SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE ROLE OF INTERNATIONAL COOPERATION

PROCEEDINGS
OF THE
TWENTY-FIRST
INTERNATIONAL CONFERENCE
OF AGRICULTURAL ECONOMISTS

Held at Tokyo, Japan
22–29 August 1991

Edited by
G.H. Peters, Agricultural Economics Unit, Queen Elizabeth House,
University of Oxford, England
and
B.F. Stanton, Cornell University, USA
Assisted by
G.J. Tyler
University of Oxford

INTERNATIONAL ASSOCIATION OF
AGRICULTURAL ECONOMISTS
QUEEN ELIZABETH HOUSE
UNIVERSITY OF OXFORD

1992

Dartmouth

CARL E. PRAY*

Plant Breeders' Rights Legislation, Enforcement and R&D: Lessons for Developing Countries

INTRODUCTION

Declining government budgets, pressure from donors and agribusiness firms and the failure of some government seed corporations are encouraging policy makers in a number of less developed countries (LDCs) to privatize plant breeding, seed production and seed distribution. Developed countries are pressing for stronger intellectual property rights such as plant breeders' rights (PBR) and utility patents as a means of encouraging private firms to transfer technology and conduct more research and development (R&D). A number of countries are considering PBR legislation.[1]

This paper examines the development of PBRs and their impact on private research and technology transfer in the United States, France, the United Kingdom, Argentina and Chile. From their experiences some policy implications for developing countries are derived.

INTELLECTUAL PROPERTY RIGHTS LEGISLATION RELATED TO PLANTS

At present 22 countries have PBRs. Most Western European countries passed their legislation in the 1960s and 1970s. The USA adopted its Plant Variety Protection Act in 1970, while Kenya, Argentina and Chile followed within the decade. Australia and Canada have recently passed legislation. France and the United Kingdom were selected for this study as examples of European PBR legislation with different historical backgrounds. The USA was chosen because it has what is generally considered to be a weaker version of PBRs. Argentina and Chile appear because they are the only developing countries which have PBR rules which they are attempting to enforce.

Protecting varieties before plant breeders' rights

The legal structures for protecting intellectual property in plants in France, the United Kingdom, the United States, Argentina and Chile are shown in Table 1.

*Rutgers University, USA.

France, the USA and Argentina had laws which helped companies capture the gains from research before PBR laws were passed.

In France, a trademark law was passed in 1927 to protect consumers against fraud. Firms could register a trademark on a plant variety and prevent other firms from using that trademark without their permission. Compulsory registration of new plant varieties was established in 1932. Before a new variety could be registered and marketed it had to be tested for three years to establish its superiority over currently used varieties. The combination of these laws provided plant breeders with the equivalent of property rights. Trademarks prohibited other firms from selling a variety under the breeding firms' name and compulsory registration made it almost impossible for a rival firm successfully to register and sell the variety under another name.

The ability of firms to appropriate the benefits from research was weakened in the 1950s, when a French court decided that plant varieties could not be protected with trademarks. Plant breeders continued to collect some royalties from firms selling their varieties, but their property rights had been seriously weakened.

Argentina had a set of regulations which gave breeders some protection from 1935, when the government established the National Commission for

TABLE 1 *Comparison of intellectual property rights on plants*

Years	Countries				
	France	USA	Chile	Argentina	UK
1929	Trademark Law (1927)	Trade secrets (common law)			Trade secret (common law)
1930	Compulsory registration (1932)	Plant Patent Act (1930)		Compulsory Registration and 3-year monopoly (1935)	
1940					
1950	Trademarks on varieties disallowed (mid-1950s)		Voluntary certification system (1958)	Closed pedigree registration for hybrids (mid-1950s)	
1960					Seed Law-included PBR and compulsory registration (1964)
1970	Plant breeders' rights (1971)	Plant Variety Protection Act (1970)	Law of Seeds (PBR) (1977)	PBR Law (1973) Implementing regulations (1978)	
1980		Utility patents applicable to plants (1985)			

Grain and Elevators to regulate commerce in grains and promote improved varieties. The law required all varieties of the main crops (wheat, oats, barley, rye, corn, sunflower and flax) to be registered. It needed several years of trials to prove that the variety was (1) high-quality, (2) disease-resistant, and (3) higher-yielding. The seed of registered varieties could be sold either in certified or identified form. The former had to meet germination and purity standards and producers of certified seed had to go back to the breeders for new breeders' seed every three years. Identified seed could be multiplied indefinitely without purchasing new seed from the original breeders.

An additional provision law was that for the first three years a variety could only be sold by one company. This was supposed to prevent any one variety from spreading too fast, but it also had the effect of giving a breeder property rights over his variety for a period of time. In the 1950s, hybrids were allowed to be registered without revealing the parental inbred lines.

The first legislation explicitly providing intellectual property rights on plants in the USA was the 1930 Plant Patent Act (PPA) which allowed the patenting of asexually propagated plants, except potatoes. This did not cover any major field crop in the USA because they are propagated by seeds.

The development of hybrid corn by university and government scientists in the USA in the 1920s and 1930s allowed breeders of new hybrid varieties a monopoly on their hybrid as long as they could keep the inbred lines secret. It was possible to take another firm's inbred lines and then reproduce its hybrids. For example, employees could move to another firm or start their own company, and bring inbreds from their former firm along with them. In the United States, trade secret law, which is based on English Common Law, protects a firm's exclusive rights to use an inbred as long as it takes all reasonable precautions not to disclose it. This did not become very important until the 1950s, when firms developed some very good private inbreds which replaced the public inbreds that they had been using earlier.

Plant breeders' rights legislation

The United Kingdom passed a new seed law in 1964. It included PBRs and compulsory registration of varieties. The French made PBRs law in 1971. Both countries require that a new variety first be registered before the breeder can be granted ownership. To be registered, a variety must be field-tested for several years to ensure that it is distinct, uniform and genetically stable. In France it also has to be superior to other varieties over a range of key characteristics. European farmers may grow their own seed, but they do not have the right to sell seeds to other farmers. The owners of a variety cannot prevent researchers from other companies from using it to produce a new variety.

The US Plant Variety Protection Act (PVPA) of 1970 provides protection for 18 years to novel, sexually propagated varieties and inbred lines of hybrids. The Department of Agriculture (USDA) checks applications against the descriptions of varieties in its data bank. If the variety is different, a certificate is issued. PVPA has several key exclusions from protection. Farmers can

reproduce seed for themselves and sell seed as long as sales are less than 50 per cent of the total product of their farm.

Argentina passed PBR legislation as part of a new seed law in 1973, though the regulations for implementation were not developed until 1978. This law, like those of Europe, requires that varieties be distinct, uniform and genetically stable. A government agency conducts appropriate field tests. The breeder may then request proprietary rights which are granted for 15 years for annual crops. First-generation hybrids are excluded from protection, but inbred lines can be protected.

Chile passed a new seed law that included PBRs in 1977, with enforcement procedures being drawn up and approved in 1979. The law provides protection for 15 years. A new variety is given a temporary permit immediately upon application for breeders' rights and then has to be grown for two years to ensure that it meets the description in the application. If government tests confirm the breeder's claims, the breeder is given the final permit.

PBR legislation in all five countries reviewed above provides the breeder or his company with 15 to 18 years of ownership. They all have the research exemption which allows a protected variety to be used in breeding other varieties without payment to the owner. In some other important characteristics the US law differs from PBRs in the other four countries. The US PVPA requires neither major differences from current varieties nor field testing, while the others require field testing to prove that new varieties are distinct and superior in some way to old varieties. In addition only the USA has an explicit exemption which allows farmers to sell seeds.

Evolution of PBR Enforcement

Legislating plant breeders' rights does not actually give breeders any rights unless someone identifies violators, and courts stop the violation and impose penalties. In most countries enforcement has grown as new institutions are developed to enforce breeders' rights and court precedent is established.

French and British breeders' rights are enforced by a plant royalty bureau which establishes and collects the amount of royalties and distributes them to the owners of the varieties. The bureau also inspects seeds in the market for violation of breeders' rights. If it finds violations, it offers the violator the opportunity to sign a contract and start paying royalties. If the violator refuses, then the company whose rights have been violated can take court action to obtain an injunction and damages.

To enforce the US PVPA, firms must identify violators and bring them to court to seek injunctions against further infringement, royalties and punitive fines. Adherence to the law has varied over time. When it was passed, firms mounted a publicity campaign to inform farmers and other firms about its provisions. In most cases when companies discovered violations, they just needed to write to farmers or cooperatives informing them about the legal provisions and the violations stopped. Adherence to the law was weakened by the court case *Asgrow* v. *Kunkle* 1987, which found that even very large sales

by farmers were legal as long as the farmer sold less than 50 per cent of his crop as seed for reproductive purposes.

Adherence to the Argentine PBR law has varied over time. The new regulations of 1978 were not enforced immediately by government agencies because they were among the last acts passed by an unpopular government before it was replaced. In the first year after the law was passed, cooperatives and firms which were selling private wheat varieties voluntarily paid royalties to the firms which bred them, though by the second year only about half of the sellers paid royalties. In the fourth year no one bothered to pay any royalties at all (Gutierrez, 1990). Firms did not take to court cooperatives owned by big farmers who violated the law because to do so would have meant taking action against some of their most important customers.

A major step in reducing the production of 'black' seed took place when three of the largest cooperatives and the national Farmers' Federation started producing and selling the national agricultural research institute's (INTA) proprietary varieties of soybeans, wheat and maize in joint ventures with INTA. Since the cooperatives were now selling proprietary varieties or trying to collect royalties on them, they stopped violating other firms' proprietary rights.

The Argentine Seed Association, INTA and the Ministry of Agriculture are establishing a private enforcement agency modelled on the French association for collecting royalties and licensing protected varieties. This is first being implemented for wheat. In 1990, Buck, Klein and INTA hired a lawyer to enforce their property rights on wheat varieties. They first arranged for government agents to inspect the seed in several key markets, when it was found that some companies were selling proprietary varieties without paying royalties. These companies were then asked to pay, and about 60 per cent did so. Legal proceedings against the remainder have begun. This is the first occasion on which that has occurred in Argentina (Gutierrez, 1990).

In Chile the government takes a more active role in enforcement than in Argentina. A company believing rights to have been infringed can bring a claim to the Ministry of Agriculture. If the claim is found valid, the Ministry can immediately stop further sales. Violators almost always obey without the need for court action. There are three or four complaints each year, of which on average one is found to be legitimate.

IMPACT OF PBRS ON RESEARCH AND TECHNOLOGY TRANSFER

Research

If PBR legislation has the expected incentive effect, private R&D expenditure on self-pollinated crops like wheat, barley and soybeans should increase as enforcement grows stronger. Five to ten years after research starts, new private varieties will appear on the market. The experience of the United Kingdom provides the strongest empirical support for the effectiveness of PBR

legislation. The French, Argentinean and American cases also provide some support for PBR effectiveness, but it is not as dramatic as in the British case.

In the United Kingdom in 1960 'commercial plant breeding in the major agricultural crops was virtually non-existent' (Murphy, 1981, p.30). Three years after the 1964 seed law ten firms were engaged in research and by 1981 the number had risen to 23. In 1981, 90 per cent of spring barley, which is the most extensively grown crop in the United Kingdom, was comprised of private varieties. Winter wheat was the only major crop in which public varieties covered a greater area than private strains at that time (Mastenbroek, 1982). Most public varieties came from the Plant Breeding Institute, Cambridge, which the government sold to Unilever in 1987.

French plant breeding started with farmers who were also breeders. During the 1930s, some of these farmers evolved into wheat-breeding firms. By the beginning of the Second World War, 15 to 20 medium-sized firms conducted most of the private wheat breeding (Joly, 1990). In 1981, private varieties covered 97 per cent of the winter wheat area and all of the spring wheat (Mastenbroek, 1982).

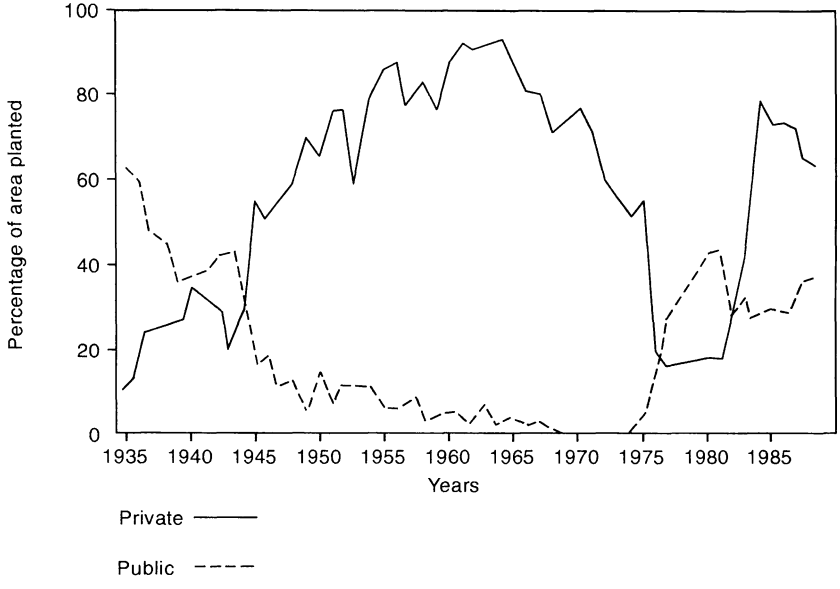
Private firms started breeding wheat in Argentina around 1925. After the grain control law in 1935, nine companies conducted wheat-breeding programmes. By 1939, at least 25 per cent of the wheat area was planted with private varieties (Figure 1). These traditional large farmer/breeding firms declined to two major companies by 1970. In the 1960s, the local firms were joined by several USA based multinationals which started hybrid wheat-breeding programmes. Despite the decline in the number of firms, the share of area sown to private varieties grew to 90 per cent by 1965. The decline in private varieties during the 1970s was due, in part, to the government research system's success in developing semi-dwarf varieties of wheat based on CIMMYT lines. In 1989, officials interviewed from Pioneer, DeKalb, Northrup-King, Cargill, Morgan and several smaller Argentine companies reported that there were no increases in private research on self-pollinated crops or on hybrids, owing to the 1973 PBR legislation (Pray, 1989).

Private plant breeding began in the USA at the beginning of the century. Most was done by farmers, with USDA and agricultural universities entering only after the First World War. Seed companies did not start breeding programmes until about 1920, concentrating on maize. Major companies did not commence wheat and soybean research until just before PBR was passed in 1970. Real private R&D on wheat, maize and soybeans in the USA increased rapidly after 1965 (Figure 2a). The growth in R&D as a percentage of the value of cereals and soybeans after 1965 (Figure 2b) is the strongest evidence available at present that PVPA fostered more private R&D. The high levels of hybrid corn and sorghum R&D in Figure 2b indicate the importance of hybrids in combination with trade secrets in inducing private research.

The increase in private R&D did not, however, lead to a steady increase in the area under private varieties in all crops. The share of soybean area under private varieties was negligible in 1960, increased to 3 per cent in 1969 and then to 21 per cent in 1984. The share of wheat area under private varieties declined from 25 per cent in 1939 to 16 per cent in 1969 and 11.5 per cent in 1984 (Huffman and Evenson, 1987). Maize shifted from 100 per cent public

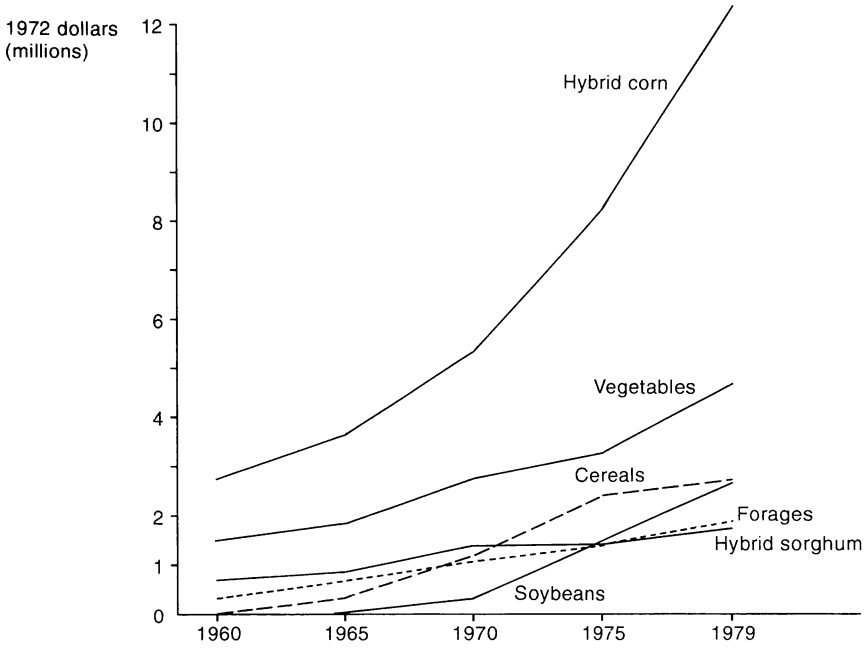
varieties to 100 per cent private hybrids between 1940 and 1960 (Kloppenberg, 1988) and has remained 100 per cent private since them. Thus soybeans is the only crop in which the share of private varieties increased after PVPA was passed.

Most Chilean private wheat and hybrid maize research started in the 1950s. Private plant-breeding expenditure remains very limited – less than US $150 000 in 1984 (Venezian, 1987). Figure 3 shows R&D expenditure on wheat by the two principal private plant-breeding organizations – SNA, which is a farmers' cooperative, and Semillas Baer, which is a private company. Baer's R&D declined after the PBR law was passed in 1977, while SNA's R&D increased. The share of wheat acreage covered by private varieties declined from 44 per cent in 1971 to 36 per cent in 1984, after PBR was passed (Venezian, 1987). The maize area was primarily planted with private hybrids by 1977. The one change that has taken place is an increase in the area under imported US hybrids, which rose to 40 per cent in the late 1980s (Nodine, 1990).



Source: Gutierrez (1990).

FIGURE 1 *Public and private wheat varieties in Argentina*



Source: Perrin *et al.* (1983).

FIGURE 2a *Crop-breeding research expenditures by 59 firms for various crops, in constant (1972) dollars (adjusted by implicit GNP Price Deflator)*

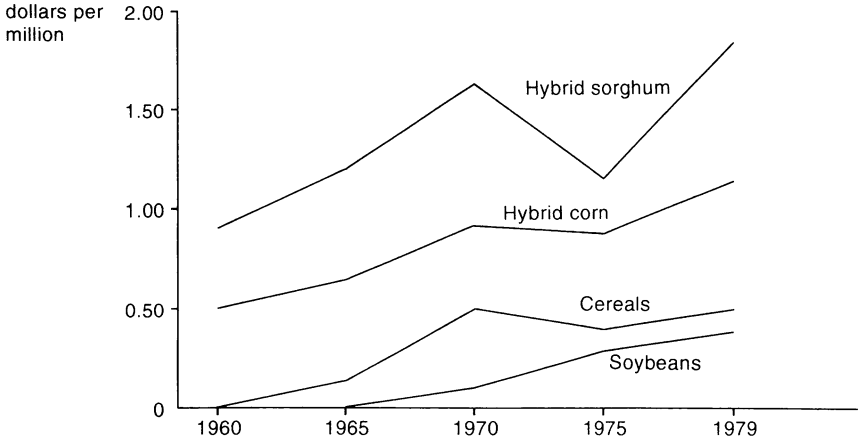
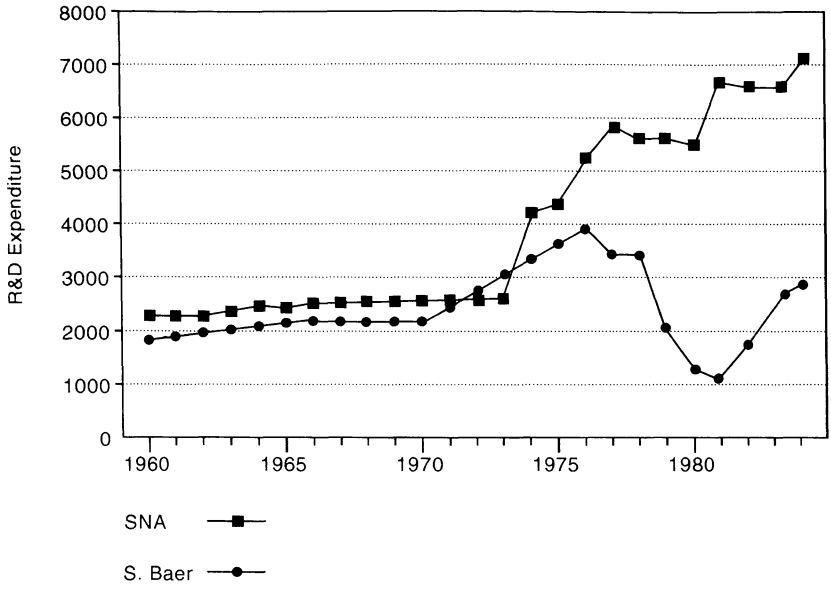


FIGURE 2b *Crop-breeding research expenditures (59 firms) per million dollars of annual US crop value in the preceding five years*



Source: Venezian (1987).

FIGURE 3 *Private wheat R&D in Chile (thousands of 1984 pesos)*

Technology transfer

PBRs have stimulated the transfer of varieties of self-pollinated crops in some countries. In the United Kingdom it provided foreign firms with an incentive to transfer technology:

> the initial improvement following from the introduction of our [PBR] legislation arose from the introduction into the United Kingdom of varieties bred abroad. The Act did in fact encourage very significantly the establishment in the UK of companies which did very little else initially than evaluate varieties bred abroad...It is interesting that many of these companies which started off by introducing foreign varieties developed their own specialized breeding programmes and are now producing varieties bred in the UK (Murphy, 1981, p.32).

Chile appears to be going through the initial stages of a similar process. With the combination of trade liberalization, export promotion, a more positive business climate and the passing of PBR legislation, many maize, fruit, and vegetable varieties have been imported from the USA.[2] Maize seed imports are associated with increased yields (Nodine, 1990) and imported varieties of fruits and vegetables have been very productive.

In contrast, in Argentina, where property rights are less secure, foreign companies are not using the single-cross hybrids which are the highest-yielding varieties in the USA and Europe. Instead they continue to transfer and breed double-cross hybrids which give firms better control of proprietary lines but may give farmers lower yields.

CONCLUSION AND POLICY IMPLICATIONS

PBRs or similar legislation appear to have increased research in all five countries, except Chile. The large impact of PBR legislation in the UK,[3] relative to the USA, is due to loopholes in the US legislation, compulsory registration in the UK and perhaps to the presence of the UK Plant Royalty Bureau. In Argentina, the 1935 law induced research but the absence of an enforcement mechanism for PBRs, and the unwillingness of seed companies to sue cooperatives and seed companies, rendered the 1973 law ineffective. The absence of any impact on private R&D on wheat in Chile is due to the small size of the Chilean market and the decline in demand for wheat when trade policies changed.

These case studies suggest a number of lessons for policy makers in LDCs. First, some type of property rights, either legal or technical (hybrids), does seem to be a necessary, but not sufficient, condition for private research on self-pollinated crops. Second, without enforcement mechanisms such as plant royalty bureaux, an efficient court system and companies which are willing to take violators of PBRs to court, PBRs provide only a limited amount of protection to breeders. Third, even if PBR legislation does effectively protect breeders' rights, markets have to be sufficiently large to justify private investments in research. Fourth, PBRs may stimulate the transfer of technology.

What are the implications of these findings for countries that are trying to stimulate more biotechnology research and technology transfer? Private firms will transfer technology and conduct biotechnology research in those countries and crops which have the best property rights and largest markets. The most effective property rights in most LDCs are provided by hybrids because only Argentina and Chile have PBRs and even those are not very effective. The largest markets are for hybrid seeds in LDCs and large countries such as Argentina, China, Brazil, India and Mexico. Thus companies will concentrate their biotechnology research on hybrid corn, sunflower, sorghum and a few other crops in large LDCs. If hybrid rice is successful in the tropics it will also attract a number of companies. Stronger intellectual property rights laws may also be able to stimulate more private biotechnology research on self-pollinated crops in large countries such as Brazil and India and may encourage more transfer of biotechnology in smaller countries.

NOTES

[1]The governments of Bangladesh, the Philippines and India are debating the merits of PBR legislation.

[2]Interviews in 1989 with the President of ANUSAC, the largest local company, and Dr Eduardo Venezian, Dean of the Catholic University.

[3]Also probably in France, though less evidence is available to support PBR impact.

REFERENCES

Gutierrez, Marta, B. 1990, INTA, Buenos Aires, Argentina, Personal communication, October.

Huffman, W.E. and Evenson, R., 1987, 'Crop Varietal Improvements', in *The Development of U.S. Agricultural Research and Education: an Economic Perspective. Part III Iowa State University Staff Paper No.170*, Ames, Iowa.

Joly, Pierre-Benoit, 1990, INRA, University of Grenoble, personal communication, August.

Kloppenberg, J.R., 1988, *First the Seed: The Political Economy of Plant Biotechnology 1492–2000*, Cambridge University Press, Cambridge

Mastenbroek, C., 1982, 'The Significance of Plant Breeding by the Private Sector', in Records of a Symposium at the 15th ordinary session of the Council of the International Union for the Protection of the International Union for the Protection of New Varieties of Plants (UPOV), Geneva.

Murphy, P.W., 1981, 'Plant Breeders' Rights and Improvements of Plant Varieties', in Records of a Symposium at the 14th ordinary session of the Council of the International Union for the Protection of New Varieties of Plants (UPOV), Geneva.

Nodine, L., 1990, 'The Impact of Seed Policies on the Research and Productivity of Wheat and Maize in Chile', MSc thesis, Department of Agricultural Economics, Rutgers University.

Perrin, R.K., Kunnings, K.A. and Ihnen, L.A., 1983, *Some Effects of the US Plant Variety Protection Act of 1970*, Department of Economics and Business Economics Research Report No. 46, North Carolina State University, Raleigh, August.

Pray, C. E., 1989, 'The Seed Industry and Plant Breeders' Rights', Report of 4–13 October, 1989, Trip to Argentina and Chile, mimeo, Department of Agricultural Economics, Rutgers University.

Venezian, E., 1987, *Chile and the CGIAR Centers: A Study of Their Collaboration in Agricultural Research*, World Bank, Washington, DC.

DISCUSSION OPENING – DOUGLAS D. HEDLEY AND W.T. BRADNOCK*

Carl Pray's paper is intended to draw the attention of agricultural economists to an important issue in agricultural development. Taken in its broadest context the issue of plant breeders' rights (PBRs) falls under the third dictum of development. 'Getting prices right' and 'getting the human capital right', as the first two tenets, are supported by a considerable body of literature which continues to grow. The third element, 'getting institutions right', is equally important, but has a far smaller research base on which to provide guidance in development.

The issue being considered is an example of the complementarity between institutional development and scientific advance in the form of the green revolution HYV package of inputs. Part of the institutional change has also involved the host of pricing and trade policies that encouraged the use of new technology. The paper makes an important contribution to our understanding

*Agriculture Canada, Ottawa, Canada.

of one particular facet of institutional change which has potential influence in augmenting the impact of the scientific effort which is occurring around the world.

Dr Pray examines two aspects of PBRs. The first covers the historical experience of the development of rights in five countries; the second involves discussion of their impact on research and technology transfer. In both cases, partly no doubt because of the space limitations on a single paper, he has taken a relatively narrow view of PBRs. Nonetheless, wider issues closely associated with PBRs and the 'bio-revolution' need consideration.

It is necessary to distinguish between the requirements under national seed laws and plant breeders' rights legislation. In many countries, the national seed law restricts varieties which can be sold to those which have been tested and found to have merit for farmers and users. This testing can be unrelated to the granting of PBRs. The seed laws can override the latter, since a variety may be eligible for rights but may not be allowed to be sold for lack of merit. This is noted by Dr Pray, but he does not clearly bring out the issue in attempting to assess the impact of PBRs on the level of research or its funding origin, whether public or private. This would seem to be of critical relevance in the analysis of whether PBRs can effectively complement HYV technology.

There are several other closely related institutional arrangements which can affect performance in research under PBRs. These include:

(1) the level and nature of PBR enforcement;
(2) collection and use of royalties from PBRs;
(3) access for further research, both domestically and internationally;
(4) the relationship beween patent rights for genetically altered life forms (DNA and RNA recombinant research among others) and PBRs; for the farmer, the patents appear to apply to the 'upstream' bio-technology research, while the PBRs relate to the finished product of research ready for the farmer and the consumer; and
(5) the international trade rules and the legitimacy of rights across national boundaries; the GATT Uruguay Round includes the question of intellectual property rights, although this part of the negotiations appears to be driven by the more traditional patent and copyright issues rather than the emerging life form patenting and PBRs.

The conclusion we draw is that all of these aspects need to be much more carefully defined to enable assessment of the impact of PBRs alone.

The paper also implies that the objective of PBRs is to encourage only private sector plant breeding, seed production and seed distribution. Our view is that this objective may be too narrowly based to capture the range of institutional design that may be necessary for combined public and private sector varietal development and distribution.

There are two concerns which are not raised in the paper. The first relates to the moral and ethical issues surrounding the patenting of life forms and varieties. The argument involves a number of issues:

(1) the 'free' collection of germ-plasm from around the world, the genetic alteration of this material and the subsequent collection of royalties in selling the material back to the countries of origin;
(2) allowing the large transnational companies to extract quasi-rents on varieties when the greatest share of the early investment in germ-plasm collection and cultivar development is public investment; and
(3) food resources and the ability to develop them should remain open and available to all the world, and not be subject to private appropriation of benefits.

These are powerfully emotive points which need careful attention in organizing future research. In the Canadian experience of establishing PBRs as one component in research, development and technology transfer they were the biggest stumbling-blocks, for which no well documented answers existed. For over a dozen years the major political parties attempted to pass PBR legislation in the face of these moral and ethical issues.

The second point relates indirectly to the objective for PBRs cited by Dr Pray, namely the decline of public funding to agricultural research and the need to marshall private funds to maintain or expand research, development and technology transfer. For the past 20–30 years, many of the productivity advances in Third World farming can be traced back to the work of the international research centres. It has been noted, however, that, while the green revolution was primarily fuelled by public funding, the bio-revolution is dominated by the private sector (Buttel *et al.*, 1985). This appears likely to continue. The implications of drawing private funding into research through PBRs, and the shift in the basis for productivity gain from varietal selection to bio-technology, raises major questions about long-term strategies for international and national research centres around the world. Dr Pray's paper is not designed to shed light on this strategic issue, though it is a major step along the way.

REFERENCE

Buttel F., Kenney M. and Kloppenburg J., 1985, 'From Green Revolution to Bio-Revolution: Some Observations on the Changing Technological Bases of Economic Transformation in the Third World', *Economic Development and Cultural Change*, 34, (1), October.