Breeder and Foundation Seed Programs

James C. Delouche

Follow this and additional works at: https://scholarsjunction.msstate.edu/seedtechpapers

Recommended Citation

This Text is brought to you for free and open access by the Mississippi State University Extension Service (MSUES) at Scholars Junction. It has been accepted for inclusion in Seed Technology Papers by an authorized administrator of Scholars Junction. For more information, please contact scholcomm@msstate.libanswers.com.
BREEDER AND FOUNDATION SEED PROGRAMS*

James C. Delouche
Seed Technology Laboratory
Mississippi State University
State College, Mississippi

Discussing the nature and importance of seed multiplication, Carter noted that: "New varieties seldom occur as a result of chance; they are usually produced by knowledgeable and skillful plant breeders. Often the amount of seed available from the breeder is small - sometimes it is literally a handful of seed. To have significant effect, this small amount of breeder seed (also called original or basic seed) needs to be multiplied many, many times ... in such a way as to maintain the genetic purity of the seed. 34/

The "handful of seed" that represents a newly developed variety is both a beginning and an end - the end of the breeder's main work, but the beginning of the seed specialist's effort. Once a variety is released, the plant breeder is much inclined to consider his duty toward improvement of the variety as complete and to turn his attention to other progenies in his breeding program. "The plant breeder has, however, a continuing responsibility to maintain recurring supplies of genetically pure breeder seed," 35/ for as long as the variety has a place in crop production in the region. One "handful of seed" is not enough and


not just any handful will do. A small quantity of seed representative of the breeder's concept of the variety must be periodically fed into the seed multiplication system to prevent breakdown of the system and/or drift from the characteristics of the variety.

The breeder is the person most familiar with the characteristics of varieties he develops, thus, it is logical that he and his assistants maintain and produce a continuous supply of breeder seed. The institution, department or firm, that sponsors the breeder's research should also share in the responsibility and commitment for supply of breeder seed, for breeders die, retire or move on to other positions.

Not all improved varieties are developed by indigenous breeding programs. Many are introduced from other countries or states. In such cases, some breeder is assigned responsibility for maintenance and production of "breeder seed" stock of the variety. Otherwise, seed from the originator will have to be imported seasonally - a costly, inefficient and risky procedure. 36/

Elimination of off-types in varieties by roguing is accomplished most efficiently in the breeding nursery under the close supervision of the originating breeder. "Failure to maintain the highest degree of genetic purity in genetic (Breeder) seed only adds to the complexity of maintaining varietal purity in later generations." 37/ Further, the small area grown

36/ We recognize that periodic resupply of seed stocks of introduced varieties is desirable and necessary.

to breeders seed is more adaptable to rigorous control and
roguing than the larger areas required for subsequent steps in
multiplication.

There is yet another reason why continued responsibility
for the variety by the originating breeder is desirable. The
breeder has opportunity to further improve the variety by
selection through additional generations. In some crops,
varietal characteristics are gradually changed with time as a
result of constant selection pressure by the breeder. Perio­
dically, the variety is re-named to bring it "up-to-date."

Although ideally the breeder should mold the variety into
a "pure line" so that the progeny are uniform in all characteris­
tics, the seed specialist should recognize that current practice
departs substantially from this ideal. Breeders in all countries
are under great pressure to name and release any superior ad­
vanced lines in their breeding program. Thus, they cannot afford
the luxury of additional selection over several years to further
improve uniformity. As a result, varieties are released with
full knowledge that a percentage of the population will have
"off-type" characteristics. Most often, these off-types do not
materially affect performance, but they do present considerable
problems to the seed specialist. First, it is difficult for
him to know when an "off-type" is characteristic of the variety
and when it is not. Secondly, such varieties effectively
sabotage his educational efforts with seed producers.
How can he convince the seed producer that varietal purity is the first consideration, when the seed producer can see that the seed supplied to him for multiplication were obviously "impure"? Finally, the tendency (and practice) of seed producers to rogue any plant visibly different from the aspect of the population can cause an undesirable shift in varietal characteristics. This danger is particularly great in the case of "broad-base" and composited varieties. Off-types, however, can usually be eliminated by selection during subsequent generations of breeder seed or even foundation seed.

The seed specialist responsible for the next step in multiplication and the originating breeder must work closely together. The seed specialist has to fully understand the breeder's concept of the variety and to keep him (the breeder) informed as to the requirement for breeder seed.

The relatively large quantities of breeder seed required for some crops (e.g., peanuts, soybeans) and under certain conditions are too demanding on the breeder's time and attention. In such cases arrangements can be made for a second increase of breeder seed or several generations of foundation seed. In either case, the production can be located at a site other than the breeder's nursery and largely supervised by the seed specialist (foundation seed specialist).

Since breeder seed are the source of seed for multiplication, the multiplication system should not be entirely dependent on a seasonal supply. A reserve stock needs to be accumulated as a hedge against production failures in the breeding nursery. A two year's supply in reserve is usually adequate but even larger reserves are advantageous as less frequent multiplication is required and there is less chance for change in varietal characteristics. Reserve stocks of breeder seed must be stored under conditions favorable for maintenance of viability and vigor. Nothing is accomplished if the seed in reserve die in storage or become so low in vigor that their planting value is nil.

Although the perogative and responsibility for maintenance of breeder seed belong to the originating breeder, it may be desirable to establish certain standards pertaining to breeder seed production of all varieties in the seed program and to arrange for internal checks on adherence to the standards. If such procedures are followed, they should be accomplished in such manner that neither the perogatives or responsibilities of the breeder are usurped. Regardless of whether or not standards are established for breeder seed, the breeder must be provided with the requisite facilities and equipment for limited seed production: harvesters, threshers, dryers, cleaning equipment, and conditioned storage.

In summary, the following points relative to maintenance and supply of breeder seed are important:

1. The originating breeder of a variety has continuing responsibility for maintenance of breeder's seed in adequate supply for subsequent steps in the seed multiplication process.
2. The institution that sponsors a breeder's research shares responsibility for maintenance of breeder seed to the extent that supply is continued should the services of the breeder become unavailable for any reason.

3. Breeder seed should be produced under rigorous control to insure maximum genetic purity and facilitate later production cycles.

4. The seed specialist responsible for the next step in the multiplication process must work closely with the breeder so that varietal characteristics are maintained and breeders seed stocks are adequate.

5. Stocks of breeders seed adequate for two or more years (seasons in multi-cropping sections) should be held in reserve under good storage conditions.

6. Breeder seed should be used exclusively for seed multiplication (foundation seed production) and as a source of authentic seed stock for other research and development programs. It should never be promiscuously distributed to cultivators.

7. The US ESCOP'S policy statement on maintenance and increase of breeder seed follows: "When it becomes evident that a new variety is sufficiently promising to merit consideration for release, breeder seed should be increased to the volume needed to produce and maintain required foundation seed. So long as a variety is retained on the recommended list of an originating station, that station should maintain a reasonable reserve of breeder seed, which will be used to replenish and restore foundation seed of the variety to desired genetic purity. When a variety is distributed in several states, or when the originating station ceases to maintain breeder seed of a variety, a mutually satisfactory plan should be worked out among the interested stations regarding the maintenance of breeder seed. Interested states should be notified well in advance by the originating states when it plans to discontinue maintenance of breeder seed of a variety. 39/"

Foundation Seed Stocks

Breeder seed is the source for the initial and recurring increase of seed of a newly developed or introduced variety. Multiplication of breeder seed is most often implemented through a Foundation Seed Project or Program. Thus, "Foundation seed shall be (are) the progeny of breeder seed or foundation seed so handled as to most nearly maintain specific genetic purity and identify. Production must be approved by the certifying agency and or the Agricultural Experimental Station." This definition of foundation seed derives from the "certification" system for seed multiplication. However, it is equally applicable to other situations and systems. The concept of (certifying agency) can be broadened to encompass a "seed board", "seed association", or other agency involved, and "Agricultural Experiment Station" to include "breeding firm or company", "research institute", "sponsoring institution", etc.

The essential task of the foundation seed program is to multiply breeder seed up to the quantity needed for large scale seed production in such a manner that the specific genetic identity is maintained. Foundation seed are the base for production of commercial seed, i.e., that used by cultivators, either directly or through other controlled multiplications. Foundation seed programs vary considerably among countries and political subdivisions within countries. This is not an unusual

40/Foundation Seed have been variously termed Elite, Original, Pedigree, Mother, and Basic seed among the different countries.

or unexpected situation as production, distribution and maintenance of foundation seed is a highly specialized operation, involving cooperation among several agencies and organizations often across state and national boundaries. The foundation seed program also deals in a valuable commodity in great demand that is most often developed at public expense. As a consequence, the program must always operate so that the interests of the general public are best served.

Although foundation seed programs vary considerably, there is rather general agreement on certain principles of operation:

1. Foundation seed are allocated (sold) only to qualified seed producers. They should not be distributed or allocated to favored or influential cultivators for production of commercial crops.

2. Releases and/or allocations of foundation seed should be in adapted areas.

3. Production of foundation seed should be controlled or checked by some specified external agency or entity independent of the program.

4. Foundation seed should be produced and handled by an officially sanctioned agency, or organization, recognized and approved private firm, or the research institution that sponsors breeding research.

5. The foundation seed stocks organization has the responsibility to provide all qualified and interested seed producers with seed at the earliest possible time.

ESCOP policy on increase, maintenance and distribution of foundation seed (public sector varieties) is as follows (in part):

---


"Foundation seed is of prime importance in the multiplication of a variety. It should be produced by those who have the experience, the facilities, and the skills to assure adequate supplies of pure seed. Foundation seed of publicly produced varieties should be increased under official guidance. Reserves of foundation seed should be maintained to assure a continuing supply in case of seed crop failure."

Since foundation seed are the very base for seed production, the program for its supply occupies a key position in the over-all seed program. In some seed programs responsibility for production and maintenance of foundation seed is assigned to the originating breeder. This is at best a wasteful procedure. The breeder's talents should be focussed on breeding and not seed production. It is enough that he maintain good breeder seed. Further, most breeders - in our experience - are seldom both good breeders and good seed producers. The good, productive breeder is apt to be rather a poor seed producer because seed production beyond the nursery plot scale is outside the scope of his real interests. On the other hand, many unsuccessful breeders gradually turn more and more of their attention to seed production in apparent compensation for their failure as a breeder - and develop into excellent seed producers. Seed production, however, is not plant breeding although it often passes as such in some research programs. Breeders who spend the majority of their time producing seed without being required to do so, should be relieved of breeding responsibilities and transferred to some phase of the seed program.
Development of a satisfactory foundation seed stocks organization requires the adoption of sound program principles, organization, competent personnel, land, facilities, and the support of administrators and others responsible for the provision of this important service to agriculture.

Organization: Foundation seed stock organizations are variously organized as (1) a project or section of an Experiment Station, Extension Service, or Department of Agriculture, (2) a non-profit corporation or growers cooperative, (3) a division of a breeding firm or company, and (4) combinations of these. The type of organization adopted can determine the relative success or failure of the program. It may facilitate or inhibit technical and management operations and coordination with other components of the seed program.\(^{44/}\)

1. The program should be officially sanctioned.

2. Operations and activities of the program should be under the over-all control of a Board of Directors and in accord with provisions of a constitution, by-laws or charter.

3. Board of Directors should be representative of the various parties concerned with and interested in agricultural development: agricultural administration, research service, educational institutions, extension service, seed control agency, credit agencies, development banks, agricultural cooperatives, seed grower's associations, certifying agencies, private firms, and public-minded private citizens. Members on the board of directors should not directly and personally benefit in any way from policies established or activities conducted by the organization. The number of directors should be as few as possible consistent with adequate representation, and they should be approved by the competent authority for specific and staggered terms.

---

4. Production, processing and handling of foundation seed should be carried out under the technical supervision of a manager, or supervisor, in accord with policies established by the Board of Directors.

5. The manager or supervisor should be experienced and competent in seed multiplication and have a good understanding of plant breeding techniques and procedures. Preferably, the manager should be a regular employee of the public agency or institution with prime responsibility for crop improvement research and/or extension (in the case of publicly developed varieties) and "assigned" to the foundation seed program. His salary should be paid from public funds. This arrangement will insure that the program continues to serve the public interest. The manager should have authority to employ office and technical personnel as required subject to approval by the Board of Directors.

6. The organization of the program should permit sound and flexible business management and fiscal policies. The cumbersome methods of operation, and convoluted bureaucracy characteristic of most governmental agencies and public institutions are simply not suitable for operation of a foundation seed program. The foundation seed program must be able to react rapidly and conclusively in response to situations, problems, or opportunities as they develop. The striking achievements of the National Seed Corporation LTD, India, in production of foundation seed and promotion of the use of improved seed can be attributed in part to its corporate structure, semi-autonomy, and relative freedom from governmental fiscal control.

7. Foundation seed should be sold to qualified seed producers at prices sufficiently high to discourage use of the seed for commercial production.

8. The foundation seed program should be organized on a non-profit basis. And, it should be self-supporting with the exception of the manager's salary and initial capitalization of limited facilities and equipment necessary to set the program in motion. The excess of sales income over expenses should be used for further capitalization of facilities and equipment, reserved funds, or granted to public research institutions for further research in crop improvement, as determined by established policy and authorized by the Board of Directors. Accumulation of reserve funds equal to at least one year's expenses is desirable to stabilize operations.

9. There should be only one foundation seed stocks organization for publicly developed varieties in each country or political subdivision in the larger countries.
Staff and Facilities: The foundation seed stocks program links the breeder and seed producer and renders signal service to both. To each breeder with varieties under multiplication, the program is "the equivalent of a skilled and dependable assistant", while to each seed producer, "it provides the equivalent of a scientifically trained and experienced breeder." 45/ Service in these important capacities obviously can only be performed by trained, competent and experienced personnel with necessary facilities and equipment at their disposal.

The staff and facility requirements of the foundation seed program vary with the number of kinds and varieties handled, and the quantities of seed needed. Some very effective moderate size programs consist only of manager, technical assistant, part-time secretary and a small office. Production, processing, storage and physical distribution are handled entirely through contractual arrangements with private farmers and processors. 46/ Other programs - usually, but not necessarily larger in scope - may have a large staff consisting of a general manager, assistant managers for each major crop and operation (e.g., assistant manager for maize seed production, assistant manager for drying and processing etc.), a corps of technicians, secretaries and bookkeeper.


This staff may occupy a large suite of offices, own all necessary equipment, plants and other facilities, and own or lease all land required for seed production.

Basically, the size of the staff and the range of facilities and equipment owned or contracted for by the program should be commensurate with the task. The program cannot be expected to operate effectively with personnel, equipment and facilities "shared" with or "loaned" from other projects. On the other hand, the program should not become a haven for political appointees, unsuccessful and unproductive breeders, crop production specialists, and other assorted excess or discarded civil servants. Nor should it become a monument of personnel and facilities to the ambition of some empire builder.

The manager is the key person in the organization. He should be a mature, trained, competent and experienced plant scientist, skilled in dealing with people, and of unquestioned integrity. He should have a major voice in the selection of other staff for the program. Other personnel should have previous experience and training in the tasks they will have to perform. In beginning programs, however, the manager will probably have to conduct inservice training for other technical employees.

Financial Support: The foundation seed stocks program in any country can soon become largely self-supporting if it is operated in a business-like manner. In the initial stages of development, however, appropriations from public funds are needed for basic facilities and equipment, and for operations
until the program is well established (4-6 years). After this initial funding, the program should be able to operate and finance additional equipment and facilities from sales income. The point has been made previously that the manager should be a regular employee of the public agency or institution with prime responsibility for crop improvement research and/or extension, and that his salary should derive from this source. In some cases his salary is indirectly financed by the foundation seed stocks program through an annual "research" grant from the program to the manager's parent institution equivalent to his salary.

Financial stability of the foundation seed stock program is very important. Since seed increase operations vary considerably from year to year, a reserve fund should be accumulated from sales and set aside so that operations can be continued in the event of seed crop failure, obsolescence of stocks in inventory as a result of the release of new superior varieties, etc. Since reserves are accumulated over a period of years, financial responsibility for the program has to be assumed by the appropriate public agency until the program is well underway.

The Board of Directors of the organization is responsible for the wise and proper use of funds allocated to the program or derived from sales.

Operations: A foundation seed program is organized to produce foundation seed. Its success must be judged on the basis of how effectively and efficiently this task is accomplished.
Production of foundation seed requires (1) a supply of breeder seed, (2) land, (3) equipment and facilities, (4) personnel (and labor), (5) decisions (management) and (6) finances. These inputs are combined in various ways in the performance of essential operations.

**AMOUNT OF INCREASE**—The amount of foundation seed increased for each variety in the program depends upon such considerations as performance, adaptability, kind of crop, need and goal. The quantity of seed produced should be sufficient for adequate distribution so as to minimize the possibility of exploitation, but not so large that a substantial portion of the seed have to be regularly disposed of in the commercial seed market. The foundation seed program should assist in the development of a seed industry and trade and not compete with it.

Basically, supply planning for foundation seed is based on anticipated demand. In turn, demand is predicted and supply scheduled on the basis of past experiences, performance of the variety in current and previous tests, advance orders, known needs, advances in the breeding program, and market analysis. Predicting demand even fairly accurately is one of the most difficult management problems in the program. Accordingly, the manager and board of directors must address themselves seriously to informed supply planning. Consistent oversupply or undersupply or seasonal alternations between these extremes can destroy a foundation seed program in a few years: oversupply because of financial losses, and undersupply because of complaints and dissatisfaction with the program.

Close coordination with the breeders is essential for informed planning. The demand for newly released varieties is usually highest for the first few years after release and then tapers off or stabilizes until the variety is partially or completely replaced by a better one. It sometimes happens, however, that new varieties outstanding in varietal tests are relative failures in the field and demand the second season after release is negligible. As a consequence, the foundation seed program takes a considerable financial loss on seed in inventory and under production. Situations such as this are unavoidable and are one of the reasons why the program needs reserve financial resources. A similar situation can arise as a result of a decision to undertake pre-release increase of a very promising line only to have a weakness show up in the last testing stage which prevents release.
PRODUCTION-- After the quantity of seed needed is determined, the next step is production. Consideration of general production practices and techniques is beyond the scope of this discussion. Nevertheless, some aspects related more to the managerial than the technical side of production need to be considered.

Foundation seed is grown on land owned (or controlled) by the program, or on lands of selected, qualified farmers under contract, or by a combination of these. The disadvantages and advantages of each of the first two methods are about equal so that there is little basis for choice. Contract production obviates any limitation imposed by inadequate land resources, requires fewer program personnel and less equipment, and facilitates dispersal of production, which is desirable as a guard against complete seed crop failure. On the other hand, production on the program's own lands enhances maintenance of genetic purity, insures more timely operation, permits closer surveillance over the seed produced, and facilitates cooperation and assistance of the plant breeders, who are usually stationed close to the foundation seed farm. Most foundation seed programs produce seed both on their own lands and under contract. And, this combination procedure is probably the most efficient and flexible one.

When the seed are produced by a private farmer (or some other public entity), selection of the producer is extremely important. He must be a capable, qualified and progressive grower and have suitable land, adequate labor, and the necessary equipment. A legal agreement or contract should be consummated between the foundation seed organization and the grower. The agreement should specify the acreage to be planted, cultural practices, and harvesting methods that are to be followed, provide for supervision and inspection of production by the manager or his representatives, and the accounting for and delivery of all the increase and any unused portion of seed provided for planting. Other provisions include the price to be paid for the seed if it meets acceptable standards, the price that will be paid if it does not meet standards, method and time of delivery, etc.

"The number of growers for a specific crop or variety should be few, but enough to make it possible to produce seed in more than one (location)... This is necessary to lessen the possibility of crop failure and consequent loss of valuable breeder seed. 47/

---

Generally, a few large plantings for foundation seed production of a variety are preferable to many, small plantings: (1) larger farms are most likely to be well managed and to have the necessary equipment, (2) large plantings permit closer supervision with less expense, and (3) the larger the seed plot, the less are the chances for mechanical and genetic mixtures.

Regardless of the system of production - contract or own farms - the foundation seed stocks organization must rigorously supervise all steps: planting, field roguing, harvesting, drying and processing. Finally, all seed produced must end up in the possession of the program whether or not it meets acceptable standards.

HARVESTING AND PROCESSING--- Foundation seed are harvested and processed in the same manner as other categories of seed. Of course, strict precautions are taken to prevent mechanical mixtures during the various operations. Since foundation seed should be high in physical and physiological quality as well as genetic quality, the seed are handled by procedures that minimize mechanical injury and cleaned to remove as much inert material and as many deteriorated, molded, off-size, and insect damaged seed as possible. It should be emphasized that foundation seed do need to be processed and cleaned. The foundation seed program that is ill equipped and has to depend on essentially "hand" operations, seldom produces seed of good quality and appearance. These characteristics are most important in the case of foundation seed. For, foundation seed are the elite of the seed classes, the example of what seed ought to be. If they contain a lot of chaff and other inert material, damaged and molded seed, then it is difficult to convince seed producers that the seed they produce should be any better.

The foundation seed stocks organization should have drying and processing equipment as necessary to produce seed of high viability and vigor, high physical purity, and good appearance, as well as of maximum genetic purity.

STORAGE----A reserve supply (carry-over) equal to at least 20 per-cent of normal demand should be maintained in inventory for all varieties in the program to insure consistency and adequacy of supply. In the case of "minor" crops or varieties in the program for which there is limited but consistent demand, it is often more efficient to produce a quantity sufficient for two or three years at a time, than to produce a smaller amount each year or season. The seed can be stored and the demand during non-production years supplied from the reserve stock.
The importance of foundation seed, its high value and relatively small quantity, and the necessity of carry­
ing-over reserve stocks, justify the use of good, well
designed storage facilities. Since the climate in most of
the less developed countries is characterized by con­
centrated rainfall, high temperature and humidities,
"good" storage conditions mean environmentally conditioned
storage.

Dehumidification and air-conditioning (cooling) require
specially constructed warehouses and are expensive. But,
the minimization of seed losses through deterioration
and insect infestations possibly with conditioned storage
will "pay" for the facility in a few years.

FINANCING — Operational costs of any type of seed pro­
duction - and foundation seed are not different - require
adequate short-term financing or credit. Relatively
high investments are required to produce the seed and
these must be paid. In the case of contract production, the
specified seed price is usually payable at the time of or
soon after delivery. The seed produced represent the invest­
ment made, yet, they are translated back into monies
only at the time of sale, which may not occur for several
months or several years in some instances.

It was previously suggested that an on-going foundation
seed stocks program should be self-supporting. Further,
that appropriations from public funds should be made
initially for acquisition of facilities and equipment and
continue at a decreasing rate for a few years until the
program is well under way. Some provisions should also
be made in the charter or mandate of the organization for
obtaining and using short-term production credit. The
Board of Directors properly determines the need for short­
term credit and authorizes its procurement.

Allocation of Foundation Seed: A specific policy related
to allocation of foundation seed is necessary to prevent com­
plaints, accusations of favoritism, political pressures, and
to insure that the program develops and maintains a good public
image. Methods of allocation range from the non-controlled
first order or ask, first have" type to the highly controlled
system that allocates through a committee, board, or association.

Foundation seed are intended for use in subsequent steps in seed multiplication. Thus, as a minimum control, allocation
should be restricted to seed producers. Further, since the objective of the program is development of genetically pure, high quality seed for the cultivator, only well qualified seed producers should receive foundation seed for further multiplication. The seed producer should be in the "business" of seed production and not a farmer or firm that gets into the business when a highly publicized new variety is released hoping to exploit the situation, and then gets out when demand tapers off or stabilizes and prices drop.

Generally, foundation seed should be allocated through a committee composed of public-service minded private citizens and public-officials or, through an organized seed grower's association, certification program, farmer's association, or cooperative. Allocation of seed through such organizations places the burden of individual producer selection on them. It is also desirable to establish some guidelines for selection of seed producers; e.g., minimum acreage per producer that must be grown, minimum number of productions within area served by the allocating organization.

When the organizations (such as a certification association) are organized on a regional or district basis, the quantity of seed allocated to each such organization (and hence region) should be based on regional production records, adaptation of the variety in the region, and experience and efficiency of the organization.

A major situation that the foundation seed organization must guard against is undue exploitation of seed supply of new varieties. It is natural and normal that the seed of a new
variety commands higher prices for the first few years after release than later. This is exploitation in the sense that advantage is taken of a short supply-high demand situation. But, it is not undue exploitation. The seed grower or seedsmen has to make his legitimate profit before the seed become widely distributed among cultivators. Otherwise, he cannot fully cover his continuing investment in producing seed. Demand and price drop sharply after the seed of a new variety becomes widely distributed among cultivators. Then, the cultivator who has not yet planted the variety is likely to turn to a neighbor for seed if the price of seed in the trade is much above "grain" price. The thing that must be minimized is undue exploitation: exorbitant prices resulting from monopoly of seed supply.

Pre-release multiplication can be used to advantage to circumvent problems and difficulties attendant to excessively short seed supply and heavy demand. This involves some risk because multiplication has to start before the final testing stages are completed. In some cases, two or more advanced lines are under final test to determine which one should be named and released. As a consequence all advanced lines will have to be multiplied knowing that at best only one will be released as a variety. Of course the worst situation that could develop would be that none of the lines are approved for release. In any event, the foundation seed program has to take a financial loss. This loss can be covered by a special appropriation in the name of public interest, or recouped by a charge of higher-than-normal prices for foundation seed.
Coordination and Cooperation: The operation of a foundation seed stocks organization must be integrated closely with research, extension service and other related groups. Its personnel need guidance from the research staff not only in obtaining an early supply of the improved germ plasm but also in newer methods and techniques used in its production and processing. Close association with extension personnel results in the development and selection of the best cooperators and in informing the public of the performance and availability of the new variety that is released. Private seed growers, seed improvement associations, and cooperatives, must also be kept informed and appraised of developments, availability of seed, and anticipated demand. The foundation seed organization should always seek to foster cooperative attitudes among the various parties that make up the seed program/industry.

The foundation seed program is not a thing apart from, but rather an integral component of the whole crop improvement and agricultural development strategy. Foundation seed programs are organized solely for advancing crop improvement through the supply of high quality seed of superior varieties and the promotion of good seed trade practices. The public interest is served when these purposes are accomplished.

---