A Private Seed Company's Views of the Roles of Public and Private Breeders—Cooperation and Support

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Background

We must ask why we are addressing the roles of private and public breeders when, for at least a century, researchers in the private and public sector have enjoyed a remarkably close and mutually beneficial relationship. The answer is the evolution of time and a changing economic environment. The public sector bore the major responsibility for both basic research and variety development as recently as 50 to 60 years ago (1920–1930), with private industry being the vendor of improved varieties. Private industry had the necessary incentive to make major capital investments in variety development, with the development of hybrid corn and potential control of the parental lines leading to proprietary products. The passage of the Plant Variety Protection Act of 1970 led to the extension of this profit incentive to all sexually propagated crops, except for 6 vegetables which have since been included.

Robert R. Kalton, at the request of the National Council of Commercial Plant Breeders (NCCPB), initiated a survey of commercial companies to determine the extent of private involvement in plant breeding in early 1982. The results of this study (2) are presented in Tables 1, 2, and 3. The expenditure is directed primarily toward the application of current basic knowledge in the development and introduction of proprietary products. It does not replace the ongoing need of basic research in the public sector.

"Basic research" (3) is defined as research to obtain fundamental knowledge which will provide the information to support technological development and application in agriculture and forestry. Fundamental knowledge refers to knowledge of biological, chemical, and physical mechanisms, principles, and processes. Such knowledge is used subsequently for the development of technology. From the foregoing survey, it is apparent that major changes have occurred since the turn of the century.

In addition to this changing involvement in plant breeding by private industry, the current economic situation has resulted in critical reviews of money allocated to support public research by both the federal and state governments. Public administrators have suggested various strategies to maintain funding of traditional research programs, particularly at state agricultural experiment stations (AES). Also, this is paralleled by various pressures on the USDA Agricultural Research Service (ARS) culminating in the announcement of their Six-Year Plan (4) which calls for a total reduction in plant research from 40% to 33%. This is a 17.5% proportionate reduction.

The further result of these actions is to challenge the traditional role of the public sector. The questions become more complex with the surfacing of biotechnology and large investments of venture capital. Whereas biotechnology offers a great deal, we are still acutely aware of the need to preserve conventional basic agricultural research pending actual developments in the "biotech" field. Another factor is the consolidation of seed companies via acquisition. Such mergers enhance opportunities for plant research and product development. Mergers are viewed by some, however, as a threat to the broad genetic base which they feel serves as insurance against potential disease epidemics and natural hazards.

Current situation

The results of these interrelated factors are now coming into focus. Some at least can be identified:

- Reaction from both within and outside the seed industry has been excessive. This overreaction has resulted in the transmission of incomplete and at times exaggerated messages to experiment station directors and department heads. We have failed to put into proper perspective the great success of United States agriculture resulting from our past ARS/SAES and seed industry partnership. We must not forget that United States agriculture is the envy of the world and remains one of our greatest natural resources.
- The current Six-Year ARS Plan is in direct response to criticisms by the public. Both ARS and AES receive most of their support from broad-based taxes levied on the public. This public has witnessed much inefficiency within the public agricultural research system and has reacted strongly to this waste. The issue is not one of reducing public support for agricultural research but rather of promoting improved peer review of research projects and the standards on which scientists are promoted.

It is important that methods for measuring the results of public research be established to provide greater incentives for productive programs and to attract dedicated scientists. The profitability of public research will not be taken for granted by the constituency it serves.
- Numerous strategies have been devised by the public sector to bring industry money into the AES system. These range from exclusive releases to the highest bidder, to royalty payments, to check-off programs. Several of these policies are strongly opposed by the ASTA (1), particularly exclusive release without adequate review to justify that decision.
- Biotechnology has become the glamour science, attracting private and public money and personnel at the expense of the conventional sciences. Large sums of private capital are being offered to public administrators with patent rights strings attached.
- Recent interpretation of the patent laws encourages the public and private sector to protect not only cultivars and germplasm, but also processes and even single genes. Final resolution of attempts to patent plant material and technology is yet to be determined.
- What effect does this changing environment have on the relationship among private and public breeders and the constituency they represent? The fact is that the appropriate roles of the private and public sector vary by plant species and will continue to change as the research environment changes, and industry capital is attracted.

Table 1. Number of BS, MS, and PhD scientists involved in private plant breeding on major United States crops in 1982.

<table>
<thead>
<tr>
<th>Major crop categories</th>
<th>BS</th>
<th>MS</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>201.9</td>
<td>100.3</td>
<td>155.1</td>
</tr>
<tr>
<td>Vegetables and fruits</td>
<td>95.7</td>
<td>62.3</td>
<td>96.4</td>
</tr>
<tr>
<td>Soybeans</td>
<td>41.8</td>
<td>15.9</td>
<td>35.9</td>
</tr>
<tr>
<td>Wheat</td>
<td>27.7</td>
<td>18.2</td>
<td>23.4</td>
</tr>
<tr>
<td>Forage legumes, mainly alfalfa</td>
<td>16.6</td>
<td>18.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Grain sorghum</td>
<td>32.2</td>
<td>12.1</td>
<td>22.5</td>
</tr>
<tr>
<td>Cotton and other fiber crops</td>
<td>19.0</td>
<td>11.0</td>
<td>17.3</td>
</tr>
<tr>
<td>Sunflowers</td>
<td>12.8</td>
<td>13.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>6.0</td>
<td>2.0</td>
<td>14.3</td>
</tr>
<tr>
<td>Forage and turf grasses</td>
<td>10.2</td>
<td>4.2</td>
<td>10.9</td>
</tr>
<tr>
<td>Barley, oats, rye, triticale, millet</td>
<td>5.6</td>
<td>2.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Rice</td>
<td>4.0</td>
<td>2.0</td>
<td>7.3</td>
</tr>
<tr>
<td>Flowers - ornamentals</td>
<td>12.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Safflower</td>
<td>1.2</td>
<td>1.0</td>
<td>1.7</td>
</tr>
<tr>
<td>Tobacco</td>
<td>0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Totals</td>
<td>487.2</td>
<td>268.5</td>
<td>435.13</td>
</tr>
</tbody>
</table>

1Director of Research, Asgrow Seed Co., and Chairman of the Sub-Committee on Research Priorities of the American Seed Trade Association "Public Research Advisory Committee."

1Data are based on full-time scientist/year equivalents.

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Responsibilities of the public sector

My association with ASTA committees suggests that the public sector has the following major responsibilities: 1) as a primary obligation to teach and train students; 2) conduct basic research on agricultural problems; and 3) to promote the practical application of research through extension. Public research should, in general, be directed to long-term opportunities and integrated systems management, and not to the development of products using traditionally applied technology.

Cultivar development always must be done by public institutions for some crops, if it is to be done at all. This applies to minor crops, or crops with minimum profit potential for seed companies as well as to situations where genetic engineering techniques may be appropriate. Seed companies must return a profit to stay in business. Thus, low-volume, low-margin crops require a different analysis. Cultivar development of minor and regionally-adapted crops frequently involve not only the crop itself but the economics of the region in relation to social benefits, and the impact on employment in industries in certain geographic areas. Such factors must be considered in any priority analysis. A small amount of cultivar development of high volume major crops must be done by the public institution in order to allow breeders to try new theories and technologies. This work also is necessary to keep public breeders in touch with reality, and provide a means of private breeders to interact fully with public breeders. A reasonable volume of cultivar development at the public institution is likewise justifiable as a means of ensuring that a broad base of imaginative breeding systems and exotic breeding stocks are being explored.

Training of students as future plant breeders is another justification for public cultivar development. The practical application of basic biological information and education in liberal arts is required to develop breadth of perspective in the new breeders. The idea of breeders developing their graduate degrees cooperatively with universities and private industry might be explored further.

Public and private plant breeding have grown up together. In general, public breeding has led the way to improved cultivar development; however, in certain major species, this responsibility has tended to pass to the private breeder, with the public breeder concentrating more on training, theory, basic biological sciences, and germplasm enhancement.

Future cultivar improvement depends upon the maintenance and growth of basic science. This improvement must be provided by public institutions, as private industry is not equipped to do so and cannot provide the necessary long range support. The public sector is likewise custodian of our National Plant Germplasm System, which must be judged of equal importance to our energy reserves. Strengthening and preserving the NPGS must remain a public trust, centered primarily in the USDA.

A major concern to the seed industry is the effect on public breeders when requested to return revenue to their departments through royalty payments from exclusive or restricted release of their cultivars. There are 4 obvious effects of such policies: 1) the program soon may be structured to develop products that will meet current competition rather than long-term objectives, and the researcher may thereby lose objectivity in evaluating recommended cultivars; 2) the researcher may become involved in maintenance, production and marketing facets of the seed business; 3) the plant breeder may face the pressure of producing a succession of cultivars to maintain a source of income; and 4) research scientists may become reluctant to share ideas and germplasm.

The interdependence of seedsmen and public breeders is most evident with small seed firms who, for lack of their own breeding programs, have received low cost new products paid for by the public. Some economists question this diversion of public funds, but a large number of seed companies still favor public breeding for this reason.

A major role of the public breeder in the past, and one that will continue, is the identification of resistance to major diseases in introduced accessions and the germplasm enhancement of these characteristics to the point where they can be exploited by the private sector. Valuable genetic material is in the pipeline of all public breeding programs. It has required money, time, and personnel to develop this germplasm and related program activities. It would be a great loss to abandon such programs with no alternative to protect this useful germplasm.

The public sector should increase its emphasis on germplasm enhancement through use of exotic accessions. This emphasis requires basic research to understand the mode of inheritance, appropriate crosses, and selection of potentially useful segregates. The use of the word "basic" often is misunderstood, as it means different things to different people. Providing knowledge of inheritance of a particular gene in a breeding line is certainly basic to a plant breeder; however, to the National Science Foundation (NSF), the study is not basic unless it is performed at the cellular or molecular level. Biotechnology or genetic engineering may provide important sources of new genetic material; however, they cannot replace conventional methods of gene transfer cultivar evaluation for creating new varieties of crop plants. Conventional plant breeding should not be dismantled in favor of biotechnologies but blended together. Monies for biotechnologies should come from a gradual shift in resources, not a dramatic cutoff of conventional breeding.

Action by ASTA

ASTA appointed an ASTA Public Research Advisory Committee (PRAC) in April of 1983, with Owen Newlin, Pioneer Hybrid International, as chairman to address the foregoing situation. This committee functions through 3 subcommittees: 1. Release of varieties, germplasm, and related technology to public institutions consistent with ASTA policy. Charlie Brim, Chairman, Manager, Research, Funk Seeds International; 2. Positions related to public agricultural research policy and programs and establishment of seed industry priorities for public agricultural research. Robert E. Strosnider, Chairman, Director of Research, Asgrow Seed Company; and 3. Influencing support for funding of public agricultural research consistent with seed industry objectives. Duane Jacklin, Chairman, Jacklin Seed Company.

Table 2. Number of companies conducting breeding programs on major crops in the United States in 1982.

<table>
<thead>
<tr>
<th>Major crop category</th>
<th>Companies with breeding programs (no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>66</td>
</tr>
<tr>
<td>Vegetables and fruits</td>
<td>46</td>
</tr>
<tr>
<td>Soybeans</td>
<td>26</td>
</tr>
<tr>
<td>Sorghum</td>
<td>21</td>
</tr>
<tr>
<td>Wheat</td>
<td>21</td>
</tr>
<tr>
<td>Sunflowers</td>
<td>16</td>
</tr>
<tr>
<td>Forage legumes</td>
<td>14</td>
</tr>
<tr>
<td>Cotton and other fiber crops</td>
<td>13</td>
</tr>
<tr>
<td>Forage and turf grasses</td>
<td>13</td>
</tr>
<tr>
<td>Oats, barley, rye, etc.</td>
<td>11</td>
</tr>
<tr>
<td>Flowers and ornamentals</td>
<td>9</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>5</td>
</tr>
<tr>
<td>Rice</td>
<td>5</td>
</tr>
<tr>
<td>Safflower</td>
<td>3</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3</td>
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</tbody>
</table>

Table 3. Approximate annual research expenditures on private plant breeding in the United States in 1982.

<table>
<thead>
<tr>
<th>Expenditure group</th>
<th>Companies (no.)</th>
<th>Projected total expenditure (in million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9*</td>
<td>0</td>
</tr>
<tr>
<td>Under $100,000</td>
<td>44</td>
<td>2.20</td>
</tr>
<tr>
<td>$100,000–500,000</td>
<td>44</td>
<td>15.50</td>
</tr>
<tr>
<td>$500,000–1,000,000</td>
<td>23</td>
<td>17.25</td>
</tr>
<tr>
<td>Over $5,000,000</td>
<td>5</td>
<td>37.50</td>
</tr>
<tr>
<td>Total</td>
<td>160</td>
<td>$ 114.95</td>
</tr>
</tbody>
</table>

*Several companies which were contacted conducted no research themselves, but contributed funds to experiment station research on plant breeding, or sold varieties and hybrids developed by others on a royalty basis.
Alternative Methods of Funding Vegetable Research

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Many vegetable research scientists in public service need additional funds above those provided by normal budgeting within their agencies to maintain productive programs. In some instances, programs receive little more than the salary for the scientist. Fortunately, my vegetable breeding projects are well funded at Texas A&M compared to many other university programs. Yet the needs of the Texas vegetable industry are great since the state is experiencing rapid growth in vegetable production. As a result, our research programs must be broad in scope, efficient, and productive to meet these needs. Therefore, additional funding has been needed to develop and maintain these large research projects. Alternative methods for funding research were investigated and pursued and resulted in excellent success, as over $700 thousand dollars have been obtained from outside sources during the past 10 years.

This paper has been prepared to share the author’s ideas and experience with other research scientists on obtaining additional funding needed for their projects. It should be especially helpful to young scientists who are beginning to build new programs. The following is based on 5 guidelines which are key points in obtaining research gifts or grants. The author’s thoughts on plant variety protection also will be discussed.

Learn the industry needs

It is very important to know the needs of the industry before approaching industry organizations to discuss funding for a research project. Grants provided by industry generally are specific in nature, and results are expected to solve the problem for which funding was generated. For example, if the research is on onions, it is important to learn everything possible about the crop and the industry needs before making a proposal for funding. If you are a plant breeder, familiarize yourself with growing, harvesting, handling, and shipping as well as the genetics of the crop before meeting to discuss the research funding. The industry people are professionals in growing and handling the crop and they can detect your knowledge of their crop rather quickly. The same rule applies if cultural work, physiological studies, marketing, or other research areas are proposed.

Get acquainted with industry people

It is equally important to get acquainted with, and become known by, the people you intend to serve. Visit their operations at all levels. Learn their names and responsibilities. Be sure they learn your name and what you can contribute to their operation. It is much easier to work with acquaintances than strangers.

Establish research goals, research budgets and bring industry and administration together

Once you feel confident that you know the needs for your commodity and have become acquainted with the industry, it is time to establish goals, budget needs, and to bring leaders of the industry and your administration together. An excellent way to get them together is at a field day in your research plots. Such an introduction will focus their attention on your work and will provide them the opportunity to see the problem you wish to solve. The question always comes up on how much money it will take to do the research, so an introduction to the budget also is accomplished. A meeting should then be set up with the industry leaders to discuss in detail objectives and budget needs. During these meetings, the industry generally decides how to collect or raise money and determine how much and for how long they will continue funding. Be sure to

"We think it imperative that ARS allocate a substantial portion of its resources to long-range, fundamental basic research to solve problems that cannot be solved with today's scientific knowledge base. We believe that this commitment must be balanced with an ongoing major commitment to those basic studies of germplasm enhancement, cytology, plant pathology and related disciplines, which have historically provided the scientific disciplines on which our applied plant breeding is primarily dependent."

The subcommittee on "research priorities" has mailed 2 questionnaires to seed companies and asked for replies by mid-September. When completed, the results will be presented to ARS and AES officials. (Note: Questionnaire replies have been received and are being summarized. Hopefully this information can be disseminated by late May 1984.) This PRAC Committee has recommended to the ASTA Board of Directors the following resolution that was passed by the Board at the June 1983 meeting in San Francisco:

"The American Seed Trade Association (ASTA) strongly supports the need to strengthen funding for agricultural research in the USDA Agricultural Research Service and in State Agricultural Experiment Stations. These activities are essential for maintaining adequate supplies of food and fiber to meet domestic and export needs.

"ASTA supports the concept of long-range research program plans and six-year implementation plans by the Agricultural Research Service. These plans provide a basis for interaction with industry, commodity and user groups to identify and establish high-priority research needs and provide a basis for the allocation of resources to those needs. The American Seed Trade Association is committed to participating actively in this process.

"We concur with the need to broaden and preserve the national germplasm resources of plants through the acquisition, evaluation, maintenance and distribution of plant germplasm in the National Plant Germplasm System. We further support expanding research in those fundamental areas of biotechnology, developing new and more efficient methods of modifying plant germplasm and developing new knowledge of basic plant growth, differentiation and reproductive processes.

"We think it imperative that ARS allocate a substantial portion of its resources to long-range, fundamental basic research to solve problems that cannot be solved with today's scientific knowledge base. We believe that this commitment must be balanced with an ongoing major commitment to those basic studies of germplasm enhancement, cytology, plant pathology and related disciplines, which have historically provided the scientific disciplines on which our applied plant breeding is primarily dependent."

In closing, let me emphasize that it is essential to maintain the dialogue between the public and private sector. We need each other just as much today as we did 50 to 100 years ago. Continuation of this dialogue through our respective associations is our mutual responsibility. Existing organizations through which this dialogue will be pursued are the Public Research Advisory Committee (PRAC). This ASTA appointed committee works with the ARS and AES as well as legislators on behalf of the ASTA membership and the ASTA/ESCOP Liaison Committee, an ASTA-appointed committee which works directly with the Experiment Station Committee on Policy (ESCOP) and related groups.

Literature Cited

3. USDA, ARS. 1983. Definitions of categories of research for OMB study from Office Management Budget. (Distributed at ARS Senior Staff Conference, 30 Oct. 1983.)