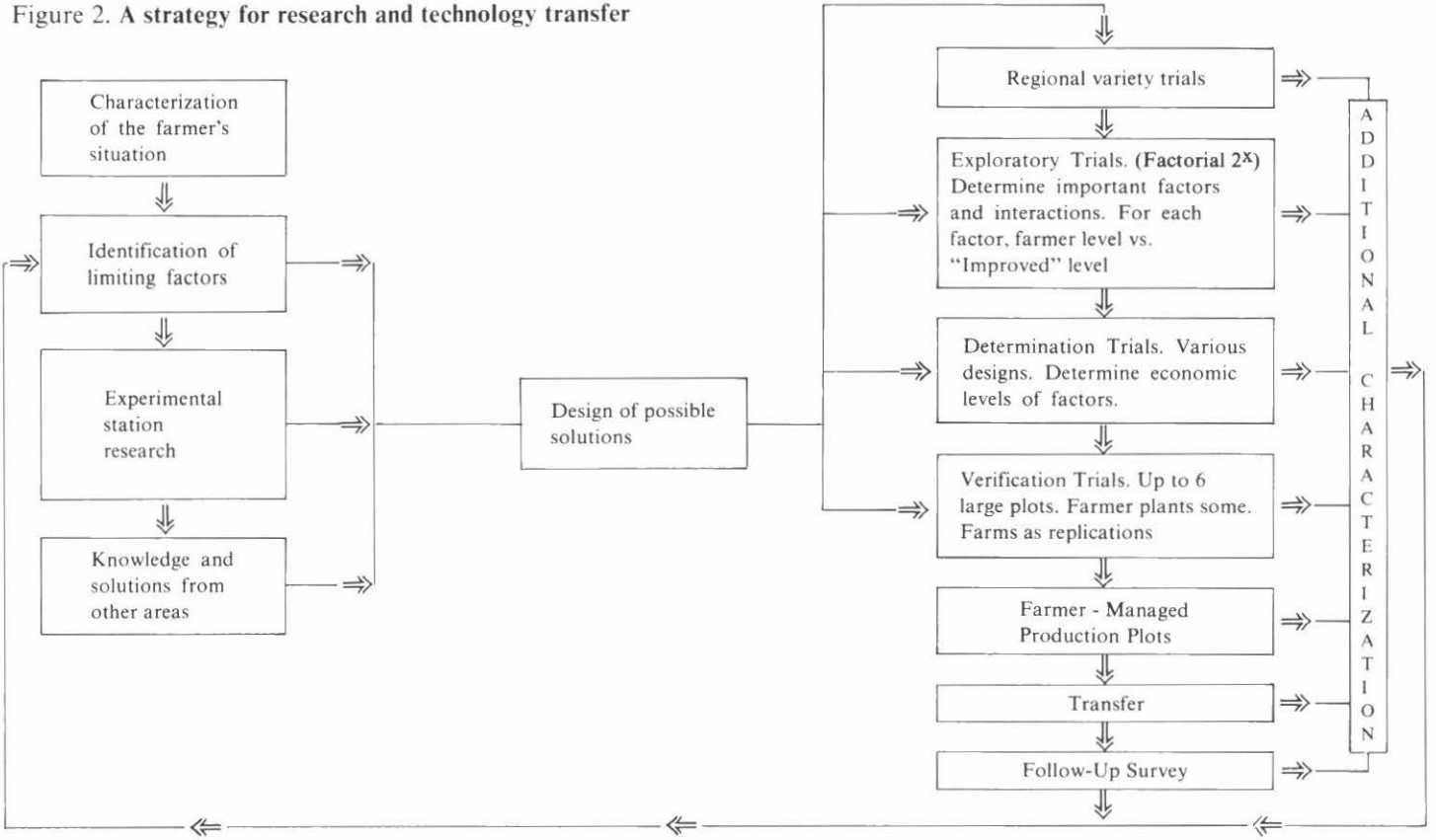


Figure 2. **A strategy for research and technology transfer**



In the regional variety trials, a small number of varieties (perhaps only one) is identified for comparison with the traditional variety. The exploratory trials check the previous diagnosis of important limiting factors and identify those that should be studied together because of their interactions. Optimum economic levels of these factors or groups of factors are then identified in the determination trials, with each factor present at three or more levels. In the verification trials, the most promising technologies identified in the previous stages are compared in large plots planted by the farmer using his technology. The most suitable technology for each type of farmer is then tested by many farmers under the guidance of the research worker and extensionist in farmer-managed production plots. This opens the way to mass transfer of technology and a follow-up survey to measure adoption. Several of the stages may be initiated simultaneously, but the relative importance of the later steps increases after one or two years' activity in a region. Comments on the treatments are requested from the farmer at all stages, and the process of characterization and diagnosis continues after the initial effort. The socioeconomic disciplines play an important role in all stages of the work.

Implications for Seed Programs

Better seed of improved varieties should be integrated with improved cultural practices. Interactions between varieties of a species and the factors of weed control, plant population, fertilization, and disease/pest control are common. Interactions also occur between the species in a system. Competition between two species is illustrated by the negative correlation of yields of maize and climbing beans in direct association, and the effect of one species on another, even when their growth cycles do not overlap, as seen in examples from the maize/bean relay system.

Occasionally, there is no substitute for using a traditional variety with improved cultural practices, although this is very rare in beans. In such cases, it is suggested that there is still a place for improved seed selection and storage practices.

Under certain conditions, genetic variability within a variety and the use of multiline varieties are desirable to give production stability to small farmers. Seed legislation should take this into account.

On-farm agronomic research depends on the researcher's interest and respect for the farmer's practices and his reasons for using them. In the same way, a thorough understanding of the farmer's seed selection, processing, and storage practices is necessary before researching or promoting changes in those practices.

Some Considerations in the Development of Appropriate Technology for Small Farmers

M.E. Swisher, P.E. Hildebrand, E.C. French, G. Clough and J. Dean

It is argued that small farmers are the victims of a technological and economic equilibrium that does not permit them to adopt new practices because, under the conditions that they face, the utilization of a new technology will not result in a more efficient use of their most limiting resources. According to this point of view, the role of the researcher is to identify which resources are the most limiting and to develop innovations that can augment the productivity of those resources. Two important considerations arise from this concept.

The researcher must insure that any innovation is neutral in scale. There are three factors that are not generally taken into account in defining the scale neutrality of research. First, it is generally true that the quality of inputs on small farms in less than on large farms. As a result, production functions are diminished and the result of a new practice is less on a small than on a large farm. Second, the obligatory diversification that frequently characterizes small farms can limit the time available for the management of each activity on the farm. The utilization of a new technology can diminish even further the time that can be dedicated to each enterprise. Third, the farmer requires time to learn a new technology. While he learns, he makes mistakes and the high production potential that the new practice offers is not realized, even though he has made the high investment required to reach this potential. As a result, net income may actually fall during this "learning period".

Some specific considerations also need to be taken into account in the development of new technology. The researcher must know, intimately, the conditions of the zone where the client population resides, and must be aware of the requirements of the population. The objectives of research are specific to a locale and to a group of producers who have the same farming system and the same problems.

Successful Extension Methods for Introducing New Varieties and Increasing the Use of Seed

Eugenio Martinez

Planning and Management

Seed is a powerful tool for increasing agricultural production. An example is maize in the United States, where production has increased 289 percent during the last 40 years (D. Byerlee, M. Collins **et al.** Planeacion de tecnologias apropiadas para los agricultores: conceptos y procedimientos. CIMMYT, Mexico, 1981).

On the other hand, yields in many developing countries have been static for decades despite the fact that the product is vital in the economy. There are many valid explanations for the low yields, but perhaps the principal ones are the lack of adequate varieties and technologies designed for the conditions where they are to be used, along with inadequate systems for diffusion of information and distribution of seed.

In the case of agricultural seed, there is little coordination between the quantity produced and the target market in developing countries. Neither is the timing of the promotion of the seed coordinated with the product's availability to farmers. It is common for a researcher to show a new variety to farmers at a field day, but when farmers want to purchase seed they are told that seed production is just beginning and will probably require two to three years. This is a critical stage because the plant breeder will deliver a small quantity of seed to the organization charged with reproducing it; in this stage there is danger that the new variety will be lost.

There are several reasons why this is true. For example, the site chosen for the seed increase may be inappropriate, the management may differ from that used by the plant breeder, the variety may be mixed with other varieties, or the new variety may not be as good as the researcher thought.

But suppose that after two to three years, a commercial quantity of seed

is available for sale. Notices are placed in newspapers announcing its availability. But unfortunately the majority of small farmers do not read the newspapers and thus are not informed. Even if they are informed, they probably do nothing about obtaining the new variety for several reasons: (a) Why pay for seed when they can produce their own? (b) Why spend money on a variety they do not know? and (c) Why make a *trip to town*, which would be an additional expense?

It is likely that not much of the seed will be sold; there will be economic losses to the organization that produced the seed; and the researcher who produced the seed is discouraged. It is concluded that the small farmer is resistant to change. But is this correct?

There are four conditions important for the transfer of new varieties or other technologies to small farmers:

1. Just because the new variety is called "improved" is no guarantee that it is better than what the farmer already has, especially under his socioeconomic conditions. The new variety must help the farmer meet his objectives.
2. Even if the new variety is truly advantageous to the farmer, he still will need experience in managing it within his own production system. He needs to visualize how he will manage it and should at least have the opportunity to observe it under conditions similar to his own, perhaps on a neighboring farm. The "farmer-managed test" used by ICTA is an ideal tool for allowing the farmer himself to judge a new variety.
3. Once the farmer is convinced that he wants to use the new technology, he must have access to it. The seed, for example, **must** be available when he wants it.
4. Finally, there must be a just market for the farmer's product, if he wishes to sell even small quantities of improved varieties.

Examples of Successful Transfer

As we have seen, there are four principal elements in the successful promotion of the use of improved seed by the small farmer. There is no exact formula for including these four elements in a system of technology generation and transfer, but each case should be examined to see if it is compatible with local conditions. Following are examples illustrating different conditions:

1. Introduction of a new crop: soybeans in Mexico.

   The soybean was introduced into the Yaqui Valley, Sonora, in 1958. Farms in that region were predominately large commercial

ones, and demonstration plots were established to introduce the crop. These were strategically located on private farms in the valley. The necessary inputs were acquired through credit unions, and the system of handling the crop and the price were fixed by oil extraction companies, which also offered credit to farmers.

Practices used in the demonstration plots were adopted rapidly. The farmers on whose land the demonstration plots were established transferred the technology to other farmers, as there were close relationships among the farmers of the region. The same strategy was used to introduce safflower, which was also successful. If we analyze these two cases we see that these new crops offered advantages to the farmer because they allowed him to use his land more efficiently. But also the farmer could observe the performance of the crop under his own conditions, he could obtain seed when he needed it, he had credit, and there was a satisfactory price for the final product.

2. A drastic change in a common crop: wheat in Sonora, Mexico.

   A frequent comment is that is it difficult to introduce changes for a crop that is already established. Perhaps this is because crop yields are stable and the changes introduced are so small that they are not very important to the farmer. Over many years, wheat yields in Sonora had reached a maximum of 3 t/ha. This was because only a certain amount of nitrogen could be applied to the area's tall wheats without lodging. Then Dr. Norman Borlaug developed dwarf wheats which could take more nitrogen without lodging; these wheats were also more efficient in grain formation.

   The advantages of the dwarf wheat were so great that there was direct diffusion from the experimental plots to the farmers' field. The first farmers having the new wheat had to guard their fields to keep it from being stolen for seed. The advantages of the new wheat could be easily observed by the farmer.

3. Maize in Guatemala's Pacific Coast and Highlands

   When ICTA started to work in the coastal plains, an important area of maize production, farmers were not convinced that fertilizer was profitable even though they were required to use it in order to obtain credit. Fertilizer did not always increase yields enough to make its use profitable; i.e., the farmer was right. ICTA had other technologies such as new varieties to increase production, but the farmers were not readily convinced that these were to their advantage either. But the use of the "farmer-managed test" was effective in introducing new technologies, as well as getting the credit agency to remove the use of fertilizer as a requirement for obtaining credit. Between 1975 and 1980 yields increased by 30 percent. This is a major increase, as compared to the 0.3 t increase in

developing countries over a 20- year period.
During the same period, ICTA was working to increase maize yields in the highlands. Even with the use of farmer-managed tests, yields did not increase appreciably because ICTA had no varieties or other technologies that could demonstrate sufficient advantage over what the farmer already used.

4. Farmers as extensionists.
The farmer-managed test has proven effective, but a disadvantage is that one agronomist cannot supervise very many tests. In Guatemala farmers were trained and paid to work with local groups of farmers in the testing of new technologies. This was very successful. This success indicates that the regular extension service could use farmers' tests as a means of reaching more farmers.

Experience with Small Farmers in the Use of Improved Seed in the Hills of Nepal

P. N. Rana and S. S. Bal

Background

Nepal, a country of 140,800 km^2, is bounded by China on the north and India on the south. The country has three distinct areas: the Terai plains bordering India are 70 to 300 m above sea level, the hills to the north of the Terai are 300 to 3000 m above sea level, and the mountains are over 3000 m above sea level.

The underdeveloped hill area has very little infrastructure. Land available for crops is intensively cultivated terraces, and average farm size is less than 0.5 ha.

Of the total 2.3 million ha of cultivated land, less than one-third is in the hills, but two-thirds of the 14 million people live in the hills.

The monsoon rains are heavy from June through Setpember.

Seed Program

Farmers generally are able to store rice seed because it is stored during the coolest months (November-March). However, wheat needs to be stored over the wet monsoon season; maize is harvested during the rainy season and requires drying.

Organized seed production began in the 1970s. Most of the seed production and storage have been organized in the Terai. But this does not

serve the hill farmer well. Varieties are not always well adapted to the hills, and transportation is a major problem.

Two agencies are involved in the country's seed program: the Department of Agriculture (DOA) and the Agriculture Inputs Corporation (AIC). The DOA is responsible for the development of varieties, basic seed, and quality control, as well as for extension as a means of promoting improved seed. The AIC is the sole agency responsible for production, processing, storage, and distribution of seed. This agency also imports and distributes fertilizer and pesticides. The AIC has 1400 sales outlets but only 300 are in the hills.

Sale of seed has increased steadily but very slowly since 1976; 70 percent of the sales volume is in the Terai.

A new strategy is being applied to overcome the problems of limited and uncertain supply, lack of adapted materials, high transportation costs, and low quality seed for hill farmers. The plan is to develop a seed multiplication system in the hills, with farmers being encouraged to produce seed for local distribution.

- At each hill site a small seed house facility for processing and storing 40 to 50 t of seed is being established.
- Outlets for seed and fertilizer are also being established at strategic points to aid the flow of inputs.
- Hill farmers are being trained in the production of quality seeds.
- The credit program and the extension service support the activities associated with the local production, processing, and storage of seed.

Seed Production and Input Storage Project (SPISP)

Starting in 1980 the AIC launched a five-year project, SPISP. The first step was to characterize the areas and identify problems. It was found that any effective strategy would have to take into account several factors, many of them unique:

- Mules and porters are the chief means of transportation, and carrying heavy equipment or bulky materials is impractical.

— At most locations it is impossible to use electrical equipment, sun drying is the only possible way to dry seed.

— Farmers are not aware of the aspects of seed quality; most farmers save their own seed.

— In food-deficit areas, land for seed production is very limited.

— Credit is scarce; bartering is common.

— It is difficult to get agronomists and extension workers to live in remote areas.

— The present cooperatives are beset with problems and not in a position to play a leadership role in seed development.

— A private, locally managed seed business is not possible due to lack of motivation and to constraints. Farmers are more interested in a no-risk arrangement as contract growers for AIC. They are interested in a farmer-managed seed program for the future if its feasilibity can be demonstrated.

— Insect and rodent damage is a serious problem.

Pilot Sites for Seed Production

Two pilot sites have been chosen for seed production. During 1981-82 production of 30 t of wheat seed was planned for each site.

The farmers are encouraged to form a Seed Growers' Association (SGA). The SGA forms a managing committee and names a leader to act as co-manager; a manager is provided by AIC.

After harvest, seed growers deliver the seed to the small seedhouse. At this time the SGA obtains a collective loan and pays the seed producers for the grain delivered. At the time of planting, seed is sold directly and through small dealers in surrounding areas.

Experience To Date

The new strategy is still in the initial stages. There are both management and technical problems to overcome. The seed house activities are being successfully managed by AIC. The entire approach is flexible and no particular concept is being imposed. As time passes, a farmer-managed

seed system is expected to emerge. The farmers can exercise the option of taking over seed house management from the AIC when they are ready.

Some of the technical problems are:

— Because of the small holdings, the targeted amounts of seed have to be produced on many farms.

— For maize seed production, it is not easy to find adequate isolation to avoid crossing with other varieties.

— Loose smut in wheat is as high as 25 to 30 percent in most hilly areas.

— Rain and hailstorms at the time of wheat maturity are other hazards. Perhaps the only safeguard is to locate seed-producing plots in different valleys.

— There is a problem of drying maize seed. The seedhouses are being equipped with solar dryers which use kerosene as supplementary heat.

Acceptance of Improved Seed by the Small Farmer

Ramiro Ortiz Dardon

ICTA in Guatemala has a mandate to generate technology and promote its use in order to increase production and income of farmers. With the creation of ICTA, research on basic food grain was given high priority. Since production of these food crops is largely in the hand of farmers with small —and medium- sized holdings, they are the principal clients of the institute.

The following is a very brief explanation of the ICTA model for research, in which the farmer is directly involved in different stages and is the principal interpreter in deciding which component(s) of technology or production alternative(s) will be promoted and recommended for small farmer use.

The Technological System and Index of Acceptability

After analyzing a specific area, the process of determining the alternatives is initiated. (Editor's note: ICTA's commodity programs usually have a considerable blacklog of technology, and these programs probably have *had some* experience in the specific area with the crop of their responsibility. Thus in searching for specific technology for a given area or zone, the most promising technology already available can be tested and evaluated objectively for the target area. The commodity programs and the area field research teams work closely together.) Perhaps 80 to 90 percent of the work is conducted in the target area on private farms and 10 percent in experiment stations.

ICTA personnel initially evaluate the technology in on-farm trials. The evaluation is based on both agronomic and economic criteria. If the technology is evaluated as promising in the researcher-managed trials, it is tested in farmer-managed tests. In this phase the farmer evaluates the technology.

At the stage of farmer-managed tests, ICTA gives technological support to the farmer, but the farmer himself furnishes the management, land, labor, and inputs. In this manner the farmer can evaluate the technology in his own terms, especially in relation to his resources and risk.

At the next planting season, ICTA again becomes the evaluator. Its personnel visit farmers who have conducted tests the previous season to determine how many have continued to use the technology and the percentage of their crop involved.

The index of acceptability (IA) is the percentage of farmers who continue to use the technology, (A) multiplied by the percentage of their crop on which the technology is applied, (C) divided by 100.

$$IA = \frac{\%A \times \%C}{100}$$

This index has been helpful in evaluating the acceptability of the technology, but it should be interpreted only in terms of the farmers who conducted the tests. It should not be used as the degree of acceptability to all farmers of the region; neither should the index be used to extrapolate for other areas.

Index of Acceptability for Improved Maize Varieties

The following information gives an idea of how the materials developed by the ICTA Maize Program were evaluated by the farmers of La Maquina, an area on Guatemala's South Coast. The data in Table 1 are based on farmers' tests conducted during 1975-78; in each case the evaluations were made one year later over the period 1976-79.

The use of this index is some what subjective and it is necessary to take into account the conditions of the region in which the evaluation is made. In La Maquina, 50 was considered a good index, while in the highlands of Guatemala, an index of 25 was considered good, because more traditional agriculture is found there. Furthermore, it is important to see if the index has been influenced greatly by the percentage of farmers that adopted the practice or the percentage of the area on which they used the technology.

Table 1. **Index of acceptability of improved maize varieties at La Máquina**[1]

Year	Number of farmers	Percent of farmers adopting	Percent of crop involved	Index
1976	25	72	74	53
1977	25	80	76	61
1978	16	100	71	71
1979	19	95	85	81

[1] Taken from: Disciplina de Socioeconomia Rural, ICTA.

(Editor's note: Today ICTA uses both percentages in graph form. The reason for this is that if 25 percent of the farmers were adopters and they used the technology on 80 percent of their crop, the resulting index of 20 is the same as the one obtained if 80 percent of the farmers had been adopters but used the technology on only 25 percent of their crop. In the first instance, the farmers probably had larger farms and machinery. The second instance is more typical of small farmers using hand labor. However, the evaluation allows analysis of the percentage of adopters versus the percentage of their crop.)

Panel B

Theme

Factors Affecting Decisions by the Small Farmer about the Adoption of New Varieties

Rice

Rafael Posada

Before attempting to analyze the factors that affect decision making by small rice farmers about adopting new varieties, it is important to distinguish between two groups of farmers. One type is the traditional, marginal subsistence farmer who remains almost entirely outside the market economy; that is, he purchases very few inputs and sells very little of the product. The other class of small rice farmer uses more modern practices, purchases inputs, uses credit and technical assistance, and sells part of this production, even though his participation in the market economy is modest. Usually this farmer is obligated to use certified seed in order to obtain credit and/or technical assistance. This presentation will focus on the subsistence farmer.

It is important to understand the situation under which this kind of farmer operates. In the first place, there is no separation or division between the consumer unit and the production unit; a decision in one of these areas will directly affect the other. Secondly, rice is not the only crop on the farm and it must compete with other crops for production resources, such as land, labor, and water. Thirdly, in each region there is an interrelation between climate and soil that determines the performance of rice as a crop. Also it is important to understand that in most areas with small subsistence farms, there is very little infrastructure and there is complete dependence on rainfall for the crop.

Factors that affect decision making by the subsistence farmer can be classified into three areas: socioeconomic factors , agroeconomic factors and agrophysiological factors.

Socioeconomic Factors

The socioeconomic factors are related to the family organization, the community, and the rest of society. Some of these factors are:

— Importance of rice in the diet. The greater importance that rice has as part of the diet, the less risk the farmer is willing to take in growing the crop. The farmer observes that local varieties may be low yielding but quite stable, even under adverse conditions. New varieties not having the most important characteristics (as evaluated by the farmer) of the local or traditional varieties represent risk to the farmer's survival.

— Rice quality. Small communities have very specific preferences, such as in rural areas of Colombia's North Coast. There medium grain rice with different culinary qualities is preferred over the long grain rice demanded in urban centers.

— Method of storage. Usually the small farmer has only one harvest each year and must store his rice for a long period. The local varieties have some characteristics that facilitate storage, such as resistance to shattering and a long panicle which can be tied into small sheaves to be hung from the ceiling. Also they may have resistance to insects and molds, which can cause damage during storage.

— The size of the family and the division of labor among family members determine the availability of labor for producing the rice crop. In some communities labor is the most limiting resource and, therefore, there will be resistance to the adoption of varieties which require more work to control weeds or to harvest. If labor is not a limitation, a new variety requiring more work may be viewed as a means of solving unemployment.

— Those with low cultural and educational levels are less amenable to change because they are closer to tradition and myth.

— Identification of who makes decisions is fundamental in understanding the process of accepting seed of improved varieties. In some communities it is the chief of the tribe; at the family level it may be either the husband or the wife.

— The attitude of the community toward modern society is a decisive factor. For example, there are native tribes that view with suspicion and fear any change introduced from the outside.

Agroeconomic Factors

Every production system must adjust to four key variables: (a) availability of land, (b) climate, (c) length of time from seeding to maturity, and (d) availability of labor. Cropping systems have evolved through the experience of several generations of farmers. Those introducing new varieties of rice into present systems of farming should give special attention to the following:

— The period from seeding to maturity.

— The amount of seed required. Different seeding methods may require more or less seed. The seed may be stored over long periods. Both the variety and the technical recommendations should take these factors into account.

— Traditional varieties tend to be tall and to grow vigorously and rapidly; these characteristics aid in weed control.

— There is preference for traditional varieties, even low-yielding ones, if they have qualities which offset limitations such as floods, drought, or even late transplanting.

— It is a very common belief among small farmers that the new varieties will perform well only with high inputs of fertilizers, which they many not be able to afford and which may not even be available in local markets.

—. Short plants increase the work of harvest. Small panicles make it difficult to form small sheaves that are stored by hanging from the ceiling.

— Any change in cropping and cultivation practices in order to use a new variety is a consideration in the farmer's decision. Therefore, it is better to minimize change and adjust as much as possible to traditional practices.

Agrophysiological Factors

Detecting the agrophysiological factors is basically the work and goal of multidisciplinary research teams. The CIAT Rice Program, in collabora-

tion with national programs in Latin America, is making a strong effort to identify and characterize the agroecological conditions under which rice is cultivated. The two most important variables detected for upland rice thus far are:

— Soil. Low fertility has been the most important. There are soils with problems of salinity, acid soils with aluminum toxicity, and soils with phosphorus deficiency.

— Rainfall. Both quantity and distribution are problems.

The following agroecological environments have been identified:

— Lands subject to flooding where the water accumulates during the rainy season and the rice is transplanted as the waters subside (Babahoyo, Ecuador).

— Highly favorable upland, situated along rivers with relatively fertile soils and adequate amounts of well-distributed rainfall (Varzeas, Brasil; Monte Llanero, Colombia; Pacífico, Costa Rica).

— Moderately favorable upland. The soils are not as fertile and the rainfall distribution results in some periods of drought (Llanos Orientales, Venezuela; North Coast, Colombia).

The incidence of disease and insects differs in each of these environments and it is important to consider these before recommending varieties.

In summary, the small farmer will adopt only those varieties that will reduce the socioeconomic and agroecological limitations when the benefit to his survival is greater than the cost involved.

Maize

J. Barnett

Factors affecting the farmer's decisions depend more on the final use of the crop than on his economic level. There are two principal kinds of farmers: those that produce for sale and those that produce for home consumption.

When the crop is produced for the commercial market, decisions are based on how to increase net income. Both yield and acceptability in the market are important.

The situation of the farmer who produces for home consumption is more complicated. Stability is evaluated as more important than yield. In addition, several other factors become important to the farmer and determine acceptability; these include color, grain size, and taste. It is also important for the variety to be compatible with the cropping system.

Sorghum

Manuel Torregroza

Sorghum, which originated in Africa, arrived to the coasts of the Americas with slaves brought from that continent. In Colombia the crop's history can be divided into three phases. The first started in the 19th Century when the first seeds arrived from Africa. It is very probable that the same material is used today for forage on the North Coast. In the state of Santander, Colombia, a native material from Africa, which is probably a Kafir type, is seeded following tobacco. About 2500 ha are seeded with this system.

The second, and most important, phase of sorghum cultivation started in 1957 when the Purina Company decided to promote sorghum for use in commercial feed concentrates for animals. Between 1962 and 1982, the area seeded to hybrids increased from 3000 ha to over 200,000 ha. Now more than 90 percent of the sorghum grown is mechanized; thus a relatively small percentage is grown by small farmers. Today, an ICA variety accounts for more than half of the area seeded. This is due to good adaptation, stable yields, colored grain (for animal feeds), open or semi-open panicles, medium height, and intermediate length of growing season.

Potatoes

Aníbal Monares

Introduction

When discussing potato production, a distinction should be made between improved varieties, that is, those resulting from programs of genetic improvement, and improved seed, which is certified to be free of disease. These two concepts are not the same. It is possible to produce certified seed of native varieties. It must be understood that many of the improved varieties have never been submitted to the certification process.

For example, between 50 and 80 percent of the potato area in the Andean region is planted with **improved varieties** but only 3 to 10 percent of the areas is planted with **improved seed.**

Despite the fact that, at first glance, it would seem that these two technologies are closely related, factors influencing their adoption seem to be quite different. With reference to the Andean region, we will examine each of these technologies.

Improved Varieties

The use of improved potato varieties varies considerably among ecological zones, types of producers, and lands with or without irrigation.

Generally, the use of improved varieties is greater in lower elevations, on larger farms, and on irrigated lands. Although further study is needed, it has been noted that in those areas where improved varieties have a

significantly greater yield than traditional varieties, and where the farmer sells his production (less percentage of home consumption), farmers tend to favor improved varieties.

These conclusions were confirmed by a study conducted by CIP in the Montaro Valley in the highlands of Peru in 1977. Many of the study's conclusions are applicable to other similar zones in Latin America.

In order to understand farmers' perceptions about the varieties used, they were questioned about such characteristics as yield, culinary quality, price, and resistance to disease, frost, and storage. Their opinions were similar, regardless of farm size or geographic location. In general, the farmers affirmed that improved varieties yield more and were more resistant to frost and disease than traditional varieties, but the latter were judged better in culinary quality, price, and resistance to damage during transportation and storage.

This kind of information has helped explain why farmers in higher areas of the Montaro Valley use improved varieties to a lesser degree than those in lower areas. Farmers of the higher areas, where there is much home consumption, prefer native varieties. Also there is only one harvest per year in the higher areas; therefore, they prefer varieties that can be more easily stored over long periods in order to have potatoes for home consumption almost the entire year. In addition, as the elevation increases, improved varieties lose their advantage of higher yield.

These observations suggest that it would be in order to ask what is an improved variety. No one variety is better than all of the others in all respects. One variety may be better in yield but poorer in quality and price. In the highlands of Peru, native and improved late-maturing varieties with good transportation and storage qualities are prefered. In the lower areas of the same country, earlier-maturing varieties with high yields are preferred.

There are two economics factors that limit greater acceptance of improved varieties by small farmers.

First, the selling price of native varieties may be double that of improved varieties. This frequently compensates for the lesser yield of native varieties should the farmer wish to sell them.

Second, each variety requires a specific cultivation technology, such as seeding, irrigation, hilling, fertilization, etc. The changes in technology associated with the use of improved varieties are costly and can discourage small farmers from applying them. Therefore, the small farmer, who

produces both for home consumption and for sale, prefers to use varieties that are less demanding of seed, fertilizer, and other inputs.

Certified or Improved Seed

In the Andean countries, seed potatoes are produced in the higher elevations, where lower temperatures reduce the population of vector insects that transmit viruses. For this reason, producers of seed potatoes in the highlands find the best market for their product at lower elevations where ecological limitations make it difficult to produce high quality seed. Thus the movement of certified seed potatoes is from the highlands to the lowlands.

In the highlands where small farmers do not use much improved or certified seed, CIP found that the use of certified seed depended on two key factors: the difference in yields between certified seed and ordinary seed, and the respective difference in price. The farmer will use certified seed only when an increase in yield will compensate for additional costs.

Information collected at the farm level indicates that in the highlands, certified seed will give equal or slightly superior yields in comparison with the area's ordinary seed. This difference in yield does not compensate for the additional costs of using certified seed; thus it is not profitable to use certified seed under these conditions. In the lower areas, however, the certified seed from the highlands gives significantly higher yields than the local seed. It is not surprising, therefore, to find that the large demand for certified seed is in the lowlands.

Although the majority of higland farmers do not purchase certified seed, they do obtain new local seed periodically, even though it may be as infrequently as every 8 to 10 years. The frequency of obtaining new seed is related to variety, to elevation, and to ecological zones. The higher the elevation, the less frequently new seed is purchased.

CIP's study on the use of certified seed found no significant relationship between farm size and the use of certified seed. The ecological zone and the availability of irrigation seem to be much more important determining factors. Nevertheless, the evidence indirectly suggests a negative correlation between farm size and the use of certified seed. Since certified seed expresses its potential under conditions of irrigation and high levels of inputs to which the larger farmers have more access, we would expect them to use more certified seed.

Beans

Roberto René Velásquez

The small farmer's decision to select his bean seed depends on factors determined by cultural and agrosocioeconomic reasons. Production objectives play an important role. When producing for the consumer, such farmers are more likely to plant materials having the right qualities than when producing for their own consumption.

Seed selection will also depend on which cropping systems they use: association, relay, or intercropping.

When the production is geared to the consumer market, the color, sheen, uniformity, size, and cooking quality of the grain play a determining role. Also the consumption preference for stringbeans, tender beans, or dry beans will be important in deciding which bean variety to plant.

Also important are maturity, foliar aggressiveness, and resistance to diseases and drought, among other agronomic characters.

Workshop B

Theme
Action that should be taken in generating and transferring technology in order to increase the use of improved seed by the small farmer

Guidelines

A. Identify the causes of the limited use of improved varieties by the small farmer.

B. What aspects of research and extension should be developed to promote the use of seed of improved varieties by the small farmer?

C. Define some specific actions that should be taken in the generation and transfer of technology to further the use of seed of improved varieties by the small farmer.

D. Explain the relationships among and responsibilities of programs of seed, research, and extension in the use of seed of improved varieties.

Workshop groups were organized by geographic regions. One group was different in that it discussed the advantages and disadvantages of a proposal being developed by ICA and CIAT to organize a special project in Colombia for promoting the use of improved seed by the small farmer.

Central America and the Caribbean

Antonio Pinchinat, Coordinator

The principal causes for the limited use of improved seed are:

1. Lack of improved varieties adapted to the climatic, technological, and socioeconomic conditions of the small farmer.

2. Insufficient coverage, both demographically and geographically, by agricultural extension services.

3. Deficiencies in the mechanisms and channels for seed distribution.

4. The farmer's distrust that introduced seed will be better than traditional seed.

5. Lack of credit policies that stimulate the small farmer to use improved seed.

The principal aspects of research and extension that should be taken into consideration in order to increase the use of improved seed by the small farmer are: (a) cooperation between the two programs, and (b) description and classification of the agroecological and socioeconomic conditions of the small farmer.

Among the specific actions that should be developed in the generation and transfer of technology to stimulate the use of improved seed by the small farmer, the following are important:

1. Opportunely analyze the production system of the small farmer and include at least the following considerations:

    a. The agroecological and technological characteristics of the farmer's production system.

    b. The primary and secondary uses of crops.

    c. The farmer's socioeconomic conditions.

    d. The situation of agricultural markets and commercialization.

2. Give priorities to the farmer's problems as perceived by him.

3. Conduct trials on the farmer's farm.

4. Evaluate and select improved varieties with the participation of the farmer, the extensionist, and the researcher.

5. Select the type of farmer, taking into account the following characteristics:

    a. Moral character.

    b. Recognition as a leader by other farmers of the community.

    c. Representative of the production systems, agroecological area, and socioeconomic conditions of other farmers of the region.

6. Give technical assistance to the small farmer in the production of seed to meet his own needs.

7. Make maximum use of mass communication to promote the use of improved seed by the small farmer.

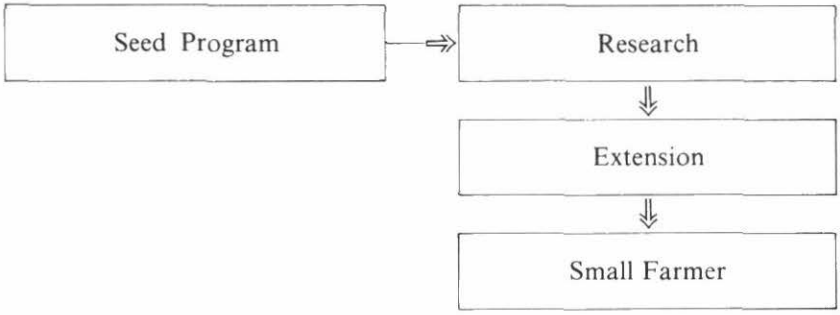
The relationships among the seed, research, and extension programs and the small farmer are summarized in Figure 1.

Within this conceptual scheme, the following are the responsibilities of the seed, rearch, and extension programs:

1. Seed program:

    a. Orients the national seed policy.

Figure 1. **Relationships of seed, research, and extension programs and the small farmer.**



b. Promotes, stimulates, and assures the availability of seed to the small farmer.

c. Maintains good seed quality.

d. Works to establish just and reasonable prices for seed.

e. Shares the risk of credit in order to stimulate use of improved seed by the small farmer.

2. *Research program:*

a. In cooperation with extension, works to involve the small farmer in the evaluation and selection of improved seed.

b. Selects varieties that conform to the agroecological and socioeconomic conditions of the small farmer and that have adequate production stability.

c. Develops and promotes agronomic practices that help the farmer take advantage of the genetic potential of the varieties selected.

3. Extension program:

a. Collaborates with research in identifying the agroecological and socieconomic characteristics of the small farmer.

b. Cooperates with research and small farmers in the selection, identification, and evaluation of improved seed.

c. Disseminates information and aids the farmer in the use of improved seed.

Brazil, the Southern Cone of South America, and Mexico

C. C. de Queiroz, Coordinator

The principal causes for the limited use of improved seed by small farmers are:

1. Lack of technical assistance.
2. Lack of communication with the small farmer.
3. Increase in production costs due to the cost of seed.
4. Lack of understanding by the researcher of the conditions in which the small farmer works.
5. Unavailability of seed.
6. Incompatibility of improved seed with production systems.
7. Lack of credit.
8. Problems of land tenure and lack of land.

Some aspects of research and extension to be considered in order to increase the use of improved seed by the small farmer include:

1. Research should be carried out directly with small farmers.
2. Programs of study in agricultural schools should be revised to

include seed courses.

3. Integration between research, extension, and farmers must be stimulated.

4. Research should give more emphasis to the formation of varieties that require fewer inputs.

5. Native varieties should be given priority in research.

6. Research and extension programs need to define a strategy to serve the small farmer as well as the larger ones; institutions should conduct self-evaluations to see if they are capable of meeting the needs of the small farmer.

7. Seed programs should participate jointly with research and extension in development projects.

8. Universities should include psychology courses in order to train agronomists to improve their work with small farmers.

9. Research projects should meet the needs of the farmer.

Some specific actions that might be taken are:

1. Study the possibility of a subsidy for seed and other inputs as a means of stimulating production.

2. Define goverment development plans and include those actions known to accelerate adoption of technology, such as agricultural insurance, demonstration units, production short courses, etc.

In establishing relationships between seed programs and programs of research and extension:

1. Plant breeders should describe more completely the varieties that they produce in order to guarantee varietal purity.

2. Researchers should not stop with the development of a new variety, but should work with extension and test the new material under conditions of the small farmer.

Andean Countries

Federico Scheuch, Coordinator

Causes of the limited use of sed of improved varieties by the small farmer include the following:

1. Many of the "improved varieties" are not adapted to the environmental conditions of the small farmer.

2. Generally, the "improved varieties" require high levels of technology (inputs) for good performance, while the small farmer requires varieties that are less demanding.

3. The small farmer has had little participation in the selection of improved varieties to meet his conditions.

4. The farmer fears the risk involved in using new varieties.

5. Because farmers have had some negative experiences due to lack of adequate information about the use of new varieties, they are very cautious about adopting new varieties.

6. Improved varieties lack sufficient advantages in comparison with traditional varieties.

7. The small farmer usually does not consider the real cost of seed of his traditional variety and does not understand that improved seed usually costs but little more.

8. Seed of improved varieties is not available to the small farmer at the opportune time.

9. Demand for improved seed is incorrectly estimated and therefore it is not available.

10. The farmer lacks credit.

11. The package of seed offered to the farmer is larger than needed.

12. There is little coordination between research and extension in promoting seeds.

13. The middleman may take advantage of the small farmer when he tries to sell the product from the new seed.

14. Prices for the final product are not attractive and do not stimulate the farmer to attempt to improve his production by using improvd seed.

Considerations for research and extension programs in promoting the use of improved seed by the small farmer:

1. Problems of the small farmer should be identified and characterized so that activities of research and extension can be correctly oriented.

2. A close linkage should exist between research and extension programs.

3. The small farmer should participate in research decisions.

4. Adequate training is needed for farmers, as well as research and extension workers.

Some specific recommendations for action by research and extension in promoting the use of improved seed by the small farmer:

1. The problems of the small farmer should be diagnosed with the participation of the farmer, the researcher, and the extension agent.

2. New technologies should be evaluated and validated through the use of regional trials, demonstration plots, field days, and conferences.

3. The extension agent should test only the most promising lines and varieties at the farm level.

4. The seed of new improved varieties should be immediately available to the farmer once it is recommended.

5. Demonstration plots in farmers' fields should be used to promote the new variety and to produce seed within the community.

6. The demand for different kinds of seed in each region should be studied carefully.

7. The movement of seed from one region to another should be facilitated and the farmer must be informed about prices and availability.

The Proposal for a Special Project on Seed for the Small Colombian Farmer

Jaime Navas A., Coordinator

The project was discussed in general terms and the workshop group agreed that at a later time an exhaustive analysis would be made of each of the project's strategies and phases.

Among the diverse topics discussed, the one that was most debated was alternatives for assigning responsibilities for conducting the project.

Conclusions

1. Some government agency should be responsible for the production and distribution of improved seed to be used by the small farmer.

2. Based on the data presented, a strong effort is justified to meet the demands of the market with high quality seed.

3. Representatives of private and government agencies interested in seed shoud analyze the feasibility of the proposal and make appropriate modifications.

4. Since the proposal is a new strategy for rural development, it will be discussed with the national planning office to seek possible financing, in case Cresemillas of the agricultural credit bank is not interested in meeting the demand of the market.

5. In general, the proposal was considered attractive for continued study and possible execution.

Production and Marketing of Seed for the Small Farmer

Seed as a Cottage Industry

Federico Poey

The availability of improved seed for small farmers is generally inadequate. On the one hand, seed businesses frequently do not sell seed to small farmers because they think that the distribution costs make it unprofitable, or that prices are too high in relation to the farmers' resources. Part of the problem is that the criteria of the small farmer differ from those of the large farmer, whose concepts are more advanced and more businesslike. He is the one for whom the seed companies produce seed.

On the other hand, in the majority of developing countries, one can identify adequate reasons to attempt other alternatives, such as a cottage industry. (*Note: "Cottage industry" has been translated from the Spanish* words, "industria artesanal.")

A rural enterprise managed by small farmers might well have artisanal qualities as well as characteristics of a small industry. Cottage industries are found among small farmers who, using family labor, produce a product which they sell. Therefore, we have used the term "cottage industry" to signify the kind of organization which might be established in a rural community and managed by local farmers.

Certain elements would be necessary to establish cottage seed industries, which would require an integrated and coordinated effort on the part of farmers and the organization promoting the business.

Any rural community in a developing country has progressive farmers

who would produce seed. These would be farmers who understand that a strong effort is necessary in order for farmers and the community to receive benefits. Improved varieties that are truly superior and acceptable to farmers would be needed. The business would have to be economically sound and profitable to the farmer-entrepreneur.

Outside help would be needed for farmers to establish this kind of rural enterprise; the help would consist of technical and financial aid as well as help in obtaining some of the required equipment.

Technical aid would be necessary in order to ensure purity and quality. It would be necessary to obtain or have access to drying, treating, and packaging equipment. This equipment could be either portable or installed in the community.

One of the important aspects of financing would be to bridge the period between harvest and selling, which might last up to six months.

Another aspect would be seed quality control, which might be different than that usually applied to commercial seed, but would have to be judged adequate by the farmer.

Two strategies might be used. One could be an individual farmer who establishes a local private seed business in the community that would sell to neighbors and through outlets that the selects. The other strategy could be to organize an association which would own the business. This would require more coordination.

We know some of the problems of organizing small farmers into businesses such as cooperatives. In general their establishment has been difficult. Because they have had some experience with it, seed might be a special product of sufficient interest to farmers, which would contribute to the success of the enterprise. One important aspect would be to meet the requirements of variety, quality, and delivery, as viewed by the farmer and at costs that he deems reasonable. One danger would be to invest too much money, thus increasing costs and lowering profits for services or quality for which the farmer has little appreciation.

This idea is presented in the hope of stimulating discussion about specific action that might be taken.

Cooperatives as Producers and Distributors of Improved Seed

Juergen Lewerenz

Communication between the small farmer and those organizations that furnish both financial and technical help is of utmost importance. Cooperatives are a mechanism which can further such communication. Governments in developed countries do not intervene in the development and management of cooperatives. There is a sufficient degree of organization among the associations of producers that they themselves do their own planning. One of the principal problems in developing countries is that the capability of rural organizations has not been developed. Some of the assistance programs directed toward farmer organizations in developing countries have been detrimental rather than favorable.

Efforts to develop rural organizations should be directed to legitimate organizations of the people themselves. Some of these have been promoted by persons and organizations which have had continuous and permanent contact with rural areas, such as church groups, regional organizations, and autonomous organizations representing specific groups.

Efforts that have not been effective in promoting sound rural organizations are state-supported cooperatives, irrigation programs, cooperatives that have been founded by international agencies with their own special objectives, and cooperatives organized with strictly philanthropic objectives (giveaway programs).

A good example of an effective cooperative is the Caja Popular Cooperativa in Tunja, Boyaca, Colombia. It is 33 years old and has 60,000 members. As an accepted, economically sound cooperative, it is in a

position to serve as a development organization. This organization is recommended for cooperation with CIAT in the promotin of seed for small farmers.

In developing seed programs with cooperatives, the following phases are recommended:

1. Study how farmers in the target region presently manage their seed.

2. Determine the feasibility of promoting seed.

3. Have an experimental phase to evaluate varieties and gain experience with production and distribution.

4. Make an agreement with the cooperative organization.

Sources of Seed

One arrangement with cooperatives would be to furnish them seed to distribute. Good quality seed and technical assistance would be important in order for the cooperative to develop effective distribution.

Cooperatives might also produce their own seed through their members. This would need supervision and technical assistance.

A third way to obtain seed might be for the cooperative to aggressively seek seed through regular marketing channels of the national seed market.

Cost, Credit, Subsidies, and Exchange of Seed

Carlos César de Queiroz

Experience with technical assistance and extension programs has shown us that it is not always easy to transfer to small farmers the technologies developed in the experiment station. The small farmer frequently does not have ready access to government incentive programs which would stimulate him to adopt new technologies. Credit programs are interested in large operations. Collateral for loans, the problems of communication, and a low level of education, are all factors that tend to separate the farmer from credit and technology.

At the same time, the small farmer is very important, especially in the production of food grains. For example, small farmers contribute 70 percent of the basic products consumed in Brazil.

Seed is an important technology for the small farmer but he tends to be separated from it. Costs are one factor. In the production of seed by or for the small farmer, costs can be reduced by adapting different but appropriate technologies for the production, handling, and storage of different crops, as well as by avoiding transportation over long distances. Farmers frequently use low-cost systems of cultivation, harvest, and storage which are unknown to the researcher. For example, the farmer uses simple drying techniques such as a platform or a simple solar dryer. Storage is probably in relatively small containers. However, the researcher frequently does not know about these practices and insists upon more sophisticated and costly methods.

Credit, subsidies, and exchange of grain for seed of improved varieties

have merit as methodologies to increase the use of purchased seed by the small farmer. The exchange of seed is an interesting strategy, and less common than credit or subsidies. In one case, the extension agent furnishes a group leader a small amount of seed which is increased in a demonstration plot. The farmer, on whose land the demonstration is located, exchanges the new seed for an equal amount of grain from his neighbors. Another method is to furnish a farmer a small amount of seed which he sows in a seed plot; the farmer then returns to the extension agent one and one-half times the amount of seed that he received. In other words, the farmer pays for the seed that he receives with a portion of what he produces. The extension agent then is able to have a seed supply to repeat the exchange with other farmers.

Production of Maize and Bean Seed as a Cottage Industry for Small Farmers in two Areas of Colombia: A Preliminary Feasibility Study

Roberto René Velásquez

This study for the development of a special project to promote the use of seed of improved varieties in two areas of Colombia was conducted jointly by ICA and CIAT. The proposal is to establish a community-level seed enterprise for the production, handling, storage, and marketing of bean and maize seed, either by local individuals or groups.

The two areas studied were the district of Garcia Rovira in the state of Santander and central area of Antioquia state.

Each area was characterized for its agricultural, cultural, and economic conditions, by collecting information through:

1. Review of documented information such as censuses and data collected previously, mainly by ICA,
2. Visits with farmers and observation of farming systems,
3. Studies of markets, and
4. Observation of infrastructure

This agrosocioeconomic characterization provided an interesting insight into conditions of the two areas as related to seed and the possibilities of the proposed project.

The two areas have several similarities and differences, but both maize and beans are important in the diet of the people, as well as being important economically. The practices of the farmers in obtaining seed were found to differ markedly. In Antioquia, for example, 78.8 percent of the farmers purchased maize seed and 39 percent bought bean seed. In Garcia Rovira, however, only 10 percent purchased maized seed and 51 percent purchased bean seed. Major differences were found also in the market prices of different bean varieties. (Note: The characterization and analysis of these areas might well serve as an example for characterizing other areas).

In the district of Garcia Rovira, 96 of the 106 farmers interviewed were interested in the seed project if they were given adequate technical orientation and other help. Of the 100 farmers interviewed in Antioquia, 82 responded affirmatively.

Strategies for Implementation

Strategies recommended for the production and commercialization of bean and maize seed by small farmers in the areas are:

1. Financing production.

   It is suggested that the farmers be selected from those who are already receiving credit from the agricultural credit bank or other source in which there is supervision. They very likely could be allowed up to 30 percent more credit to offset the additional costs of producing seed.

   The credit situation for seed producers should be studied in order to determine if they could be given longer term credit. It is customary for them to sell grain immediately following harvest and then five months later return to the middlemen to purchase the same grain for seed at double or triple the price. In part this is due to the requirement of repaying loans immediately after harvest. Longer term loans would encourage small farmers to participate in the complete seed cycle from production through marketing.

2. Basic seed.

   It will be necessary for plant breeders of the experiment stations to furnish basic seed to seed producers for each year's crop, at least during the initial years of the project.

3. Certification.

The norms generally applied for the certification of seed may be too strict. It will be important to apply standards that fit the needs of the farmers. Through supervision, however, the certifying agency will play a very important part in seeing that important requirements are met. With this supervision, farmers will be trained to produce high quality seed of genetic purity and good germination.

4. Technical assistance.

   Farmers will have to be trained in efficient production and equipment operation. Therefore, institutions already working in those areas will have to conduct short courses, visit the producer frequently, and furnish complete and dependable technological assistance.

5. Seed handling.

   The farmers will not know how to handle seed, nor will they have the equipment for cleaning, treating, storing, bagging, etc. It will not be necessary in either area to classify the seed by size or shape because the farmers plant by hand. Seed handling equipment might be installed in each region, or portable equipment or equipment already installed by government agencies could be used. This will be especially important during the initial stages of the project.

6. Guaranteed sales.

   It will be important to stimulate the seed business, especially the producers. It is suggested that some agency guarantee to purchase a portion of the producers' seed. The farmer would attempt to sell his seed, but would be assured of a sale for part of it, which would reduce his risk. However, the price of the guaranteed purchase might be slightly lower than seed prices, which would encourage the farmer to seek his own outlet, either through the group seed business or individually.

7. Storage.

   Government agencies in each zone have facilities to store the amounts of seed needed for the first few years of the project. These facilities might be used and the storage charged as a production cost. This would help guarantee quality seed until the farmers could establish their own storage facilities.

8. Follow up and evaluation.

The amounts of seed produced during the first years would be relatively small. It would be important to evaluate the progress and give follow-up help where needed. The objective would be to establish over a period of a few years either individual or group enterprises that would be economically independent and not need government aid. However, the government would play a critical role in furnishing the basic seed. Therefore, acceptability of the varieties, as well as other aspects of the process, should be carefully studied. Another important role of the government would be to carefully study the demand for seed and the costs involved in processing, in order to meet the economic requirements of establishing the enterprise.

Increasing Seed Sales Especially to Small Farmers

W. H. Verburgt

I will relate some of my experiences in Kenya, Africa, and explain how we went about the job of selling seed to small farmers.

Distribution

Distribution seems to be the bottleneck of most seed organizations, no matter how they are organized or owned. Distribution is particularly important to top management in order to reach small farmers within a very large area. This requires attention; it is no easy task. But it is possible if you work hard and do not try to do it over a short span of time. In Kenya it took us at least 10 years, and I will admit that this was longer than we expected when we began.

Many problems have to be overcome. Storage points have to be organized. Physical movement of seed needs a lot of attention, particularly in an area where there are few roads. Furthermore, it is difficult to make sure that adequate quantities of seed are available at the right time and in the right place. We always aimed to have seed available within walking distance for farmers.

Payment and Prices

On the one hand, the price of seed should enable the farmer to benefit substantially from his investment. On the other hand, the seed grower and the seed organization should get a fair return on their money as well. It is up to top management to price seed so that it is a worthwhile investment

for all concerned. This is not easy to achieve because, as you know, (a) seed growers always want more for their seed, (b) the seed company needs quite a substantital market to pay for overhead and operating costs, and (c) the costs of distribution under difficult conditions are quite high. Moreover, the actual distributor should get a return for his efforts, and we found that it is not good to cut his margin while everybody else gets a fair return. In fact, it is very important to make sure that the final distributor gets a high share of the market since it is he as the storekeeper who has to sell the seed to the farmer.

Therefore, we always try to give the final link in the retail chain a very fair opportunity in order to encourage him to purchase seed before the rainy reason starts and to stock sufficient quantities of seed in the store at the right time. One cannot be certain that the system, once it begins to function well, will always continue to work well in the future. One has to keep it working; the retail effort has to be kept alive all of the time.

As far as payment is concerned, we always work on a cash basis in Kenya. It is the only system that we could make work on a large scale. Farmers may need credit, but to administer credit for thousands of small farmers is a major exercise. It not only is difficult to administer but is very expensive.

Subsidies might be used to lower the cost of the seed to the farmer and to assure a good price to the producer. But the question is what happens when the subsidy stops. For example, a unit of seed might cost $10. The seed organization is subsidized $5 and then sells to the farmer for $5. When the subsidy is terminated, which almost always happens, the farmer is accustomed to paying $5, but the seed organization must sell for $10. When this occurs, the volume of seed sold will decrease. The seed organization probably has based its estimate of seed needed on the sales under the subsidy arrangement and will probably have unsold stocks on hand at the end of the season.

Hybrid Seed

We have heard arguments for and against hybrids. Hybrid seed is more expensive. It has been said that hybrids make small farmers dependent on a seed organization because they need to purchase seed each year. There are different ways to think about hybrids. It is my opinion that once hybrids increased maize yield by 30 percent in Kenya, it was obvious that small farmers ought to benefit from the heterosis as much as large farmers. From this viewpoint, therefore, there is no reason to distribute hybrid seed to farmers with large and medium holdings and then provide seed of open-pollinated varieties to small farmers.

Plant Breeding

The marketing of seed should start with the plant breeder. Too often plant breeders try to improve crop yields without looking first at the market. This is not a very efficient or commercial attitude to take. The breeder first should find out what the farmer needs, the conditions under which the crop is grown, and all the other factors influencing adoption.

In Kenya, we were fortunate to have plant breeders who were fully aware of requirements of both large and small farmers. The breeders produced material, hybrids in this case, that could be sold on a large basis to small farmers.

The extension service should be very much involved if such a service is available. Again in Kenya, we were fortunate in being able to motivate the extension service to the extent that everybody was pulling in the same direction.

Also the policy maker in the highest levels of government should be convinced that improved crop production is worth attacking on a national scale. The executives of the seed organization should be in touch with the policy maker continuously so that they know what government officials are thinking.

Marketing

Although it may appear that marketing is beyond the scope of the seed company or seed organization, farmers should be able to sell any surplus grain at a fair price. The small farmer who has done everything that he has been told to do becomes very discouraged when he has a good yield but is unable to sell his product at a fair price.

It is difficult for a seed organization to control marketing of the product, but one should be aware of this and try to assist whenever possible so that a smooth marketing of products is assured.

Perhaps the situation in Kenya was unique. On the other hand, there must be some similar opportunities in other countries. Perhaps the right key has not been found to reach the small-scale farmer in the proper way.

The Seed Business in the Transfer of Technology to Farmers: The Guatemala Experience

Roberto René Velásquez

The use of improved seed has been shown to be one of the most effective means of improving agricultural production. In Guatemala, it is estimated that in 1979 the use of improved varieties of maize seed contributed (U.S.) $7.3 million to national production. This amount is double the total budget of ICTA. Since 1979 the use of improved seed, especially of maize, has continued to increase. ICTA adopted the policy that private industry should play a major role in producing, processing, and distributing adequate quantities of seed, and took steps to encourage its participation. The available information indicates that they have been successful, especially in the case of maize.

In 1979, ICTA sold 209 t of seed. By 1981, the amount had risen to 3100 t, of which 90 percent was handled by private industry.

In order to encourage private industry, ICTA produces basic seed of most crops and offers its drying and processing facilities as a paid service to the incipient seed industry.

ICTA also produces, processes, and distributes realtively small quantities of seed in an effort to establish a quality standard and a guideline for contracting and selling prices. A summary of the strategy follows.

1. ICTA contracted seed production with carefully selected farmers at a favorable price to the producer.

2. These contract producers were taught how to produce good seed.

3. The private contract producer was then encouraged to sell his own seed rather than sell back to ICTA.

4. ICTA furnished basic seed, and would even dry, process, and bag seed for the qualified producer who wished to sell his own seed.

5. In order to further encourage the private producer to sell his own seed, ICTA lowered the previously rather high price paid to contract producers and increased retail prices in order to increase the margin between the production price and retail price of the final product. This encouraged the contract producer to sell his own seed.

Other strategies, some of which have been applied by ICTA, might be:

1. Sponsor a production contest on the use of proven technology including the use of the new variety (or varieties).

2. Coordinate credit with seed production. For example, obtain credit for the seed producer, so that the loan does not have to be repaid at harvest but when the seed is sold. This can be important because the common production loan does not anticipate the need to store seed for a few months.

3. In the case of ICTA, some seed was distributed through credit agencies that could deliver the seed immediately once the credit was approved.

4. When the seed is produced in the humid topics, storage is a problem. The government might store the seed at a fair price in order to assure good storage conditions.

5. Supervise seed producers in order to help them meet the requirements of seed regulations and to train them to produce good seed.

6. Coordinate the promotion of the use of improved seeds, both directly and through extension agencies, for all improved seed, both government and private.

7. Organize demonstration and field days on the seed production fields as a means to motivate local interest.

8. Form organized groups to handle production and marketing of seed in the community.

9. Structure the seed business so that it will function economically without subsidies. Do not accustom farmers to low seed prices through subsidies, because the subsidies will probably not be a long-term arrangement. For example, the seed processing by ICTA for farmers who sold their own seed was charged on a cost basis. This service did not subsidize seed producers but did allow farmers to learn the seed business without large investments.

10. A "cottage industry" model that can be promoted to small farmers in a community is discussed in detail in another presentation.

Clusa's Involvement in the Oilseed Growers Cooperative Project in India

CLUSA began a cooperative project in India in 1979 to help develop OGCP, a massive system of cooperatives of vegetable oil producers. The project was made possible through a grant from the United States Agency for International Development of $110 million worth of soybean oil. This is the largest oilseed project ever undertaken by a U.S. organization and the grant is the largest commitment under the U.S. Food for Peace Program (PL 480). At the conclusion of the project, 350,000 Indian oilseed producers will be organized in 8000 village-level cooperatives.

The project is being implemented by the NDDB, which was capitalized by selling foreign-donated food on the Indian market.

Importance of Vegetable Oil

Vegetable oil is second only to food grains in providing calories in the Indian diet. Vegetable oil production has increased in recent years, but not nearly as rapidly as demand. The deficit has risen to more than 1 million t a year. Even though average per capita income is less than (U.S.) $100 per year, the price of vegetable oil is roughly four times the price of oil in North America.

Changes in Control of Market

Peanuts and other oilseeds (soybean, rapeseed, mustard, palm, and coconut) are produced in India by small farmers, whose land holdings average less than 2 ha. These small farmers fall prey to those who buy peanuts and process and sell the oil.

Although their businesses are not large, these middlemen, each working in his own rural area, exert considerable influence over market supply and demand, and therefore, prices. At harvest time they buy at low prices. The farmer has no storage facilities and needs the cash to pay off loans made by the same middleman ("trader").

The trader stores the peanuts and then processes the oil with crude, inefficient equipment. He sells oil when market demand has made prices high.

The unfortunate system of the local trader/middleman is being changed by putting ownership and control of purchasing, processing, and marketing directly in the hands of the oil seed producers. Many cooperatives established by governments in the Third World continue as part of the government extension system; they do not meet the needs of farmers but of a bureaucratic government.

In this cooperative project, the NDDB does not directly help the individual farmer. Rather, the oilseed farmers are assisted in organizing themselves into cooperatives, which are designed and managed to meet their own needs. While cooperative organizational teams live in the villages and work with the oilseed farmers, the necessary economic infrastructure (processing facilities, transportation facilities, marketing outlets, etc.) are being designed and developed by NDDB. As the local cooperatives grow in size and strength, local facilities are handed over to the newly organized local cooperatives for direct ownership and control.

These village-level cooperatives will, in turn, own and control state facilities and eventually national facilities for meeting needs of members. This bottom-up/top-down simultaneous approach to creating large cooperatives has been proven successful by CLUSA and others in various parts of the world. Farmer involvement is a key part of the system.

The implementation and management of the project are 100 percent Indian. CLUSA is assisting in various technical matters and monitoring activities. However, CLUSA is not doing the project; it is conducted by NDDB and the newly formed cooperatives.

Cooperative League Assistance

CLUSA backstops the project in several ways. The expertise of the U.S. oilseed cooperative is being tapped. In addition to securing the AID grant for the project, and assuming full responsibility for handling the proceeds of the sale of the donated oil, CLUSA worked closely with the NDDB in developing the project plan. Although CLUSA has provided technical

assistance to many aspects of the project, the main emphasis has been on marketing. The development of high quality seed stocks and improved methods of storing and handling seed have also received attention.

This is the first time that U.S. food donation has been used in this manner. Rather than distributing food to poor people, the food is sold directly on the Indian market in order to obtain funds to develop the cooperatives.

Oilseed Growers Cooperative

Officially begun in mid-1979, the project had 34 village-level societies with a total of 300 members by October 1980. By July 1982, some 900 local cooperatives were functioning in over 2000 villages and benefiting more than 70,500 farmers.

Four processing plants are in operation, with seven more in various stages of planning and implementation. About 4200 farmer-leaders have received formal cooperative training. They are assisted by 32 mobile teams, which include nearly 400 agronomists, extension workers, and cooperative organizers. Nearly 1500 t of improved seed have been provided through the cooperatives, along with insecticides, pesticides, and fertilizers. Project operations are underway in seven oilseed growing regions in four states of India.

The strong hold that traditional vegetable oil traders had over the small producers was very lucrative and many efforts have been made to dissuade the leadership of NDDB and the new cooperatives. NDDB officials have been harassed and beaten. Four project field workers have been killed in the past two years. Cooperative oil mills have been shut down by impromptu strikes. Arsonists set fire to the cooperative oil mill in Bhavnagar, Gujarat, in December 1981. This may have been a blessing is disguise. The farmers felt that it was their mill and many rushed to help put out the fire. The incident demonstrated to the vested interests and to the rural communities that the oilseed cooperative was truly a movement of the people. In addition, NDDB staff, located six hours away, also helped put out the fire; this demonstrated to the local people that the NDDB is committed to the new oil cooperatives.

All oilseed prices have increased substantially in the project areas. In Madhya Pradesh, soybean prices to the producer have increased 67 percent. Peanut prices have increased 250 percent in Western Gujarat.

In addition to providing financial resources to the project, the donated oils are being used to establish marketing systems created through the

project, which later can be used for marketing oil produced by the cooperative.

The government of Canada, through the Cooperative Union of Canada (CUC), has donated $3 million worth of rapeseed oil to the OGUP. CUC expects to donate an additional $10 million worth of rapessed oil each year for four years.

Although U.S. food has not previously been used in this way, the interest generated by this project has encouraged the U.S. government to consider similar projects in other developing countries.

Panel C

Theme
Experiences in Marketing Seed to Small Farmers in Different Geographic Areas

Guatemala

Roberto René Velásquez

Experience has been gained in Guatemala in marketing seed of maize, beans, sesame, rice, and sorghum to small farmers. The first three are planted mainly by small farmers; rice and sorghum are not as important to small farmers.

The infraestructure for marketing the seed includes entrepreneurs (or small seed producers) and wholesale and retail distributors. Retail distribution is done through a chain of agricultural service stores or stores selling agricultural products in the agricultural production area.

The price policy applied in these marketing systems is based on economic incentives to all sectors involved.

Traditionally, these seed were sold in bags of 25 kg or more. However, these amounts were frequently impractical for small farmers. Bags of 5, 12, and 25 kg have been successfully marketed although they cost more to bag, process, and certify and create storage and handling problems.

El Salvador

Napoleón A. Puentes M.

Background

Hybrid maize seed was introduced in El Salvador on an experimental basis in 1950, to evaluate its adaptability. Promotion of hybrid maize seed was initiated by the government in 1955.

A year later, a governmental decree established the norms for the control and certification of hybrid maize seed. This same year the Ministry of Agriculture offered the first certified seed to farmers. This stimulated private industry to produce seed in 1957.

Rules and regulations were established by governmental decree in 1971 for the certification of seed and plant material, thus extending the regulation to other crops.

Now improved seed is used in approximately 66 percent of the cropping area, resulting in adequate grain production for a good level of consumption.

Seed marketing has developed mainly for the basic food grains (maize, rice, sorghum, and beans) because they:

1. Contribute to the basic diet of the population;

2. Aid in the development of the animal industry;

3. Are an input for the country's agricultural industry; and

4. Increase the demand for labor.

For these reasons it has been the policy of the government to give priority to research and seed production for these crops. Among these basic food grains, maize is of first importance; its per capita consumption is the highest and it occupies a large percentage of the cultivated land.

In general, basic food grains are produced by farmers with small and medium holdings. For this reason, both the government and private industry have sought mechanisms and channels to make seed available to farmers on time and at fair prices.

Availability of Seed

The seed available for any year's planting consists of that carried over from a prior year plus the national production.

Maize. In 1975-76, the available maize seed totaled approximately 70,000 hundredweigh (cwt), of which private industry accounted for 86 percent. The estimated amounts for 1982-83 total 92,000 cwt; private industry is expected to account for 99 percent of the total. Increases in government production of maize seed paralleled those of private production until 1978-79. Since that time, government participation has decreased but seed produced by farmer cooperatives has been included in the amounts attributed to private industry. The total amount of seed has increased about 28 percent since 1975-76.

Rice. Production of rice seed has not been increasing appreciably. The government was responsible for certified seed production until 1978-79, when private industry produced seed. Most of the private seed production has not been certified. Total amounts of seed available for the year 1982-83 have been estimated at 4356 cwt, of which private industry is expected to account for 60 percent.

Sorghum. Only the government has produced certified sorghum seed, both varieties and hybrids, and only during the last four years. Production for 1982-83 is estimated at 2400 cwt.

Demand

Small farmers usually purchase from 12.5 to 500 pounds, with 25 pounds being the most common amount.

Sales have been for both local seeding and exportation. Only hybrid maize seed has been exported. Sales have decreased from 1977-78, and in 1979-80 only about 7 percent of the hybrid production was exported.

Distribution Channels

Certified seed has been distributed by the Ministry of Agriculture, the Agricultural Development Bank, and private industry; the latter accounted for 75 to 80 percent of the total.

Distribution has been through agencies of the development bank as well as private retailers. There are approximately 290 retailers throughout the country. Retailers repack the seed in smaller bags in order to sell amounts ranging from 12.5 to 25 pounds to small farmers.

Mexico

Robert Manilla Chavez
Joel Arteaga Fernandez

The following report is based principally on the experiences of PRONASE, the principal producer of maize, rice, bean, and wheat seed in Mexico. It is also active in the production and commercialization of oilseed crops, such as sesame, peanut, safflower, and soybean.

PRONASE receives small amounts of seed of new varieties from INIA, increases the seed on its own stations, and then contracts commercial production with farmer producers. This seed is then processed and stored in the facilities of PRONASE.

PRONASE has three distribution channels: the official bank, distributors licensed by contract, and direct sales. The bank is the principal client of PRONASE, taking 70 percent of its production. Distributors, who sign contracts with PRONASE, distribute 18 percent of the seed, and direct sales account for 12 percent.

In 1982, PRONASE processed and distributed 238 t of seed, an increase of 230 percent over 1977. Of the 238 t, 85 percent was seed of basic food crops and 9 percent was seed of oil crops.

The use of improved seed of improved varieties is considered vitally important in increasing production and productivity of the national agriculture. However, social, cultural, economic, agronomic, and ecological problems have restricted the use of improved seed.

As a new (1980) strategy to increase the use of improved seed, the government has authorized a subsidy to the farmer of up to 75 percent of the cost of seed. This strategy is based on the premise that this will lower costs and stimulate production, which, in turn, will be reflected in more food at lower prices for the consumer. This subsidy will cost 2 billion pesos "during the first stage."

Areas Outside Latin America

R. L. Paliwal

Small farmers constitute more than 75 percent of farming people in the tropical world. By "small farmers" I mean farm holders whose income is at subsistence levels and who face greater constraints in increasing their productivity than do larger farmers.

There are many limiting factors to agricultural production in the developing world. These vary from lack of weed control to improper or inadequate policies. One common factor, unequivocal and universal in impact, is a lack of proper seed production and distribution systems.

In papers presented here last year and at an FAO/SIDA conference in Nairobi also in 1981, I emphasized some points dealing with the need to develop more effective seed systems. I will repeat them here since I sincerely believe that these points need our attention and remedial action.

1. For much of the tropical world, the maize germplasm currently available has a reasonably good yield potential, well above the average yields obtained by farmers. The overriding need is to increase yield stability.

2. The farming situation under which maize is grown must be taken into consideration in planning maize research and seed production programs. The need for on-farm experimentation is particularly important for a crop like maize.

3. Lack of effective seed industries is a critical factor limiting maize

production in most developing countries. The success of several private seed companies in the developed world is attributable mainly to two factors: a) they developed materials which were acceptable to farmers, and b) they were able to make timely delivery of good quality seed to farmers.

4. The production of good quality seed has the same importance for open-pollinated varieties of maize as for hybrids. Seed industries do not have to depend only on hybrids to be successful. Development of good national seed programs is essential for increasing maize production.

5. Technology for hybrid maize seed production is well established. There is, however, only scanty information on the maintenance and production of seed of open-pollinated varieties. Added attention is now being given to the problems of seed production, marketing, and distribution of open-pollinated varieties.

I will emphasize and elaborate on some of these points and then discuss the seed production and marketing systems, keeping in mind the specific needs of small farmers.

1. What is and who is a small farmer? It is really difficult to define small farmers and lay guidelines which will be applicable in most, if not all, conditions. We can generally agree that three major factors enter into such a definition: size of the holding, agroclimatic conditions, and resources.

2. Improved technology is technically size/scale neutral but it can be highly influenced by, and therefore dependent on, resource and risk perceptions. It is necessary to produce input-responsive germplasm with stable performance under adverse conditions, and with the genetic capacity to respond to more favorable situations.

3. Most of the maize in the tropical world is grown under high-risk and low-input situations.

4. The farmer will adopt improved technology that gives him economic returns, if he perceives the risk as bearable and if his resources permit.

5. Our attempt should be to provide farmers suitable germplasm with stable performance and appropriate technology that will give them improved returns under high-risk, low-resource situations, but which will respond well to more favorable situations.

6. We have often heard the argument that hybrids are more suitable for large farmers and open-pollinated varieties suit the needs of small farmers. This statement misrepresents the situation. Under the appropriate circumstances, either hybrids or open-pollinated varieties can be used by small and large farmers alike. For example, in the Indian state of Bihar —not one of the more progressive states, and one with very small holdings— farmers, regardless of size of holding, use hybrid seed for growing winter maize, but do not use hybrid seed for the rainy season crop. In Zambia, all farmers, large and small, plant SR52 hybrid maize and benefit from it if they plant at the right time.

7. John Gerhart's study on diffusion of hybrid maize in Rift Valley, western Kenya, showed clearly that in higher altitudes where suitable maize hybrids were available, both small and large farmers used them. Agroclimatic zones were very important in the adoption of hybrid maize. Its adoption was much greater in the high elevation/high rainfall areas, where farmers had lower risk perceptions. Hybrid maize adoption was much lower in low elevation/low rainfall areas where there was a higher risk perception. Farm size was not significantly related to adoption of hybrid maize.

8. Similar situations can be found in Latin America. Farmers in coastal areas of Peru have adopted hybrid maize, but its adoption is poor in lowland areas of the Amazonian basin and the Peruvian highlands.

9. Availability of suitable and adaptable germplasm acceptable to ther farmer is the basic consideration for a successful seed system.

10. A seed system consists of two basic components: seed production and seed distribution and marketing. There are both small and large seed systems. Most efficient large seed systems started as small seed enterprises.

11. My experience in India and elsewhere has convinced me that organizing a good seed production system is easier than establishing a good marketing system. You can import seed but you cannot import a marketing network. This has to be established in your country to meet specific needs and situations.

12. It should be realized that in the developing world, if we exclude hybrids and crops where grain/seed is not the end product (vegetables, cotton, jute, etc.), over 80 percent of the agricultural land is covered by seed which do not enter marketing channels

(farmer's own seed or farmer-to-farmer distribution). This situation will continue for quite some time and must be taken into account when considering the kind of seed to produce and the marketing network. This is why CIMMYT's emphasis is on high-yielding, open-pollinated varieties as a more practical approach to supplying better germplasm to a large number of small, resource-poor farmers.

13. Basically there are two types of national seed systems: (a) small-scale, farmer-based, and farmer-managed seed systems, and (b) large-scale, commercially organized seed production/marketing systems. In most developing countries, small-scale, farmer-managed seed production systems can play a very important role in supplying seed to small farmers. These were quite effective in India and some of them gradually grew into large-scale enterprises.

Workshop C

Theme
Strategies to Increase the Production and Marketing of Improved Seed for the Small Farmer

Guidelines

A. State your opinions on the advantages and disadvantages of the proposed special project to expand the use of improved seed (maize and beans) in two areas of Colombia.

B. Describe briefly the important characteristics of some projects that have successfully produced and marketed seed for the small farmer.

C. Recommend action and define responsibilities of public and private organizations (seed companies, farmer organizations, cooperatives, distributors) for the improvement of production and marketing of seed of improved varieties for the small farmer.

Rice

Rafael Posada, Coordinator

The principal conclusion of this workshop group was that the basic element needed to increase the use of improved seed by the small farmer is the availability of varieties that are adapted to the needs and conditions of the farmer. The characteristics will vary among countries and among regions within a country.

Improved varieties should:

- Be easy to thresh by hand.
- Have a vegetative cycle that fits the production systems of the farmers.
- Have grain with an appearance that is very acceptable to the farmer.
- Have a good yield percentage when milled.

In the case of rice, farmers will accept varieties that are adapted to their conditions, even though they may be slow in doings so. Therefore, this group concluded that the problem is not so much production, but rather marketing.

For remote regions, where upland rice is grown, seed should be produced locally, preferably under irrigation, in order to ensure that seed will be available.

It was the consensus that rice seed often does not arrive to production areas on time nor is it in good condition. This occurs when the farmers are far from the principal production centers. The seed is exposed to unfavorable conditions while being transported to the area. Furthermore, infrastructure is lacking and there is no adequate place for storing seed once it arrives.

In order to increase the utilization of improved seed, therefore, the appropriate distribution channels must be organized by either government or private industry. If this function is to be carried out by private industry, the government should create incentives such as credit for seed drying, handling, and storage.

The demand for seed can be increased by organizing groups to purchase seed, which will improve the availability of not only seed but also other inputs that make up the technological package.

Farmers will be willing to accept these innovations (improved seed, group purchasing, other inputs) if there is a good market for the sale of their product. Therefore, policy related to such things as minimum price, purchasing prior to harvest, etc., will have a direct effect on the use of improved seed.

Four points that should be given high priority in projects to increase the use of improved seed are:

— research should be oriented to solve principal agronomic problems.

— credit that will strengthen marketing channels should be provided.

— extension agents, those who sell inputs, and farmers need training.

— markets for the farmer's final product should be guaranteed.

Maize

German Torres Torres, Coordinator

Advantages of Proposed Colombian Seed Project

1. Those who have developed the proposal are able to cite quantified data because they have made a systematic study of the situation. They understand the customary practices for obtaining seed and know that farmers differentiate between seed and commercial grain.

2. They understand the types of materials that are most appreciated by the farmer and will be in a position to improve, with minor modifications, the traditional varieties.

3. Some organizations are already working in the zones and the project can take advantage of their contacts with farmers.

4. The project planners have not identified maize varieties adapted to the zone and, therefore, are going to initiate the project with material with which the farmer is already familiar.

5. The project will be initiated in areas (zones) having development projects, which should guarantee continuity of the program.

Disadvantanges of the Proposed Project

1. The areas selected currently have no processing plants for the handling, cleaning, and classifying of seed.

2. There is no experience in the use of portable equipment which they suggest be used.

3. It is risky to experiment with the equipment and the project's new strategies at the same time.

Characteristics of Successful Seed Projects

Colombia has had some successes. Field days stimulated farmers' interest in seed. There was no seed certification service. Interest on the part of progressive farmers in one community showed the demand for seed. Farmers interested in producing seed have practically a guaranteed market with their neighbors.

Material is selected from the farmers' own fields, thus assuring adapted material. The material selected has been evaluated for yield and the results have been favorable.

These farmers are fortunate to have technical assistance from a development project working in their area.

Responsibilities of Public and Private Organizations

1. Incentives should be created for the establishment of seed production as a rural enterprise.

2. Projects of this kind should receive government support. For example, the government should have credit to support this kind of rural industry.

3. Policies for research and commercialization should be coordinated.

4. If there is a national seed production program, it should support the community enterprise.

5. In defining policy, the short-, medium-, and long-term aspects should be considered to give continuity to the enterprise.

6. The enterprise should assume the characteristics of private enterprise.

Sorghum

Napoleón Puentes, Coordinator

Advantages of Proposed Colombian Seed Project

1. Economic levels of the farmer should improve.
2. The plan should produce varieties that are well adapted to the areas selected.
3. Employment will be increased.
4. The project considers sociological interrelationships, which should favor increased use of improved seed.
5. The farmers should have confidence in the seed as they will be able to observe all of the steps taken to produce it.
6. Establishment of seed as a rural enterprise might stimulate other small industry.

Disadvantages of the Proposed Project

1. There may not be improved adapted varieties for the areas selected.
2. Development of the project will require time.
3. The project does not include training.

4. During the early stages of the project, good quality might not be maintained due to poor management, which would impair the project's credibility over the long term.

5. The project may be excessively costly.

6. There could be the danger of introducing and/or spreading diseases because the small farmer is not adept at controlling them.

Characteristics of Successful Seed Projects

1. An improved variety better than what the farmers already have is used.

2. Organizations other than those of government participate in the production and commercialization of seed.

3. Marketing infrastructure is adequate.

4. There is a fair pricing policy.

5. A credit policy allows financing for both capital and operations.

6. Appropriately sized packages of seed are sold to small farmers.

7. Seed is available opportunely.

Responsibilities of Government Organizations

1. Generation and transfer of appropriate technology.

2. Production and distribution of high quality seed.

3. Setting prices of both seed and final product that are incentives to the producer.

4. Having credit available for both capital expenditure and production.

5. Control and certification of seed quality.

6. Production of the needed foundation seed.

7. Establishment of an efficient policy for commercialization of seed.

8. Promotion of the use of improved seed.

Responsibilities of the Private Sector

1. Production of good quality seed.
2. Development of infrastructure for commercialization.
3. Provision of technical assistance that promotes the use of seed.
4. Making seed available at the right time.

Beans

Federico Scheuch, Coordinator

Advantages of Proposed Colombian Seed Project

1. The project area has been studied to determine the varieties available, their qualities, their acceptance in the market, the traditional habits of farmers in obtaining seed, etc.

2. Seed will be produced in the same area where it will be used, thus lowering costs for the processing plant and the user.

3. Since the seed will be produced locally, it should be available at the right time in places convenient to the farmer.

4. The project should establish a market for seed where none existed before.

5. It focuses on an existing problem in an organized manner.

Disadvantages of the Proposed Project

1. Excessive help such as credit and technical aid might create a dependence which would damage future initiative by the target group.

2. Since the project is to be managed by the public sector, it might be inefficient due to excessive bureaucracy.

3. Groups participating in the project may be difficult to coordinate.

Characteristics of Successful Seed Projects

1. Acceptable cultivars shown to be superior to local materials are used.

2. Seed is packaged in sizes appropriate for sale to the small farmer.

3. There are adequate distribution outlets.

4. Sale of seed from the seed enterprise to distributors is done on a cash basis.

5. There are sufficient profit margins for the seed retailer.

6. There is adequate flexibility in the pricing of seed.

7. Private and public sectors collaborate in marketing seed.

Recommendations for Increasing Seed Production and Marketing

1. Incentives, such as exemption from taxes, should be used to stimulate seed production.

2. Farmers receiving credit should be required to use approved seed.

3. Price incentives should stimulate seed production.

Cassava and Potatoes

Anibal Monares, Coordinator

Cassava

There is sufficient knowledge of better technologies for improved production of seed (see Leihner, page 30). The principal need to transfer this information to the small farmer. For those countries in which varieties have not been impoved, it is recommended that they focus on this problem, as well as seed quality.

Potatoes

New potato varieties have been adopted by all types of farmers. The main problem is healthy seed of both native and improved material, for which there have been only a few successful projects.

1. In the Colombian state of Narino, there is a project under an agreement between Colombia and Holland in which ICA (Instituto Colombiano Agropecuario) distributes improved seed to small producers in a regional development project. The seed project finances seed for the small farmer while his application for credit is being processed. When the farmer obtains credit he reimburses the seed distribution project. He pays the regular commercial price but receives good quality seed at the right time for planting.

2. Several national organizations (ICA of Colombia, INIAP of Ecuador, INIA of Peru, and others) furnish improved seed to small farmers in varying quantities on a continuing basis.

3. Some semiautonomous organizations, such as the Caja Agraria (agricultural credit bank) in Colombia and Chile's national seed enterprise, have produced seed and have had sporadic successes in distributing seed to small farmers.

Recommendations for Improving Seed Production and Marketing

1. Train small farmers in promising seed areas to produce good seed to sell to farmers in areas that are inappropriate for seed production

2. Promote seed production by developing programs to share risks between small seed enterprises and the government.

3. Encourage small farmers in lowland areas to obtain seed produced in higher areas more appropriate for the production of good seed.

4. Promote the organization of associations that facilitate the production and distribution of potato seed.

5. Improve the efficiency of present seed producers, both governmental and private.

Experience in International Financing of Seed Projects

Some World Bank Experience in Financing Seed Projects

Maxwell L. Brown

This paper is based on the author's experience in Burma and on a review of World Bank reports.

Bank Lending for Seed Production

The Bank's support of seed projects has been relatively modest, with nine projects in Asia and the Pacific for a total of (U.S.) $118.5 million and one in Latin America for (U.S.) $3 million. However, seed has been supported by other agencies, and the Bank has supported many other projects that have a seed component.

Some Lessons Learned

Among the Bank's projects in Asia are the Tarai Seeds Project in India, the Indonesian Seeds Project, and the Bangladesh Seeds Project.

These three projects differ greatly in their nature and their success. The Tarai Project, the most successful, was characterized by good management, prior experience with seed, and a good demand for seed. Some of the lessons we have learned can be summarized as follows:

1. Success comes more easily when building on a successful innovation (as in the Tarai Project) rather than starting a project when the necessary resources, structure, and incentives to produce high quality seed are lacking.

2. Success is more easily achieved with relatively flexible and dynamic management, as in the Tarai Project, than under a government or quasi-government agency in which autonomy is restricted.

3. Large-scale, capital-intensive technology is often inappropriate for developing countries.

4. Private farmers are usually more efficient than public-sector agencies.

5. Farmers are more likely to take a greater interest in the project when their share of the profit is assured.

6. Public-sector agencies have been shown to be capable of producing breeder and foundation seed.

7. Strict quality control and certification administered by an impartial agency are indispensable for the success of any seed production project.

8. Special consideration must be given to providing social amenities in project areas, not only for the visiting staff, but also the local staff.

9. Those trained through the project must be provided with enough incentives to retain their services.

10. There is a tendency to overestimate the effective demand for seed of crops like rice and wheat, which are self-pollinated. With these crops, the aim of the project should be to spread new varieties. There are exceptions. The Tarai Project was successful with wheat, which was sold to northeastern India where wheat could not be stored. Hybrids are another exception.

Context for Future Action

The greatest need in providing improved seed to the small farmer is to strengthen the linkage between research and the farmer through an effective extension service. To be effective, the extension service should be sensitive to the needs of the farmer, relay these needs to the researcher, and keep the farmer abreast of recent developments. Too often farmers have been asked to purchase seed of questionable quality, which is not suited to his environment, entails greater risks, or lacks consumer acceptance. Thus, it is not surprising that "government seed" gets a bad name, and farmers refuse to buy it.

More than one country has found that little improved seed is reaching

the farmer, despite the existence of a donor-supported seed program and despite spending more than 2 percent of the government's budget on research. In these cases, we do not necessarily need to spend more on research but we need to reorient the work, increase adaptive trials, strengthem links with extension to get more feedback from the farmer, and effectively reorganize the system of improving, multipliyng, and distributing seed.

Too often, we tend to focus almost exclusively on the physical indices of production, blindly ignoring the financial implications for the farmer. The basic assumption underlying most projects is that since improved yields have been attained on experiment stations, they are automatically achievable by the farmer. Also it is often assumed that increased yield will mean additional profit for the farmer, without considering cost. There is a great need for properly designed and conducted trials and demonstration plots in farmers' fields in different ecological zones to measure performance and to calculate the financial profitability of each new seed variety for farmers with different levels of proficiency.

As a development institution, the World Bank is naturally interested in promoting the development of its member countries. But we go a step further and make a distinction between success from the point of view of society as a whole, and the impact of the project on different classes of beneficiaries.

Support of Seed Projects by the Interamerican Development Bank

Carlos Enrique Ampuero

The IDB considers agricultural development one of its highest priorities in Latin America. According to the mandate of the member countries, agricultural development for the well-being of small farmers is a priority.

For more than a decade, the IDB has been promoting and financing projects for research, technical assistance, and improved seed within Latin America and has also supported the three International Agricultural Research Centers in the region: CIAT, CIMMYT, and CIP. In this manner the IDB has supported seed as related to these technical programs. The projects have taken different forms in different countries, according to local needs and situations. The support has been through technical cooperation projects with nonreimbursable funds, as well as with loans.

The Bank's Experiences

Latin America has made outstanding progress over the last decade in establishing firm bases for agricultural research. However, there are disparities among countries and regions. Iowa State University has recently completed a study for the IDB which shows in detail the situation in 22 Latin American countries. This analysis mentions the national progress made in those products emphasized by CIAT, CIMMYT, and CIP. More specifically, the Bank's experiences show:

1. Information about new varieties does not rapidly reach the farmer, and at times the information is not readily understoood.

2. Promotion and demonstration at the small-farmer level are inadequate. Many of the demonstrations are established at experiment stations or on land of large farmers.

3. Varieties produced by research have not always responded well under conditions of the small farmer. Some research organizations need to improve the production of basic seed in order to rapidly multiply it in the amounts needed. The lack of flexibility for the timely increase of seed causes undue delay in getting seed to the farmer.

4. Seed organizations

   (a) Private and public seed organizations have not given due attention to the needs of the small farmer.

   (b) There are few distribution mechanisms for reaching distant and remote areas.

   (c) Seed quality suffers in storage and during transportation.

   (d) Inflexible and rigid seed regulations reduce the amounts of seed available.

5. Seed policy

   (a) Governments do not provide incentives to stimulate seed production and establish the seed industry.

   (b) Policy does not clearly establish the roles of public and private organizations in seed production and distribution.

   (c) There are excessive bureaucratic controls in seed quality programs.

Looking to the Future

Despite great efforts by many organizations to financially assist agricultural research and national seed systems, the opportunity for investment is still great. It would be very helpful to have current information from each country so that financial needs could be better determined.

Project preparation is one major problem of the financial organizations. Many times there is little national capacity to develop the projects. It is suggested that CIAT might expand its seed unit to aid in project

preparation and analysis. If this is not possible, CIAT might suggest ways to overcome the problem.

In order to reach the small, limited-resource farmer, it will be necessary to develop methods of multiplication and handling that meet existing limitations. Seed production and processing by the small farmer himself might not be effective. It will be necessary to simplify the quality control regulations according to rural conditions. Many times regulations from developed and industrialized countries have been adopted. These are often difficult to meet and may impede the production and supply of seed to farmers.

International Collaboration in Seed for Small Farmers

G. John

These comments are made on behalf of the GTZ, which is under the West German Ministry of Economic Cooperation. GTZ has a mandate for technical cooperation with developing countries. The bank of reconstruction (KFW), another government agency, is charged with financial cooperation.

Public funds currently assigned to the GTZ are (U.S.) $300 million annually. About 40 percent of this amount is assigned to agriculture, cattle, fish, and forestry. Following the criteria of the United Nations, most of these funds are assigned to the less-developed countries, with 55 percent going to African countries, 18 percent to Asian countries, and 26 percent to countries of Latin America and the Caribbean.

German government policy is to give highest priority to projects that satisfy the basic needs of the population and that protect and conserve renewable natural resources.

The GTZ is supporting a few projects of plant improvement or seed multiplication. There are other integrated development projects in which seed is a component, but none is in Latin America.

Personal experiences about seed, which are not observations of an expert, include the following:

1. Frequently, seed is not available in the market at the time it is needed for planting.

2. Varieties acceptable to the farmer often are not available.

3. The quality of seed in the package is not what the label says.

The technology of seed multiplication is relatively simple, at least for the majority of cultivated species. Neither can cost be the reason why farmers do not use improved seed, because seed represents only a small portion of production costs. There are two problems: the marketing system does not function well, and the varieties do not meet the requirements for home consumption.

Another problem not directly related to organization of markets, is that governements have made inadequate investments. It is my personal opinion that one problem with foreign aid is that the funds are directed to governments and not to private industry.

Program of the Workshop

Monday, August 9

J. Valle-Riestra, moderator

08:30	Welcome	J.L. Nickel
08:45-09:15	Seed in the transfer of technology to the small farmer	R. K. Waugh
09:15-09:45	Quality and varietal characteristics of seed saved by the small farmer	F. Poey
09:45-10:15	Practices used by small farmers in selecting and maintaining their own seed	J. Douglas
10:15-10:45	Discussion	
10:45-11:05	Recess	
11:05-12:30	Panel: Practical recommendations of selection and production for the farmer who saves his own seed	D. Laing, Coordinator
	Rice	D. Muñoz
	Beans	O. Voysest
	Maize	J. Barnett

	Sorghum	V. Guiragossian

12:30 Lunch

02:00-02:45 Audiovisual, This is CIAT

02:45-05:00 Visit installations of CIAT and the Seed Unit

05:15-06:45 Reception

Tuesday, August 10

F. Gomez, Moderator

08:15-09:20 Recommendations for the farmer to dry and store his own seed L. G. Villa

09:20-10:20 Seed quality guidelines for the small farmer J. Deloche

10:20-10:45 Recess

10:45-12:30 Guidelines for selecting and producing reproductive material of:

Cassava	J. Cock
Potato	A. Monares

12:30 Lunch

02:00-05:00 Workshop (grouped by crops) on the production, selection, handling and storage of his own seed by the farmer Coordinators

Rice	D. Muñoz
Beans	O. Voysest
Maize	J. Barnett
Sorghum	V. Guiragossian
Cassava and potatoes	J. Cock and A. Monares

Wednesday, August 11

A. Pinchinat, Moderator

08:15-09:00	Selection of appropriate varieties for small farmers	J. Woolley
09:00-09:30	Some considerations in the development of appropriate technology for small farmers	M. Swisher, *et. al.*
09:30-10:30	Panel: Factores which affect decisions by the small farmer about the adoption of new varieties	M. Swisher, Coordinator
	Rice	R. Posada
	Beans	R. Velasquez
	Maize	J. Barnett
	Sorghum	M. Torregroza
10:30-10:45	Discussion	
10:45-11:05	Recess	
11:05-11:35	Panel (continued)	
	Cassava	J. Lozano
	Potatoes	A. Monares
11:35-11:45	Discussion	
11:45-12:30	Extension methods that have proven successful to introduce new varieties and increase the use of seed	E. Martinez
12:30	Lunch	
02:00-05:00	Workshop on action that should be taken in the generation and transfer of technology in order to increase the use of improved seed by the small farmer (groups organized by region)	
	Brazil, Southern Cone, and México	C. C. de Queiroz
	Central America	A. Pinchinat
	Andean Zona	L. E. Chavez

Colombian proyect J. Navas

Thursday, August 12

C. Montes, moderator

08:15-08:40 Seed as a cottage industry F. Poey

08:45-09:45 Cooperatives as producers and distributors of improved seed J. Lewerenz

09:45-10:45 Cost, credit, subsidies and interchange of seed C. C. de Queiroz

10:45-11:05 Recess

11:05-12:30 Panel: Experiences in marketing seed to small farmers

Guatemala	R. Velasquez
El Salvador	N. Puentes
Mexico	G. Torres
Outside Latin America	R. Paliwal

12:30 Lunch

02:00-02:45 Production of seed of maize and beans as an artisanal industry for small farmers in two areas of Colombia: a preliminary feasibility study R. Velasquez

02:45-06:00 Workshop on strategies to increase the production and marketing of improved seed for the small farmer

Rice	R. Posada
Beans	F. Scheuch
Maize	G. Torres
Sorghum	N. Puentes
Cassava and potatoes	A. Monares

Friday, August 13

J. Valle-Riestra, Moderator

08:15-10:30 *International funds in support of projects*

World Bank	M. Brown
IDB	C. Ampuero
GTZ	G. John

10:30-11:00 Discussion

11:00-11:20 Recess

11:20-01:00 Conclusions of the work shops

01:00-02:30 Lunch, closing session

Glossary

CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIP	Centro Internacional de la Papa
CLUSA	Cooperative League of the USA
CRESEMILLAS	Seed Organization of the Colombian Agricultural Credit Bank
GTZ	West German Organization for Technical Cooperation
ICA	Instituto Colombiano Agropecuario
ICTA	Instituto de Ciencia y Tecnología Agrícola
IDB	Interamerican Development Bank
IICA	Instituto Interamericano de Cooperación para la Agriculturra
INIA	Instituto Nacional de Investigaciones Agrícolas (Mexico)
NDDP	National Dairy Development Board (India)
OGCP	Oilseed Growers Cooperative Project (India)
PRONASE	Productora Nacional de Semillas (Mexico)

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