Colleges of agriculture have been working with stagnant or declining applied research budgets for several years. In spite of the budget squeeze, new items must be added to the research agenda and traditional clientele groups continue to expect services. In an effort to supplement research funds, many universities have begun to patent varietal releases from their experiment stations.

Supporters of patenting plant varieties released by universities see this approach as a "fair way" to generate needed research funds because the users of the research output—producers—pay the royalty.

Those against patenting public sector releases fall into at least three groups, each with a very different basis for opposition. One group opposes patenting any and all life forms, whether by the public or private sector, on ethical grounds.

A second group specifically opposes patents on public sector varietal releases. They disagree with the fairness argument suggested by supporters of public sector patenting. In contrast, members of this opposition group argue that competition in agricultural production and marketing makes it difficult for producers to pass on cost increases, such as royalty charges, to consumers. Yet consumers, not producers, are the main beneficiaries of agricultural research. In addition, consumers have already paid for the research through their tax dollars. As a result, the argument goes, it is "unfair" to charge royalties either to producers or consumers. In the same vein, restricted licensing of public varieties is also opposed; because the research was funded through taxes, all who want to use the variety should have access to it.

A third group of opponents moves beyond the question of patenting to argue that universities should concentrate on basic research—leaving breeding and other applied research to the private sector. The USDA is following this line of reasoning by switching funding to more basic research programs. Going one step further, Great Britain sold the Plant Breeding Institute at Cambridge to Shell Oil Company.

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Even with increased private investment, there is still a role for
the public sector in plant breeding.
Ruttan has given three reasons for publicly sponsored agricultur­
al research: to invest when the market does not provide sufficient
incentives for private research, to maintain competitive conditions
in agriculture, and to provide training in research as one compo­
nent of education.

The primary question is whether
the public sector can perform its role
if it patents plant varieties.

The applied/basic research dichotomy oversimplifies the issue.
Some areas of basic research provide incentives for private
research. Bell Laboratories is perhaps the best known example of
private investment in basic research. On the other hand, not all
applied research is attractive to the private sector. In addition, the
university's education mission, particularly at the post-graduate
level, is to provide research skills. To provide graduates with skills
relevant to the private sector, universities need to engage in some
applied research.
The focus on who benefits and who pays for the research is only
part of the point. The primary question is whether the public sector can perform its role if it patents plant varieties. Depending
on how this question is answered the issue of who pays for the research may or may not be relevant.

Some Other Things To Consider

As the main debate above illustrates, administrators of public research programs
confront extremely difficult choices about their approach to patents.
Public patenting may in fact subvert the very reasons for the
existence of public research. The patent system creates incentives
for the private sector to invest in research and development. Given
patent incentives, the public sector is likely to begin acting and
reacting like the private sector, rather than fulfilling its unique
role. In particular the public sector might invest only in the same
crops, work to develop the same characteristics, and use the same
breeding techniques as the private sector. In addition, public
patenting and licensing may result in premature release of vari­
eties, changes in seed and nursery industry structure, and a
decrease in genetic diversity. Such a patent policy could also result
in a net decrease in the flow of scientific information and damage
farmers' perceptions of the Extension system's objectivity.

Concentration on Major Crops. Patenting of publicly bred vari­
eties creates incentives for researchers to concentrate on crops
which are likely to bring in the most money—the major cereal
crops. The danger is that the public sector will withdraw from the
breeding of minor crops, crops which the private sector does not
breed despite the availability of patents to them. There is a danger
that there will be no breeding programs, public or private, for some
crops.
Adapting plant varieties to local conditions has been an objec­
tive of state breeding programs for many years. Yet in addition to
withdrawing from minor crops, the public sector may also
decrease breeding of regionally and locally adapted varieties
because these markets tend to be small even though these varieties
may be important to the state's economy. New York State, for
example, is closing down its strawberry breeding program which
developed varieties adapted to local conditions.

Ignoring Particular Plant Characteristics. Private firms may lack
incentives to focus on characteristics important to society. The role
of the public sector should be to identify and breed those charac­
teristics which may have high social payoffs but provide little pay­
off for the private sector. To do this the public sector may have to
maintain a breeding presence even in crops which have substantial
private investment. For example, a seed company owned by a
chemical firm does not have an incentive to breed a plant that
would require fewer chemical inputs. Rather, it would work to
adapt the plant to chemicals, as is the case with the development
of varieties resistant to common herbicides.

Concentrating on Hybrids. Patenting has not made private
investment in plant breeding as profitable as was expected when
the laws were originally passed. This is because growers can avoid
the royalty charges by saving their grain for seed. Hybridization is
a breeding technique which forces farmers to buy seed every year
so that they cannot avoid any royalty charges. Hybridization was
the private sector's technique of choice before patents, and contin­
ues to be so. For example, Pioneer has closed down its wheat
breeding program in the United States. Even though the varieties
were protected, farmers avoided the royalties and an economical
way to hybridize wheat has not yet been found. The private sector
will continue to select breeding techniques which are the most
profitable either in terms of lowering breeding costs or increasing
sales and revenues. Biotechnology may provide new ways of preventing farmers from saving grain for seed.
In contrast, to date the role of the public sector is to explore promising techniques
for creating genetic improvements even if they do not increase revenues to the
breeding program. If the public sector finds out that patenting does not produce
the revenues it envisioned, will breeders be pressured to develop and choose
breeding techniques which increase revenues? The incentives cre­
ded by giving breeders a share of the royalties could also lead
breeders to choose techniques based upon potential royalties.

Premature Release of New Varieties. Prices are highest when a
variety is introduced because supply is limited. Once a variety is
on the market, farmers and seed producers can multiply it, increas­
ing supply and causing price to fall. Seed companies maintain a
steady flow of new varieties. The varieties are enough of an
improvement over existing varieties that farmers switch and pay
the higher price. Similarly, I found that fruit tree nurseries intro­
duce sports of popular varieties when prices decline or patents expire on the first variety. Admittedly, there is a question of cause
and effect. For example, seed firms argue that a variety only has an
economic life of 6-8 years so they must introduce a new variety.
However, the short life may be caused by the introduction of a new
variety.
The time spacing of new introductions for variety marketing rea­
sions may override sound agronomic practices. For example Spar­
row concluded that between 1964 and 1968 the uncoordinated
introduction of fifteen barley varieties in Northwestern Europe
with only small improvements in barley mildew resistance
allowed the pathogen to quickly overcome any new resistance by
1969.

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THE WORD "PATENT"
The word "patent" is used in this article to include all laws although
Plant Variety Protection issues a certificate which appears to be a cross
between a patent and a copyright.

Public research nurtures competitive
conditions in agriculture by providing
both products and information.
For a characteristic such as disease resistance, a pathogen can rapidly overcome a small improvement in new varieties. To slow the pathogen, a large difference in resistance is needed between the new and older varieties. Better gene management would have provided longer-term resistance.

The public sector generally has not had incentives to release new varieties with only minor improvements. But with public sector patents, breeders may be pressured to release varieties more rapidly in order to increase royalty income for their universities.

In an effort to retain breeders, most universities have established royalty sharing agreements. The pressures for early release can be exacerbated by these contracts. Some contracts provide a high percentage of royalties in the first few years and a lower percentage in later years. High-quality varieties increase their market share over time and remain on the market longer. To encourage high-quality varieties, breeders should receive a higher percentage of the later royalties and thereby discourage early introduction of varieties.

Industry Effects. Implications of patenting procedures obviously extend beyond the individual researcher. Extensive licensing by the university deans across the country could lead to decreased competition among firms, reduced genetic diversity of plants, limited flows of scientific information, bias in extension information and undue influence of private companies on public research agendas.

Decreased Competition. University policies for the release of patented varieties can impact the structure of the seed and nursery industry. The most common policies include:

• Licensing the variety to the state crop improvement association;
• Licensing the variety to any firm willing to pay the royalty;
• Licensing the variety exclusively to one firm.

Exclusive licenses tend to go to big firms with large advertising budgets. There are many regional seed companies which do not have their own breeding programs or significant advertising budgets. They tend to concentrate on multiplying and distributing publicly bred varieties and varieties uniquely adapted to the region. Today these firms are a major source of competition in the market. However, Wisconsin economists Butler and Marion conclude that without access to public varieties they probably would not survive.

Private firms will heavily promote and advertise only varieties for which they hold exclusive license. Currently, university interest in exclusive licensing may be motivated as much by the desire to see public varieties widely used as by the desire for funds. For example, public breeders argue that superior public varieties are losing sales to the heavily advertised private varieties. Alternative mechanisms for achieving wide use of publicly bred superior varieties include increased investment in both field trials and dissemination of the trial information.

Even if a university licenses its varieties to all firms willing to pay the royalties, the royalty structure or licensing fees may shut out smaller firms. In particular, a lump-sum license fee rather than (or in addition to) a per unit royalty may strain the cash flow of small firms. In the early 1980s, for example, several smaller nurseries did not obtain a license on an apple rootstock released by Michigan State University because of the lump-sum license fee.

Reduced Genetic Diversity. Several universities have responded to criticism of exclusive licenses by granting exclusive licenses to other firms on the sister seedlings (seedlings of similar quality resulting from the same parental cross). This practice can have major impacts on genetic diversity.

The importance of genetic diversity was demonstrated during the 1970s by the Southern Corn Leaf Blight. The majority of hybrid seed corn in the United States had a common ancestry which made it susceptible to the blight, causing severe crop losses in several states. Generally, farmers plant several varieties which mature at different times and which have a range of resistance so that an entire crop will not be lost to a single disease. To insure genetic diversity, farmers often buy from more than one firm, but when sister seedlings are available from several companies, farmers may assume mistakenly that they are acquiring genetic diversity.

Chemically testing each variety to determine its genetic heritage—and disseminating that information to farmers—will be costly. The costs are likely to exceed any revenues the public sector receives from the release of sister seedlings.

Limited Flow of Scientific Information. The public sector must also consider the impact of its patent practices on dissemination of scientific knowledge. For a patent to be issued in the United States, the product or process must be "new," that is, it cannot have been disclosed to the public more than a year before the patent application is filed. In Europe, the requirements are even more restrictive; there can be no disclosure whatsoever prior to the patent application. Traditionally, public breeders in the United States have discussed promising new varieties while still testing them and have exchanged germplasm at all stages of development. Both public and private sector breeders have noted that public sector interest in patenting has limited this flow of information and germplasm.

Extension Information Bias. The extension system provides a mechanism for distributing agricultural information to farmers and agribusiness. There is a conflict of interest when a breeder is in charge of field trials which include varieties on which the breeder receives a royalty. If public breeders and research programs stand to gain directly from the sales of patented varieties, extension service recommendations of public varieties would no longer, by definition, be objective.

A recent article in Science magazine discussed the conflict of interest problems faced by medical colleges when a scientist participates in clinical trials of a drug and holds shares in the drug company. Major medical colleges are instituting strict rules to govern such situations.

A BRIEF HISTORY

For the last half century the United States has been steadily expanding the right to patent plants. In 1930, the United States became the first country to specifically allow the patenting of some plants. The 1930 Plant Patent Act allowed patents for asexually reproduced plants, except tubers and micro-organisms. The 1970 Plant Variety Protection Act allows certificates of protection for sexually reproduced varieties. Hybrids do not meet the criteria for protection under this law.

A 1980 Supreme Court decision found that microorganisms were patentable under the general patent statute. A 1985 decision by the Patent Office Board of Appeals clarified this decision by finding that any plant could be patentable under the general patent statute rather than being confined to the 1930 and 1970 Acts specifically for plants.

Faculty evaluation on the basis of grants and contracts obtained has also become more common.
One alternative is to give the breeder salary increases or bonuses rather than direct royalties. A second alternative is to set up a crop testing association which is independent of the breeder.

Undue Influence By Private Companies. In addition to patents, the public sector has increased contracting with the private sector to obtain additional research funds. What is new in these relationships is that the public sector is the subordinate partner in the contract and the private firm has control over the research product. To get such research contracts, universities must orient their research program to the needs of the private firm rather than to broader societal needs. Faculty evaluation on the basis of grants and contracts obtained has also become more common. This increases the potential for undue influence by the private sector on the public research agenda.

As they gain control over the public research agenda, private firms and organizations may attempt to gain control over other aspects of the university. In 1987 the Rochester Sunday Democrat and Chronicle reported that the graduate business school of the State University of New York-Rochester (SUNY-Rochester) is heavily funded by the Kodak Corporation, and Kodak executives interact with students during their training. A Japanese employee of Fuji (a major Kodak competitor) was admitted to the MBA program. Under pressure from Kodak, the business school rescinded the admission. While SUNY-Rochester now has established a mechanism for avoiding future incidents, it seems likely that more incidents will occur as research contracts with the private sector become more important to universities.

FOR MORE INFORMATION


Emphasize the Basics

As technology and institutions change, the public research agenda will be affected. In adjusting its agenda, the public sector must keep in mind its unique role in agricultural research. By responding to incentives created for and by the private sector, the public sector must not lose sight of its own unique responsibilities.

The role of the public sector in agricultural research is to do the research the market does not drive the private sector do, to maintain competitive conditions in agriculture, and to provide training in research.

Public research nurtures competitive conditions in agriculture by providing both products and information. Regional seed firms which multiply public varieties have been shown to be an important source of competition in the seed industry. But universities can thwart that competitive atmosphere by patenting and variety release policies coming into play. Also, release of sister-seedlings by the public sector to private seed firms makes it more difficult for farmers to get information on genetic diversity. Further, extension will lose its position as a source of unbiased information if field trials are supervised by a breeder who stands to benefit directly from the sales of a particular variety. The need to maintain secrecy about a product until a patent application is filed slows the flow of valuable information to the rest of the public sector and to the private sector.

Money is always tempting to administrators and scientists of cash-strapped breeding programs.

However, the private sector has been disappointed in the revenues from patents and public decision-makers should be careful not to overestimate royalty income. For many varieties, royalties will be low, perhaps less than the cost of patenting. If research administrators feel they must patent (or are required by university policy to do so), they should simultaneously consider ways to ameliorate some of the potentially negative impacts on their research agenda.